10 messages for 2010
Agricultural ecosystems

European Environment Agency

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This document is the 7th in a series of assessments under the title '10 messages for 2010'. Each message provides a short assessment focusing on a specific ecosystem or issue related to biodiversity in Europe. The remaining messages will be published at various intervals throughout 2010. More detailed information on the published and forthcoming messages can be found at www.eea.europa.eu/publications/10-messages-for-2010.

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Agricultural ecosystems

Key messages

- Increasing attention to environmental issues within the framework of the Common Agricultural Policy during the last 50 years has not yet delivered clear benefits for biodiversity.
- With agriculture covering about half of EU land area, Europe's biodiversity is linked inextricably to agricultural practices, and there should be recognition that these are creating valuable agro-ecosystems across the whole of Europe.
- Biodiversity in agro-ecosystems is under considerable pressure as a result of intensified farming and land abandonment.
- Maintaining and restoring biodiversity provides the basis for all agro-ecosystem-related services.
- There are several opportunities to preserve and use biodiversity better in Europe's agricultural areas, while meeting demand for food, fibre, feedstock and bioenergy. With stronger ecosystem connection the new multifunctional CAP tools would have the potential to serve biodiversity better. They are still far from reaching this objective.

1 Introduction: biodiversity, agriculture and the Common Agricultural Policy (CAP)

Europe's agricultural sector has received sustained public support under the Common Agricultural Policy (CAP) over the last 50 years. This support has evolved alongside growing recognition and awareness of the strong links between agricultural production and biological diversity conservation.

On one hand, it was recognised that changing agricultural land use is a major cause of the decline of biodiversity in Europe. Whereas on better land farming systems have generally intensified, poorer land has been subject to abandonment or afforestation. Traditional, low-intensity farming systems with high nature value have gradually and steadily disappeared (EEA, 2009a).

On the other hand, maintaining biodiversity makes agricultural production and related practices both more sustainable and more cost-effectiveness. Biodiversity and agricultural production are inextricably interlinked and their capacity to be mutually supportive is increasingly recognised.

Consequently, CAP assistance has shifted from strict agricultural production support towards a broader focus including the inventory of public goods and ecosystems services provided by agriculture (as identified in a recent European Commission report (EC, 2009a)).

Since the European Commission highlighted the importance of using the CAP to halt the decline of biodiversity, various efforts have been made to merge biodiversity conservation into agricultural policy. At present, the CAP is divided into two main 'pillars', which differ in terms of financing, functioning and structure. Pillar 1 (financed fully from the EU budget) consists of direct payments (income support) to farmers and market interventions such as subsidies. Pillar 2 — the rural development policy — is partially co-financed by Member States and regional administrations. This rural policy aims to improve agricultural and forestry sector competitiveness, protect the

environment and the countryside, enhance quality of life in rural areas and diversify the rural economy.

Both CAP pillars can contribute directly and indirectly to biodiversity conservation, in particular via 'decoupling' of Pillar 1 direct payments from quantities of agricultural production, and via 'cross-compliance' rules, which focus primarily on preventing environmental damage from farm operations. Under Pillar 2, biodiversity issues are addressed specifically via instruments such as the agri-environmental measures.

Unfortunately, despite recognition of agriculture's heavy impact on nature, the CAP is not changing sufficiently to reduce biodiversity loss (EEA, 2009a). In several EU countries, direct support is provided on a historic basis, which in practice favours more productive land, usually farmed intensively. Moreover, cross-compliance rules can only make a small contribution to biodiversity conservation because although they limit environmentally damaging practices, they cannot really ensure active management of ecosystems rich in biodiversity. The same can be said for some current support under Pillar 2. By contrast, agri-environmental measures may explicitly target management practices beneficial to biodiversity.

Last of all, it is worth stressing that the 2003 'Health Check' of CAP reform reduced direct payments ('modulation') to bigger farms in order to finance the new rural development policy (Pillar 2).
The present message highlights key questions that emerge from the long history of interaction between biodiversity and agriculture. Specifically, can the CAP be reformed to serve biodiversity better after 2013? And how should that be done?

2 Europe's biodiversity is inextricably linked to agricultural practices creating valuable agro-ecosystems across whole of Europe

In Europe, human activity has shaped biodiversity over time, with settled agriculture and animal husbandry spreading gradually from south-east to north-west. New habitats formed and species populations were enriched by animal and plant species migrating into these agro-ecosystems from neighbouring biogeographical areas such as the Asian steppes. New crop and livestock varieties were raised and actively introduced by humans for agricultural purposes (ELO, 2009).

As a result, a large number of highly valued wildlife species and semi-natural habitat types in Europe are dependant on continuing low-intensity agricultural practices. Areas where farming practices are associated with high biodiversity value are qualified as High Nature Value (HNV) farmland (EEA, 2004; Paracchini *et al.*, 2008; EEA, 2009b).

Of the 231 habitat types of European interest targeted by Annex I of the EU Habitats Directive, 55 depend on extensive agricultural practices or can benefit from them. Similarly, 11 targeted mammal species, seven butterflies species and 10 orthoptera species, as well as 28 vascular plant species of Annex II of the EU Habitats Directive depend on a continuation of extensive agriculture (Map 2).

Good trend data are available for farmland bird species and grassland butterflies. It is widely acknowledged, however, that agricultural practices affect many other habitat types beyond agricultural land in the narrow sense. Halada *et al.* (in press) have listed all the habitat types in Annex I of the Habitats Directive whose conservation status directly or indirectly depends on agricultural practices such as grazing or mowing. These habitat types include types of heath, wetlands, forest and even sand dunes. There is variance across Europe, however, in the types of habitat affected and their specific links to agricultural management practices.

Most important for agriculture, yet arguably also the most unknown and neglected, is soil biodiversity. The species richness below ground is certainly greater than above ground (Heywood, 1995) but most soil organisms are still unknown (Wall *et al.*, 2001). Indeed, one study estimates that only 1 % of soil microorganism species are known (Turbé *et al.*, 2010). This biological diversity underpins processes and ecosystems services that are essential for agriculture, such as soil formation, maintaining soil fertility, water cycle regulation and pest control (Turbé *et al.*, 2010). The precise ecological and economic values of these services are still largely unknown.

Pressures on soil biodiversity are certainly increasing. For example erosion, a natural process that is exacerbated by human activities such as overexploitation of agricultural lands (Gardi *et al.*, 2009), can remove fertile soil that took hundreds of years to form. Inventories and monitoring are necessary to better understand the rich soil biodiversity and the threats it faces (Gardi *et al.*, 2009).

High Nature Value (HNV) farmland contains many European biodiversity hotspots

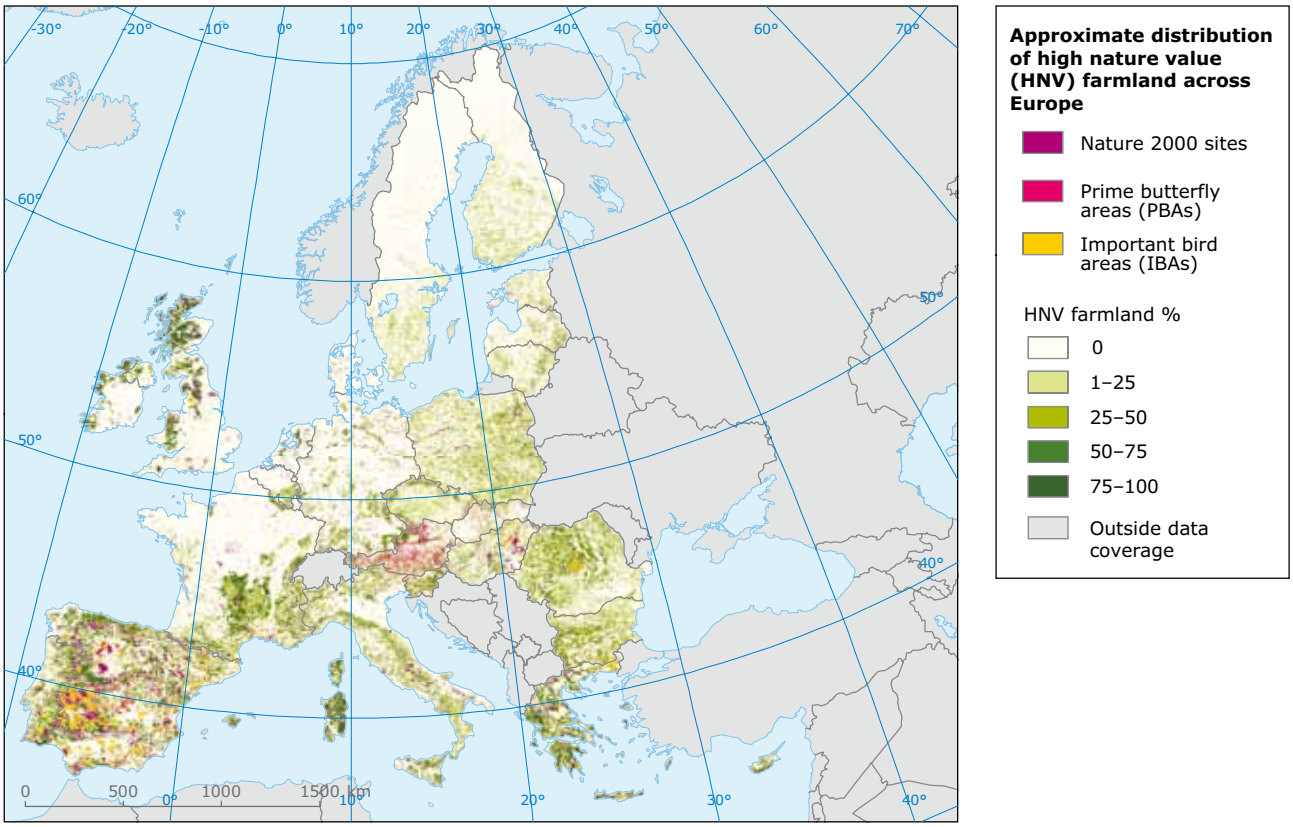
Areas where farming practices are associated with high biodiversity values are classified as High Nature Value (HNV) farmland. HNV farmland is characterised by a high proportion of semi-natural vegetation with a mosaic of low intensity agriculture and semi-natural structural elements (e.g. field margins, hedgerows, stone walls, patches of woodland or scrub, small rivers), and farmland that supports rare species or a high proportion of European or world populations.

Studies have used datasets from Corine land cover, the Natura 2000 network of protected areas, Prime Butterfly Areas (PBAs), and Important Bird Areas (IBAs), and national biodiversity datasets to estimate the potential importance of farmland for supporting rare species and the proportion of European or world populations (Paracchini *et al.*, 2008; EEA, 2009a; Map 1).

Biodiversity in agro-ecosystems is under considerable pressure as a result of intensification and land abandonment

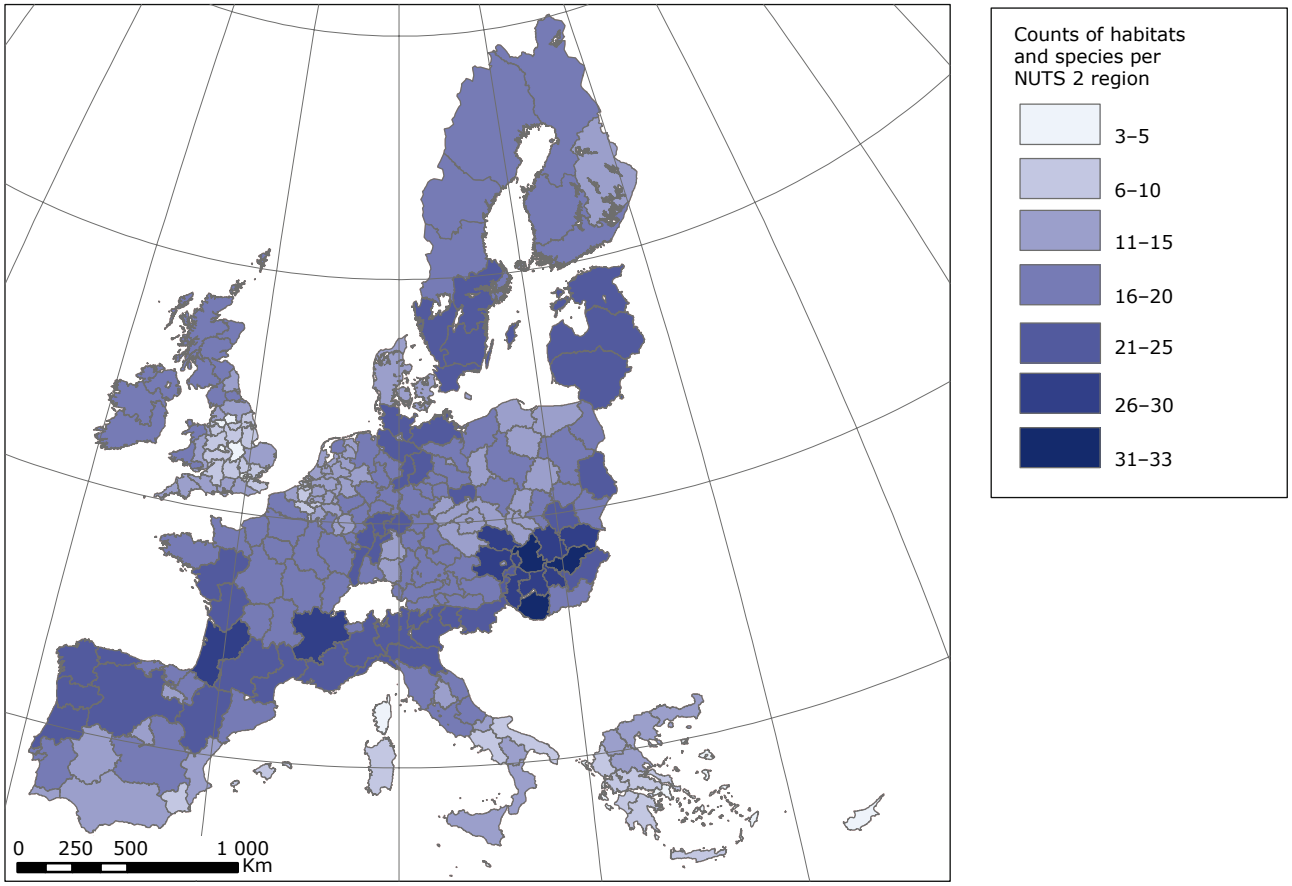
Agricultural intensification and land abandonment are the two main trends affecting the species and habitats that depend on low intensity farming in Europe. Mechanisation, drainage, introduction of irrigation crops, loss of fallow fields and increased use of agro-chemicals are main features of agricultural intensification. Land abandonment causes the loss of specialised species and the replacement of low intensity agro-ecosystems with successions of less rich and diverse vegetation or afforestation (Moreira *et al.*, 2005).

Map 1 Approximate distribution of HNV farmland across Europe



Source: JRC/EEA, 2008.

Map 2 **Distribution densities of mammal, priority plant, butterfly and other insect species, and habitat types of Community interest listed in the EU Habitats Directive, at the NUTS 2 level**



Note: Species and habitat type distribution data is derived from Article 17 reporting under the EU Habitats Directive.

Source: ETC/BD, 2008.

Mechanisation and intensification of Europe's farming practices has not only affected a wide range of farmland habitats and associated ecosystems but has also simplified the whole agricultural landscape. While farm and field size have increased to allow heavy machinery to move, landscape features such as small woodlands, ponds and hedges have disappeared. Intensive farming systems are also based on genetically uniform crops and livestock breeds, vulnerable to pests and diseases (McCracken *et al.*, 2005).

As a result of these trends in agricultural practices, European farmland bird populations declined sharply until the mid-1990s. Although the decline seems to have levelled off, it did so at a low level compared to populations in 1980 (Figure 1).

The situation seems to be even worse for grassland butterflies in Europe. Populations have declined by almost 70 % since 1990 without signs of levelling off (Figure 2).

These negative trends are consistent with reports from EU Member States on the conservation status of species and habitat types targeted by the Habitats Directive. Habitat types linked to agro-ecosystems generally have a relatively poor conservation status, with only 7 % of assessments being favourable, compared to 17 % for habitat types not related to agro-ecosystems (Figure 3).

The situation is particularly severe in the Atlantic biogeographical region where none of the habitats associated with agriculture were assessed as favourable. The Atlantic biogeographical region has the highest pressure on agricultural land and includes some of the most intensively farmed areas on the continent. In the Pannonian and Mediterranean biogeographical regions, the percentage of favourable

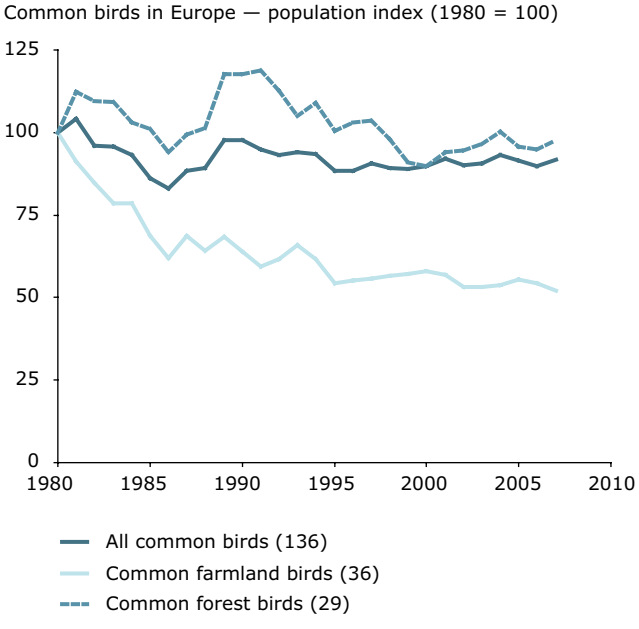
assessments for these habitat types was 4 % and 3 %, respectively. However, the situation in the Mediterranean biogeographical region is complicated by the very high proportion of assessments being reported as 'unknown' (EC, 2009b; ETC/BD, 2008).

The Habitats and Birds Directives are but one of the policy instruments supporting biodiversity conservation in rural areas. Financial support for biodiversity-friendly actions and programmes is also provided by the Common Agricultural Policy and the Rural Development policy, as well as regional policy (Cohesion and Structural funds). LIFE + projects are an important source of funding for initiatives at the country level.

3 Maintaining and restoring biodiversity provides the basis for all agro-ecosystem-related services

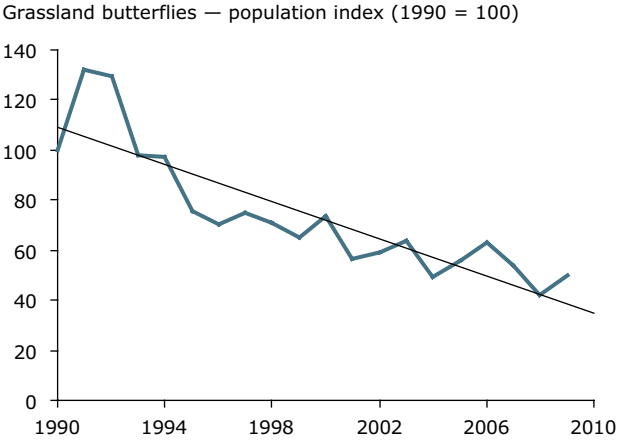
The deteriorating status of biodiversity in agro-ecosystems described above has consequences for the quality and quantity of ecosystem services provided by agricultural ecosystems. The Millennium Ecosystem Assessment's classification of ecosystem services is shown in Figure 4.

Figure 1 Trends in European common birds populations



Source: EBCC/RSPB/BirdLife International/Statistics Netherlands, 2009.

Figure 2 Trends in grassland butterfly populations in Europe



Source: De Vlinderstichting/Butterfly Conservation Europe/ Statistics Netherlands, 2010.

The agriculture-biodiversity relationship is closely linked to other environmental pressures. For example, climate change means that potential arable land area will decline in Europe (Jones-Walters and Nieto, 2007; EEA 2010a). Likewise, agriculture, public water supply and tourism in some locations pose a significant threat to freshwater ecosystems (EEA 2010b). To address these threats, Europe's freshwater ecosystems should be managed using an integrated approach, combining sectoral measures, such as in agriculture policy, with nature conservation and water management.

Agricultural ecosystems deliver numerous services, including providing food and aesthetic enjoyment. Less visible but equally important services are delivered by agricultural soils and agricultural genetic diversity.

Soil biodiversity is an excellent example of ecosystem service provision. It is essential for regulating ecological processes such as water, carbon, and nutrient cycling. Moreover, soil fertility is the basis for sustainable harvests in the future. Humus is the main component and product of biologically decomposed organic material in fertile soils (Turbé *et al.*, 2010). Therefore, the soil organic carbon (SOC) is an indicator of the soil quality as part of functioning agro-ecosystems (Podmanicky *et al.*, 2010). In particular, pastures and forests can generally store more carbon than cropland (Schulp *et al.*, 2008).

In addition to improving the quality of agricultural products (in terms of taste, sugar content and so on),

Figure 3 Conservation status of habitat types of Community interest (Annex I) of the EU Habitats Directive related to agro-ecosystems (left), and not related to agro-ecosystems (right) in the EU-25

Source: ETC/BD, 2008.

Low input farming systems

In the agricultural context, the concept of sustainability developed mainly as a result of growing awareness of intensive farming's negative environmental impacts and the fact that high yields were increasingly dependent on external inputs, in particular fossil-based, non-renewable energy, fertilisers and pesticides.

Several concepts of environmentally friendly agriculture emerged, such as integrated farming, conservation agriculture, organic farming and *silvopastoralism*. Some are ancient methods, which acquired renewed attention. For example, silvopastoralism combines cultivating trees with grazing animals. Others, like *organic farming* are governed by precise rules, such as EC Regulation No. 834/2007, which provides that no artificial fertilisers or pesticides can be used and that farmers may call their products 'organic' if their farming methods are approved by a special certification bodies. Contrastingly, *integrated farming* and *conservation agriculture* are less prescriptive because they are dynamic concepts, which must be flexible enough to be relevant on any farm and receptive to change and technological advances (EISA, 2009).

Integrated farming started with the notion of 'integrated disease and pest control'. It avoids using chemicals or biological controls, instead applying well thought out techniques of crop rotation, timing of sowing, choice of varieties and so on, and providing habitat suitable for organisms that fight pests and diseases. Integrated farming thus encourages farmers to create and keep areas called 'ecological infrastructure': hedges, field margins, small ponds and woodlots.

Conservation agriculture is based on minimising soil tillage to preserve soil cover and structural organisation; maintaining the biological activity of arable soils; maximising soil vegetal cover; and improving crop rotation.

Precision farming uses new satellite technologies, such as Global Positioning System (GPS) and Geographic Information System (GIS) to evaluate very precisely matters such as fertiliser requirements or the density of sowing. GPS allows very exact estimations — the exact location in the field can be pinpointed within one metre. This helps minimise environmental impacts and increase economic efficiency.

genetic diversity represents a natural insurance against pests and diseases. It also provides a genetic pool that facilitates adaptation to changing environmental conditions, including those brought by climate change.

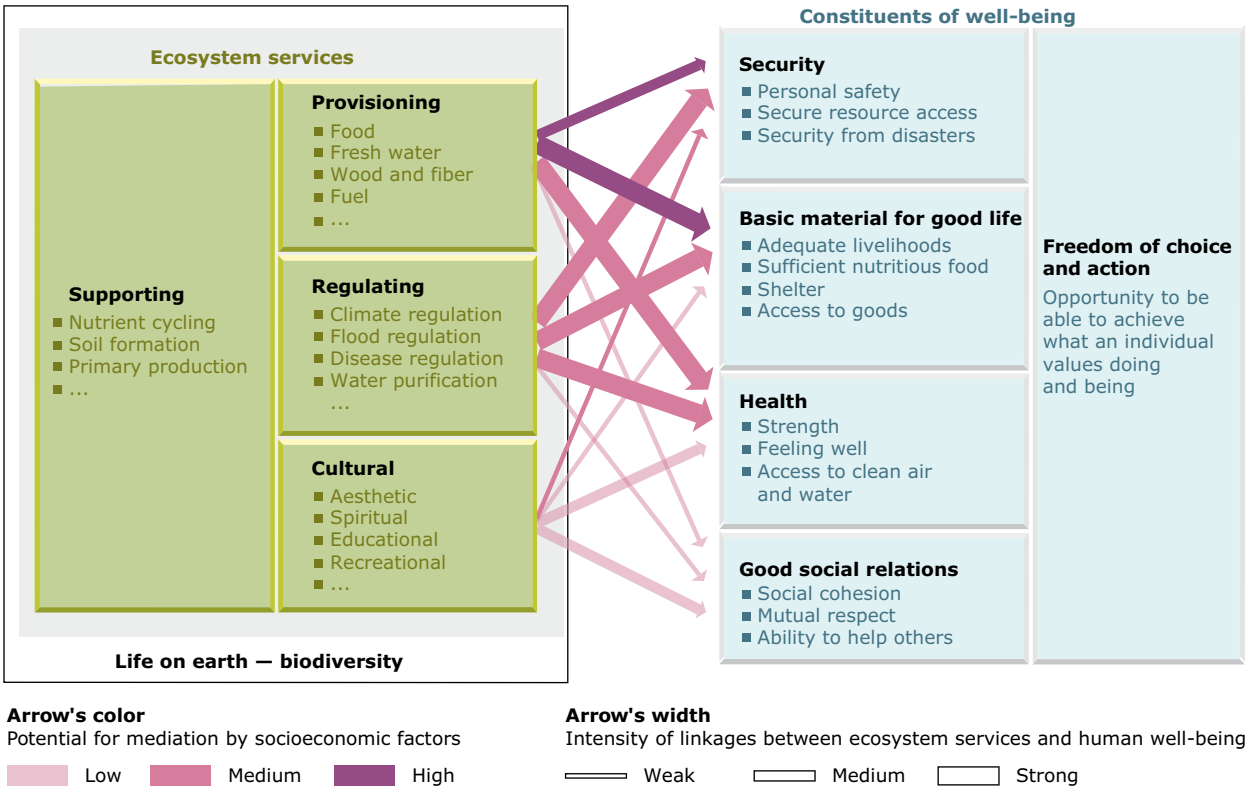
4 Opportunities exist to preserve and use biodiversity better in Europe's agricultural areas, while meeting demand for food, fibre, feedstock and bioenergy

Currently a wide range of farming systems — ranging from very intensive to highly extensive — serve different societal demands in Europe. The latter type form a large part of the High Nature Value farming areas (HNV). Between the extremes there is a range of farming systems that can be defined as 'low input farming systems', including integrated farming, precision farming, conservation agriculture, organic farming and silvopastoralism (combined farming-forestry systems) (Biala *et al.*, 2008). These low input farming systems all aim to enhance biological soil fertility and the natural capacity to reduce negative effects on agricultural production, such as disease and climatic change (Biala *et al.*, 2008).

In the context of needing to guarantee stable and affordable food supply (food security) for a growing world population and with increasing demand for biomass to achieve the EU bioenergy targets for 2020, it is difficult to advocate halting agricultural intensification completely on land with high production potential (EEA, 2009a; Firbank, 2005).

The challenge for biodiversity conservation is therefore to introduce into intensely farmed systems buffering elements that enhance the landscape complexity of the agro-ecosystems and provide a mosaic of habitats for species. Often named 'ecological infrastructure', they include hedges, small ponds, beetle banks and other habitats. Combined with agricultural practices such as long and diverse rotations, more heterogeneous regional distribution of crops and better adjustment to the natural soil fertility, these practices can contribute to enhanced biodiversity while at the same time maintaining a high level of productivity (Le Roux *et al.*, 2008; Cooper *et al.*, 2009). Green Infrastructure can play an important role in this context.

Figure 4 Relationship of ecosystem services and human well-being



Source: MA, 2005.

5 Final reflections

Tackling the relationship between agriculture and biodiversity under the CAP is crucial if we are to halt biodiversity loss in Europe and at the global scale and help ensure sufficient healthy food and renewable bioenergy.

The upcoming CAP reform provides a good opportunity to integrate biodiversity issues more effectively. It is therefore important to coordinate closely the reforms of these policy areas Although food production remains the primary role of agricultural ecosystems, we cannot forget that farming and rural land management perform other important functions for society. They provide ecosystem services and public goods, and although the most important are environmental, they also include maintaining rural social fabric, especially in more marginal areas.

The European model of multifunctional, sustainable agriculture can address these challenges and raising awareness and increasing public support for agriculture's role in the provision of public goods is at the heart of this discussion (EEA, 2009a). The multiple objectives of the CAP reform (due by 2013) reflect the varied functions that agro-ecosystems serve. Equally, they should allow policymakers to address the challenges of delivering sustainable and multifunctional agriculture in the future.

Further reading

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