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Constraints and opportunities for mainstreaming biodiversity and ecosystem services in the EU's Common Agricultural Policy: Insights from the IPBES assessment for Europe and Central Asia

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ABSTRACT

The European Union's Common Agricultural Policy (CAP), being one of the strongest drivers of agricultural land-use practices, has a substantial impact on biodiversity and ecosystem services in the Member States. The initial focus of the CAP to increase and intensify agricultural production affected water and land qualities and contributed to the degradation of traditional agricultural landscapes, cultural identities, and erosion of typical farmland biodiversity. Recent CAP reforms have begun to consider biodiversity and ecosystem services, but still fall short of a thorough mainstreaming approach. The objectives of this paper are to point out main findings regarding (i) key shortcomings of the current CAP, and (ii) major opportunities to enhance the mainstreaming of biodiversity and ecosystem services within the CAP. The paper is based on insights generated in the sub-global assessment of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) for Europe and Central Asia[1]. Our results illustrate the evolution of agricultural policy objectives and instruments applied in the CAP, and their effects on selected ecosystem services and biodiversity. We shed light on key shortcomings of existing policy and provide recommendations for further CAP reforms to achieve more effective biodiversity conservation and sustainable use of ecosystem services.

1. Introduction

The Common Agricultural Policy (CAP) exerts a great influence on agricultural land and rural areas of the European Union (EU). Since its inception in the early 1960s, the overall objective of the CAP was to enhance agricultural production. This has been achieved mainly through a market and price policy, subsidising production and regulating import and export (European Commission, 2004; Hodge et al., 2015; Van Zanten et al., 2014). Although successful in enhancing agricultural production, achieved through the intensification of agricultural practices (*e.g.* by chemical inputs, mechanisation) and habitat conversion, the CAP has also resulted in negative economic, social and environmental impacts. In fact, subsidising production dramatically inflated CAP expenditure that peaked at 70–75% of the total EU budget in the mid/late 1980s. The resulting agricultural surplus was destroyed, stocked and dumped towards developing countries in an effort to

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[1] A major part of this contribution is based on an earlier, pre-peer reviewed version of Ring et al. (2018): Ring, I., Sandström, C., Acar, S., Adeishvili, M., Albert, C., Allard, C., Anker, Y., Arlettaz, R., Bela, G., ten Brink, B., Fischer, A., Fürst, C., Galil, B., Hynes, S., Kasymov, U., Marta-Pedroso, C., Mendes, A., Molau, U., Olschewski, R., Pergl, J., & Simoncini, R. (2018): Chapter 6: Options for governance and decision-making across scales and sectors. In: IPBES (2018): The IPBES regional assessment report on biodiversity and ecosystem services for Europe and Central Asia. Rounsevell, M., Fischer, M., Torre-Marin Rando, A., Mader, A. (eds.). Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany, pp. 661-802.

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control market prices (European Commission, 2004, 2013a). The intensification of agricultural practices dangerously undermined the delivery of ecosystem services, such as provisioning of quality water, water run-off control and prevention of soil erosion, contributed to degrading many traditional agricultural landscapes and cultural identities, and accelerated the loss of typical farmland biodiversity (Martín-López et al., 2018: Visconti et al., 2018; Elbakidze et al., 2018; EEA, 2015a, 2015b; Van Zanten et al., 2014; Stoate et al., 2009; Henle et al., 2008).

Several studies have addressed the negative impacts of the intensification of farming practices on ecosystem services (*e.g.* Gordon et al., 2010 on water supply and quality; van Berkel et al., 2014 on cultural ecosystem services), while others have investigated the positive effects of ecologically-oriented agriculture on farmland biodiversity and ecosystem services (*e.g.* Sandhu et al., 2010; Bengtsson et al., 2005; Crowder et al., 2010; Bommarco et al., 2013). Furthermore, researchers and policy analysts have shed light on the impacts of agricultural policies on biodiversity and ecosystem services (*e.g.* Millennium Ecosystem Assessment, 2005; Poláková, 2011; Plieninger et al., 2012; Van Zanten et al., 2014; Pe'er et al., 2014; Hauck et al., 2014; TEEB, 2015, 2018; Maes et al., 2015; EEA, 2016). However, a rigorous assessment that takes stock of the best available knowledge of CAP effects on biodiversity and ecosystem services in Europe is still lacking.

Following scientific and political recognition of the need for a better integration of the benefits of biodiversity and ecosystem services for human well-being into policy-making (Pascual et al., 2017; IPBES, 2016a; Millennium Ecosystem Assessment, 2005; TEEB, 2010; EEA, 2016), the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) was officially established in 2012 by more than 100 governments (IPBES, 2019a). IPBES, currently counting 132 members, works as an independent intergovernmental body whose overall scope is to provide "*policymakers with objective scientific assessments about the state of knowledge regarding the planet's biodiversity, ecosystems and the benefits they provide to people, as well as the tools and methods to protect and sustainably use these vital natural assets*" (IPBES, 2019b).

This paper is based on results generated in the assessment of IPBES for Europe and Central Asia. More specifically, it draws on insights from the section on agricultural governance in Western and Central Europe in chapter 6 of the IPBES regional assessment report (Ring et al., 2018). The aim of the paper is to review the state of knowledge on constraints and opportunities to better mainstream biodiversity and ecosystem services into the CAP. The integration of conservation and sustainable use of biodiversity and ecosystem services into sectoral policies (CBD, 2011), on land- and seascapes that are not formally protected, appears as one of the most important issues to be addressed by decision makers nowadays (see also Bouwma et al., 2018; Schleyer et al., 2015).

2. Materials and methods

We based our assessment of major policy objectives and policy instruments of the CAP on both scientific and grey literature. Several data bases were used to identify potentially relevant literature (*e.g.* Web of Knowledge, Google Scholar, SCOPUS). Relevant information was also obtained from official websites of governmental and non-governmental international institutions such as, EU, EEA, FAO, IUCN, OECD and UNEP. We used search strings that combined the agricultural sector with keywords (*e.g.* policy, objective, instrument, strategy, constraints, opportunities, ecosystem services, biodiversity, Western and Central Europe, EU, *etc.*). At the beginning of the search the focus was to look for systematic reviews and meta-analyses by using ("Review" OR "Systematic Review" OR "Meta-analysis" OR "compare") as an additional search term. After a first search, the titles and the abstracts of the papers found were checked for thematic relevance. When a relevant paper was found, it was read and its references were systematically consulted. A total of around 250 relevant papers were eventually retained, 130 of which were considered highly relevant for an assessment of the CAP. Papers were considered particularly relevant if they provided insights regarding the positive or negative effects of CAP on biodiversity and ecosystem services. Constraints and/or opportunities for enhancing agricultural governance were identified by analysing main policy objectives and instruments in order to achieve further integration of biodiversity and ecosystem services into the CAP.

We first identified policy objectives of the CAP which were directly or indirectly related to biodiversity or ecosystem services, and then analysed the related policy instruments implemented to achieve those goals. For that purpose we used the following three categories of policy instruments: legal and regulatory instruments; economic and financial instruments; and social and information-based instruments (see IPBES, 2015a, 2015b and Ring et al., 2018 for more details).

The analysis of policy instruments aimed at assessing, where feasible, their effectiveness, efficiency and equity with respect to the integration of biodiversity and ecosystem services into public and private decision making (Ring and Schröter-Schlaack, 2011; Ring et al., 2018). Policy instruments are often analysed for effectiveness and efficiency (including cost-effectiveness) in reaching an environmental objective. Effectiveness comprises the assessment of the outcomes achieved with respect to different policy approaches, while efficiency deals with the (economic) comparison of inputs and outputs. Equity touches upon raising social awareness and enhancing participation as well as legitimacy and transparency in the decision-making process, thereby improving the distribution of benefits and reducing social conflicts.

3. Analysis of the CAP's main objectives and instruments

3.1. The CAP's overall policy objectives

Recognising the economically, socially and environmentally unsustainable model of the CAP, major reforms were undertaken in 1992, 1999, 2003, 2008 (health check) and 2013. The overall objectives of these reforms were: changing the policy from a production support system to one more adaptive to liberalized world trade; reducing agricultural surplus; keeping budget costs stable and manageable; and making the policy more flexible and better shaped to the social, economic and environmental needs and conditions of rural areas (European Commission, 2004, 2013b). The 1992 CAP Reform, for instance, introduced accompanying measures on forestry and agri-environment schemes, set-aside of arable land and marketing of quality products. Later, a number of structural and accompanying measures and disciplines were unified by regulations on Rural Development (RD) (*i.e.* Reg.1257/99, Reg. 1698/05). The 2003 Reform introduced decoupling of payments from agricultural production, and structured the CAP into two pillars: the first addressing the Common Market Organisation (*i.e.* agricultural commodities), the second focusing on RD and delivery of public goods. Cross-compliance was made compulsory for farmers to be eligible for direct payments of Pillar 1. Cross-Compliance consists of Statutory Management Requirements referring to standards in environment, food security and animal welfare, and Good Agricultural and Environmental Conditions regarding soil protection, maintenance of soil organic matter and structure, avoiding the deterioration of habitats and water management (Commission Regulation (EC) No 1122/2009). The 2003 Reform envisaged also the transferring of funds from Pillar 1 to 2 (*i.e.* modulation). In Pillar 2, new measures were introduced for management practices of agricultural land compatible with the conservation of the environment and biodiversity (*e.g.* Natura 2000 payments).

The main objectives of the last 2013 CAP Reform were to 1) ensure long-term food security for people in Europe and contribute to the growing global demand for foodstuffs; 2) produce diversified, high-quality food sustainably while conserving natural resources and biodiversity; and 3) to ensure the viability of rural areas (European Commission, 2013b). This reform has seen the reduction of pillar 1

funding by about 13% and of pillar 2 by about 18% compared with the previous programme period 2007–2013 (Pe'er et al., 2014). Another objective of this reform was to further enhance the joint provision of private and public goods by increasing the integration of Pillar 1 and 2 in a more targeted, efficient and complementary way (European Commission, 2013b). For example, this included the introduction of the mandatory greening component (making up 30% of direct payments under CAP pillar 1) conditional on the adherence of farmers to the following three greening requirements: 1) to cultivate at least two or three different crops in case of arable land exceeding 10 ha or 30 ha, respectively; 2) to maintain permanent pastures; and 3) to establish ecological focus areas on at least 5% of arable land exceeding 15 ha (Hodge et al., 2015).

For the period 2014–2020, 118 rural development plans with economic, environmental and social objectives for Pillar 2 have been proposed by national or local administrations on the basis of the EU Reg. 1305/2013 and co-funded by the European Agricultural Fund for Rural Development (EAFRD). Agri-environmental-climate payments are allowed for farmers enrolling for a minimum period of 5–7 years and for practices going beyond cross-compliance and greening requirements. Agri-environmental-climate payments are estimated on the basis of additional costs and income foregone, resulting from the commitments to be undertaken by farmers. An additional payment can be granted to cover transaction costs up to 20% of the payment, or 30% in the case of commitments undertaken by a group of farmers. The spending for Agri-Environmental Measures (AEMs) for the period 2014–2020 is foreseen to reach €25 billion (European Commission, 2015).

3.2. CAP's main policy instruments linked to selected ecosystem services[2]

This section addresses the most important policy instruments of the CAP by linking them to selected ecosystem services in order to point out what have been or are envisaged to be their impacts. The ecosystem services selected are those related to food and biomass-based energy production (provisioning services); to climate, water quality, pollination, species conservation and habitat maintenance (regulating services); as well as to physical and psychological experience and heritage (cultural services).

3.2.1. Provisioning services: food

In the European Union, agricultural land-use covers roughly 45% of the total area (Maes et al., 2018). The EU is one of the largest producers of agricultural commodities in the world and it has achieved food self-sufficiency for almost all agricultural products with the exception of sugar, maize, sheep meat and, to a lesser extent, other meat (European Union, 2017). In the period between December 2015 and November 2016, the value of EU agri-food exports reached € 130.7 billion, an increase of 2% compared to the previous year. In the same period, the EU imported agri-food for a value of € 112 billion, with a decrease of 0.9% compared to the previous year. In this period, the EU surplus in agri-food exports reached *ca.* € 19 billion (European Commission, 2017a). However, despite the greater value of agri-food exports compared to that of imports, around 40% of food and food products consumed in the EU-28 are still imported according to UNEP/UNECE (2016).

The strong impact of the CAP on enhancing the production of food is highlighted in the literature. For instance, historically, the provision of food has been heavily subsidised by the CAP; at first by support prices and then, after the 1992 Reform, increasingly, by direct payments. The rational for introducing direct payments was to compensate farmers for the reduction of support prices (Tangermann, 2011). In the financial year 2013, direct payments from Pillar 1 amounted to 71% of the whole CAP expenditure, pointing out a marked increase, compared to 61% and 65% of the financial years 2000 and 2005, respectively. This was mainly caused by new Member States joining the EU (European Commission, 2014c). The level of direct payments differs between countries and farmers because they are calculated as compensation for production-support reduction, taking historical production and past income support as reference. This has resulted in large productive farms receiving more payments than small ones, creating problems of distributional equity and social cohesion (European Commission, 2014c).

Despite continuous discussions about the extent and appropriateness of funding the production of agricultural commodities (*i.e.* private goods) through the CAP, the funds available to Pillar 1 are historically far greater than those spent on Pillar 2 (including provision of public goods). In the period 2014–2020, for instance, out of a total CAP budget of € 362.79 billion (at 2011 prices), the funds allocated to Pillar 1 amount to € 277.85 billion (direct payments and market-related expenditure) compared to € 84.94 billion for Pillar 2 (rural development) (European Commission, 2013b).

3.2.2. Provisioning services: biomass-based energy

A general objective related to renewable energy is stated in the EU Directive 2009/28/EC which sets a 20% share of energy from renewable sources to be achieved by 2020. The agricultural sector is contributing to this objective with the production of biomass-energy. Production of energy crops increased since 2000 in ten years by 10% (Maes et al., 2015). In 2010, agriculture supplied 2.1% of the total primary energy produced and 10.6% of the total renewable energy produced in EU-27 (European Commission, 2015a). The Directorate General for Agriculture and Rural Development has estimated that in 2011 direct production of biomass and energy crops was covering 6.1 million ha of agricultural land in the EU-27, around 3.4% of the total Utilised Agricultural Area (UAA) (European Commission, 2015a).

The CAP, in synergy with Directive 2009/28/EC on renewable energy and in parallel with market price signals, technological progress, new installations and infrastructure development for the use of biomass-based energy, has contributed to increased cultivation of energy crops and production of biomass-based energy (European Commission, 2017b). In fact, the production of energy crops benefits from the same direct payments from CAP Pillar 1 as food production. However, the production of energy crops by farms may additionally benefit from some measures of CAP Pillar 2 such as those supporting biogas production (on farm and local production), perennial energy crops (short rotation coppice and grasses), processing of agricultural/forest biomass for renewable energy, and installations/infrastructure for renewable energy using biomass (European Commission, 2017b).

3.2.3. Regulating services: climate

Climate regulation in agro-ecosystems depends on agricultural practices and land use. Agricultural management of soils, such as no deep ploughing, soil cover maintenance, and the conservation of natural grasslands, can contribute to the sequestration of greenhouse gases (GHG). On the contrary, the application of manure, use of synthetic fertilisers and enteric fermentation from livestock digestion processes are the main causes of GHG emissions. (European Commission, 2015a).

According to the European Commission (2015a), agriculture GHG emissions accounted for a total 471 million tons of CO_2 equivalents in 2012. This represented 10.3% of GHG total emissions in 2012 for the EU-28. In the period 1990–2012, GHG emissions from agriculture have been claimed to have decreased by approximately 24%, from 618 million tons CO_2 equivalents in 1990 to about 471 million tons CO_2 equivalents in 2012 (European Commission, 2015a). However, a recent report from EEA (2018) provides another picture: a decrease in GHG

[2] For a synthesis see Table A1 (Appendix). For a thorough analysis of agriculture's impacts and state of ecosystem services, see chapters 2, 3 and 4 of the IPBES Regional Assessment on Biodiversity and Ecosystem Services for Europe and Central Asia (Martín-López et al., 2018: Visconti et al., 2018; Elbakidze et al., 2018).

total emissions in EU-28 from 543 million tons of CO_2 equivalents in 1990 to 419 million tons of CO_2 in 2012, but an increase again afterwards, with 431 million tons of CO_2 equivalents estimated in 2016 (EEA, 2018: Tab. 5ES).

The EEA report (2018: Tab. 5ES) also estimates that, in the EU-28, CO_2 removals by land use, land use change and forestry showed a positive trend from 250 million tons of CO_2 equivalent removals in 1990 to 291 in 2016. These removals can be attributed to conversion from agricultural land to forest and, to a lesser extent, to CO_2 sequestration by grassland (EEA, 2018).

Many are the policy instruments which potentially can be used to address climate change in the CAP. Regarding regulatory instruments, in Pillar 1, cross-compliance and greening requirements on conservation of grassland and ecological focus areas could have some positive effects on carbon sequestration if thresholds were set at an appropriate level. According to EEA (2018), the cross-compliance requirements of CAP Pillar 1 had some impacts on reducing emissions from agriculture, particularly in the so-called Nitrate Vulnerable Zones. More specifically, Statutory Management Requirements linked to the Nitrate Directive and referring to mandatory measures for timing and amount of fertilisers' application, and for storage of manure, had the largest impact. The milk quota system further contributed to agricultural GHG emission reductions through a decrease of the number of animals in the dairy sector, until its repeal in 2015 (EEA, 2018).

Regarding economic and financial instruments, two objectives of rural development of the CAP programming period 2014–2020 are linked to climate: 1) Restoring, preserving and enhancing ecosystems dependent on agriculture and forestry and 2) Promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in the agriculture, food and forestry sectors. Rural development measures are therefore available for CO_2 sequestration, reduced emissions and energy use efficiency. Further price-based economic instruments to mitigate emissions are energy or CO_2 taxes. Quantity-based economic instruments include emissions trading. However, at the moment, the agricultural sector is excluded from the EU Emissions Trading System (EU ETS) (European Commission, 2016c).

3.2.4. Regulating services: water quality

In the EU-28, the nitrogen surplus decreased by 15.6% between 2000 and 2011, from an estimated average of 55 kg N/ha in 2000–2004 to 47 kg N/ha in 2008–2011. The average phosphorus surplus also decreased by 76.2% between 2000 and 2011, from 4.2 kg P/ha in 2000–2004 to 1 kg P/ha in 2008–2011[3] (European Commission, 2014a). However, despite this progress, more than 40% of rivers and coastal water bodies are still considered polluted by agricultural activities, with only 53% of surface water bodies classified under a Good Ecological Status by 2015 in Europe (EEA, 2015d). It is also important to note that the destruction of riparian vegetation and ecosystems, notably wetlands and floodplains (Martín-López et al., 2018), dramatically undermines the purification capacity of adjacent agro-ecosystems.

Many policy instruments contribute to enhanced water quality in the EU. Some are embedded in the CAP through a mainstreaming approach or implemented in close synergy with it through policy integration, while others are used in different sectoral policies (*e.g.* Urban Waste Water Management Directive, Drinking Water Directive). The EU Water Framework Directive (2000) (WFD) and the EU Nitrates Directive (1991), for instance, are implemented by the CAP through cross-compliance requirements such as "protection and management of water" and "to protect water against pollution and run-off and to manage the use of water" (Matthews, 2013). According to the European Environment Agency (EEA, 2015d), Norway and Iceland are also abiding by the WFD, while in Switzerland and Turkey there are similar policies for water protection and management. The WFD has been developed with an innovative management approach based on the Good Ecological Status baselines for water quality (*i.e.* biological, chemical and hydrological state), the river basin management plans covering the period 2009–2015 and 2016–2021 (EEA, 2015d) and also pricing policies that aim to reflect the true opportunity cost of water use through the full cost recovery of water services (Stoate et al., 2009). Furthermore, the Nitrates Directive demands the delineation of Nitrate Vulnerable Zones and the implementation of farming practices following the Codes of Good Agricultural Practice (Stoate et al., 2009).

Some AEMs of CAP Pillar 2, such as the establishment of buffer strips along water courses (Pe'er et al., 2014; Stutter et al., 2012), Integrated Pest Management (IPM) and organic production, are also contributing to lessen pressures on freshwater bodies. However, according to EEA (2015d), the decline of nutrient levels in freshwater bodies is due more to progress in the treatment of waste water and the reduction of phosphorus in detergents than to reduced inputs of agricultural nitrates, the latter still being high in lowlands of Western Europe (EEA, 215d).

3.2.5. Regulating services: pollination

The widespread decline of many wild bee species in Western Europe has been so severe that 50% of species are classified as threatened with extinction in some countries (Visconti et al., 2018; IPBES, 2016b). The decline in wild pollinators has obviously led to deficit in pollination services (Schulp et al., 2014; Breeze et al., 2014). Land-use change (*e.g.* habitat loss and fragmentation), and agricultural intensification (*e.g.* use of pesticides) driven by the production subsidies of the CAP, are considered the most important drivers (Elbakidze et al., 2018; Scheper, 2015). Climate change, spread of pathogens and invasive species are other causes of decline.

The last reforms of the CAP have introduced many regulatory and economic policy instruments, which can be used, directly or indirectly, to address the decrease of pollination. The Framework Directive on the Sustainable Use of Pesticides (Directive 2009/128/EC) requires Member States to deliver National Action Plans to reduce the impacts of pesticides and to promote alternative techniques such as IPM. Agri-environmental payments, which accounted for ca 24% of the funding of the rural development programme in 2007–2013 (European Commission, 2013c), also supported IPM and organic farming. Organic agriculture practice is considered to have beneficial effects on biodiversity because of reduced use of inputs, in particular pesticides and fertilisers (Bengtsson et al., 2005; Tuck et al., 2014). However, despite an increase in land under organic agriculture in the EU-27 from 5.7 million ha in 2002 to 9.6 million ha in 2011, the total area still represents only 5.4% of total utilised agricultural area (UAA) in Europe (European Commission, 2013d).

According to Scheper et al. (2013), the effectiveness of AEMs for pollinators depends on the local context. Better results have been obtained in simple agro-ecosystems (such as croplands) rather than in monotonous (cleared) or complex farmed landscapes (such as grasslands) because simple agro-ecosystems provide more habitat and ecological contrasts. Increasing the habitat heterogeneity of the wider agricultural landscape also contributes to an increase of pollination services (Kennedy et al., 2013; Meyer et al., 2017). High Nature Value Farmland (HNVF)[4] with a variety of biodiversity-rich habitats (natural

[3] The gross nitrogen and phosphorus surplus, estimated by the Gross Nitrogen and Phosphorus Balances, are calculated as the balance between inputs and outputs of nutrients to the agricultural soil. The area (agricultural soils) to which the balance refers is the Utilized Agricultural Area (UAA) as reported in the Crop Production Statistics (land use) (European Commission, 2014a).

[4] "Three types of HNVF are identified. 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, streams, *etc.*; Type 3:

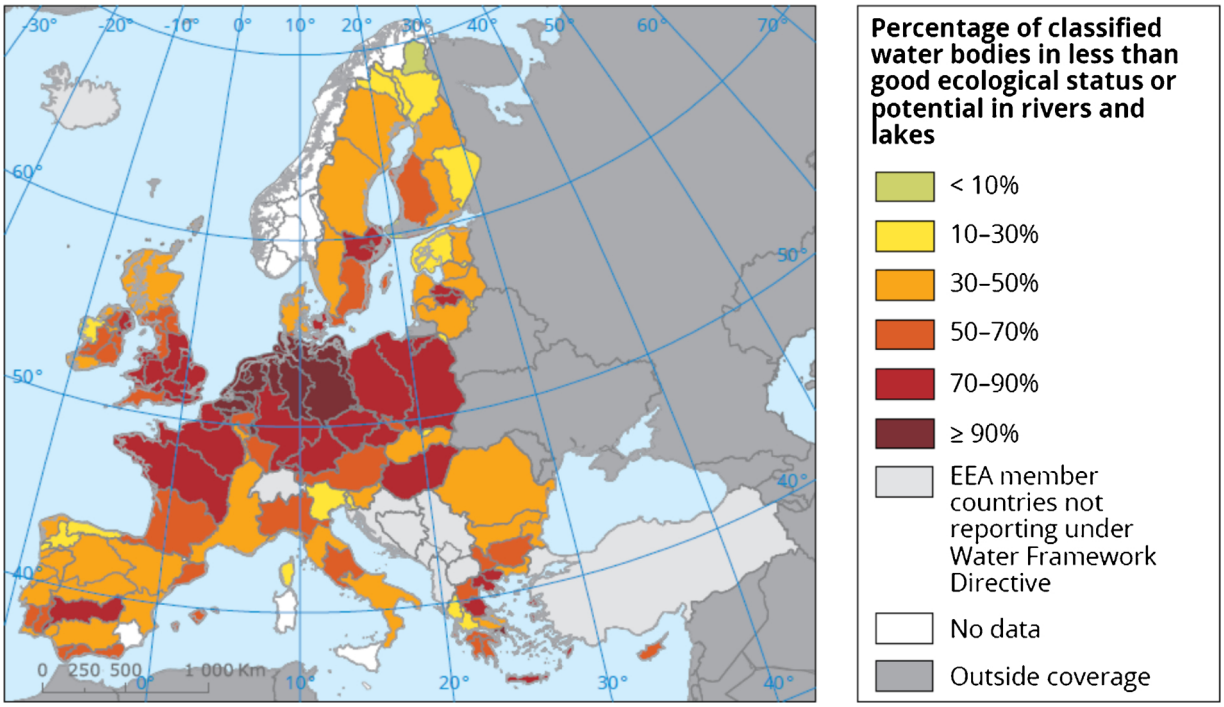

Fig. 1. Percentage of classified rivers and lakes in less than good ecological status or potential in Water Framework Directive river basin districts. Source: EEA (2015d: 65).

and semi-natural grasslands, traditional orchards, traditional agro-forestry areas, hedges, field margins) better supports pollinating arthropods and the services they provide (Kennedy et al., 2013; European Commission, 2014b; Senapathi, 2015) (Fig. 1).

3.3. Regulating services: species conservation & habitat maintenance

The intensification of agriculture, heavily subsidised by the CAP, has been the most important driver for the loss of wild and domesticated agro-biodiversity in the European Union in the last 50 years (Visconti et al., 2018; Elbakidze et al., 2018). Moreover, despite almost 25 years of integrating environmental concerns into the CAP, species loss remains unabated or has even worsened (see Fig.2).

In fact, many biodiversity-valuable farmed habitats have been further degraded (European Commission, 2015) or have dramatically shrunk. Permanent grasslands, for example, decreased by 6.4% between 1993 and 2011 in the EU and by 11.8% in the new Member States (Pe'er et al., 2014). All this occurred despite the efforts of the CAP to improve the status of species and habitats.

Regulatory instruments of CAP Pillar 1 include environmental standards of cross-compliance, introduced by the 2003 CAP Reform, and the greening requirements of the 2013 Reform. From an ecological perspective, the rationale underlying the design of these regulatory instruments is to have the greatest number of EU farmers to comply with environmental requirements and thus, indirectly contribute to the maintenance of species and habitats in agro-ecosystems. Although the underlying idea is to make their uptake more agreeable by EU farmers, cross-compliance and greening requirements have been criticised as being too loose to translate into meaningful ecological outcomes (Hauck et al., 2014; Pe'er et al., 2014; Hodge et al., 2015). The so-called greening policy, for instance, would lead to at least 88% of farms and 48% of total farmland being in fact exempted from establishing 5% Ecological Focus Areas due to a farm size of fewer than 15 ha of arable land (Pe'er et al., 2014). Moreover, farms with less than 10 ha of arable land, representing 13% of arable land across the EU, are exempted from the two-different-crops rule, which, in many Member States, results in a lower diversity of crops than the current average observed at the farm level.

Economic and financial instruments of CAP Pillar 2 directly addressing biodiversity and habitat conservation include Natura 2000 payments to support areas devoted to nature-friendly agriculture and forestry management. The Natura 2000 network was established under the Birds Directive (1979) and Habitats Directive (1992). It now covers approximately 18% of EU territory (Hodge et al., 2015). The agricultural area included in the Natura 2000 network covers 10.6% of the total UAA of EU-27 (European Commission, 2013c). Natura 2000 provides effective conservation for species-rich habitats, with for instance birds and butterflies particularly benefiting from this instrument (Van der Sluis et al., 2016). Yet, only 7%, out of ca 38% of all Natura 2000 habitat types linked to agriculture, show a favourable conservation status, compared to 21% for "non-agricultural" habitats (European Commission, 2014b). Many of these Natura 2000 sites require the continuation of traditional extensive agricultural practices. This should be enough justification for improving and implementing better policy and funding to further restore and manage Natura 2000 habitats towards a favourable conservation status (Van der Sluis et al., 2016). Unfortunately, Natura 2000 payments and the specific Natura 2000 payments linked to the Directive 2000/60/EC (WFD) have both represented only 0.1% and 0.5%, respectively, of the expenditure of the EAFRD Axis 2 on the environment in 2007–2013 in the EU-27 (European Commission, 2013c). This further demonstrates the dramatic lack of funding for Natura 2000 sites (Hansjürgens, et al., 2011; Hochkirch et al., 2013). Beside this, in 2012, management plans that were either active or under development covered only 58% of the Natura 2000 network (European Commission, 2015). This fact illustrates the deficit in implementing the EU commitments made by Member States to national and local scales (Hochkirch et al., 2013;

(*footnote continued*)
Farmland supporting rare species or a high proportion of European or world populations" (European Commission, 2014b: pag.11)

Frederiksen et al., 2017). Moreover, the absence of well-designed management plans of Natura 2000 areas impairs the ability of local administrations and farmers to better understand, program and coherently use the opportunities that may be offered by measures of CAP Pillar 2.

3.3.1. Cultural services: physical & psychological experience

The attractiveness of traditional agricultural landscapes is a basis for rural tourism as it provides opportunities for outdoor recreational activities, including sports and ecotourism. The rural tourism business is a private sector activity driven by market demand, often resulting in the diversification of small- and medium-sized farms. It currently represents ca 10–20% of rural income and employment (European Parliament, 2013). In 2010, about one third of all EU farmers (34%) were engaged in alternative income-generating activities, particularly accommodation and catering for tourists (European Commission, 2013c). In 2008, the EuroGîtes, the European rural tourism umbrella group, estimated that rural tourism supports, directly or indirectly, 900,000 jobs in Europe, generating € 150 billion of gross annual income (European Parliament, 2013). The number of bed places in tourist accommodations in EU rural areas has increased by 4.7% between 2007 and 2012 (EU Commission, 2013c). Kenward et al. (2013) estimated in 2011 that private local spending on activities dependent on wild biodiversity across Europe (hunting, fishing, wildlife excursions and to gather nature products) was averaging € 62 billion annually and urged better integration of conservation resources from all sectors.

Several CAP policy instruments may be used to support rural tourism. In rural development plans, for instance, there are measures that encourage the supply of recreational activities by farmers and restoration of infrastructure linked to tourism. Also the LEADER initiative promotes integrated and synergistic local development based on endogenous resources of rural areas. Public money to support rural tourism by private farms may be justified by the fact that the attractiveness of rural areas for tourism very much relies on maintaining the aesthetic quality of traditional landscapes, which are considered a precious public good.

3.3.2. Cultural services: heritage

The conservation of traditional agricultural landscapes is crucial to achieve the EU 2020 Biodiversity Strategy Targets (Beaufoy and Cooper, 2009; EEA, 2012) and to conserve local culture and Indigenous and Local Knowledge (ILK). The concept of HNVF was developed in the early 1990s to define farmland characterised by low application of inputs, significant presence of semi-natural vegetation, diversity in types of land cover and occurrence of rare or significant species (Andersen et al., 2003; Beaufoy and Cooper, 2009). Before World War II all European agro-ecosystems are likely to have been HNVF (Keenleyside et al., 2014a). Nowadays, HNVF land cover estimates vary markedly between countries, ranging from ca 15% of UAA in Germany and the Netherlands, ca 46% in Switzerland and Turkey, up to 80% in Albania and 90% in Croatia (EEA, 2012). Within the EU, the total extent of HNVF is estimated to be between 15–25% (European Commission, 2014b) and 30% of agricultural land (EEA, 2012; Keenleyside et al., 2014a). The intensification of agriculture promoted by the CAP in the past century was clearly the most important driver for the loss of traditional agricultural landscapes (Visconti et al., 2018; Elbakidze et al., 2018). The last CAP reforms have pointed out the importance of preserving both the cultural and natural heritage of traditional agricultural landscapes. On that basis, many policy instruments, be they of regulatory, economic or social and information-based nature, are potentially available in the CAP to maintain cultural heritage in EU rural areas.

HNVF was finally adopted as an environmental indicator for the Common Monitoring and Evaluation Framework of the CAP 2007–2013 (Fig. 3). It was also included among the priorities and targets for rural development to be addressed by Pillar 2 measures, with the idea to continue it beyond 2013 (EEA, 2012). However, it could be useful to further develop the HNVF concept into an informational instrument in order to raise awareness among policy makers and the general public about the importance of traditional agricultural landscapes.

ILK is considered one of the most important factors in managing HNVF and traditional agricultural landscapes (Babai et al., 2015; Iniesta-Arandia et al., 2014). In fact, biodiversity-rich landscapes result from traditional farming practices and specific socio-economic features, such as labour-intensive management, low mechanical and chemical inputs, small rotational parcel systems, mixed crop-forest-pasture systems, subsistence agriculture, all depending on strong traditional knowledge, and local norms and institutions (Fischer et al., 2012; Molnár et al., 2016). Some measures envisaged by rural development plans, such as conservation of rural heritage, management of low-intensity pastures, preservation of landscape and historical features, hedgerows, ditches and woods, are expected to contribute to conserving cultural identity and traditional cultivated landscapes in rural areas. Unfortunately, while some CAP instruments generally support low-intensity farming practices, not every scheme is appropriate or widely implemented, particularly in Central European countries. For instance, the support of the CAP to small and semi-subsistence farms preserving ILK is still limited, despite the fact that these farms make up the majority of HNVF and traditional agricultural landscapes (Sutcliffe et al., 2015).

Regarding social and information-based instruments, the CAP includes three dedicated schemes within the EU food quality policy: Protected Designations of Origin (PDO), Protected Geographical Indications (PGI), and Traditional Specialities Guaranteed (TSG). These three labels spatially link agricultural products and foodstuffs to a specific geographical area (PDO and PGI) or to traditional composition or means of production (TSG) with respect to the production, processing and preparation of the produce. In Europe food represents an important part of the cultural heritage. These three schemes contribute to the promotion and maintenance of both local gastronomic specialities and the traditionally farmed agricultural landscapes, where, in many cases, these products have been cultivated or reared for decades if not for centuries. The potential impact of these information-based instruments in promoting and supporting local rural economies is shown by an analysis of 2768 PDO and PGI products registered in the EU-27 in 2005–2010 (Chever et al., 2012). This study has estimated that worldwide the sale value of PDO and PGI products was € 54.3 billion in 2010 at wholesale stage in the region of production, with an augmentation of 12% between 2005 and 2010, while their value premium was 2.2 times higher than for non-PDO/PGI products (Chever et al., 2012).

4. Discussion: constraints and opportunities[5]

Constraints and opportunities for the CAP to mainstream biodiversity and ecosystem services into agricultural governance are discussed from the perspective of the three main categories of policy instruments: legal and regulatory, economic and financial, and social and information-based, in that sequence.

4.1. Legal and regulatory instruments

The rationale underlying the design of cross-compliance and greening requirements is that of having the greatest number of EU farmers who respect environmental requirements and thus contribute to achieving positive ecological impacts. However, this rationale seems to give more priority to the efficiency of these policy instruments, trying

[5] The grassland butterfly indicator (1990-2011) is based on population trends in 19 European countries, 17 out of which are EU Member States (EEA, 2013); the common farmland birds indicator (1990-2011) is based on population trends in 27 European countries (EEA, 2015d).

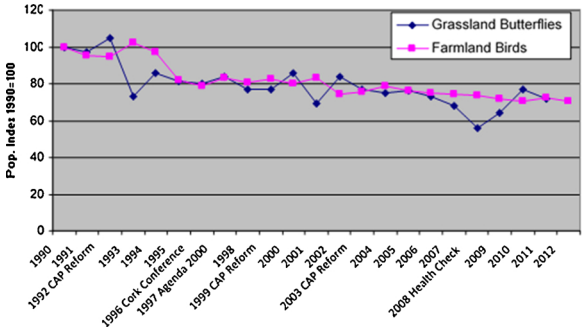

Fig. 2. Population indices for grassland butterflies and farmland birds in Europe[6]. Sources: Our elaboration on data from EEA (2013; 2015a Butterfly Conservation Europe/Statistics Netherlands, and European Bird Census Council (EBCC)/ Birdlife International/Royal Society for the Protection of Birds/ Statistics Netherlands. http://www.eea.europa.eu/data-and-maps/indicators/abundance-and-distribution-of-selected-species/abundance-and-distribution-of-selected-species).

to reduce the costs of their designing, implementation and monitoring, rather than to their effectiveness (Hauck et al., 2014; Hodge et al., 2015; Pe'er et al., 2014). In fact, the effectiveness of cross-compliance and greening requirements, and that of regulatory instruments in general, depends on baseline setting, land-use alternatives, farming systems and site-specific ecological characteristics (Hauck et al., 2014). The way EU legislation is transposed and enforced by national governments also plays a crucial role (Keenleyside et al., 2014a; Frederiksen et al., 2017). Art. 43 of Reg. 1307/2013 (on rules for direct payments) envisages the possibility for Member States to select greening-equivalent practices tailored to their national situation which "yield an equivalent or higher level of benefit for the climate and the environment". However, according to Hart (2015), this flexibility seems to have been used by Member States more as an opportunity to facilitate the implementation of greening by farmers with very few changes to their farming practices rather than as a way to increase environmental outcomes. The actual provision of public goods by cross-compliance and greening requirements should be verified on a territorial basis and, in case of low effectiveness, reference levels should be adjusted locally (see also Tangermann, 2011). The integration of the territorial dimension in regulatory instruments is not new in EU policy. It was already implemented in the EU Water Framework Directive (2000/60/EC), identifying "Good Ecological Status" baselines for water quality and river basins management plans (EEA, 2015d) and in the Nitrate Directive (91/676/EEC) by the definition of Nitrate Vulnerable Zones and codes of good agricultural practice (Stoate et al., 2009).

With regard to the conservation of biodiversity-rich farmland, out of 57 habitats associated with agricultural activities, only 30 and 19 habitats have at least 60% and 30%, respectively, of their area included in the Natura 2000 network (European Commission, 2014b; Keenleyside et al., 2014a). This precludes a large proportion of agricultural habitats that are rich in biodiversity from legal protection An opportunity to improve this situation is integrating biodiversity-rich agricultural habitats in green infrastructure (EEA, 2014; European Commission, 2012, 2013e).

4.2. Economic and financial instruments

There are many political justifications for CAP Pillar 1 income support to EU farmers producing agricultural commodities (*i.e.* private goods). The most important are that farming is essential to achieve food security, fundamental for the provisioning of some public goods of environmental and social character (Matthews, 2013; Tangermann, 2011), and is subjected to volatile market prices, unpredictable weather conditions and variable costs of inputs (European Commission, 2015). However these justifications have been criticised for lacking a robust rationale and clear objectives (Hodge et al., 2015; Pe'er et al., 2014). In particular, forecasts of global food demand and prices indicate that markets will provide enough incentives for food production (Matthews, 2013). Also funding the provision of public goods by Pillar 1 through the definition of farmers eligibility for direct payments on the base of cross-compliance and greening requirements, may present problems. In fact, by not appropriately considering local ecological and agronomic specificities, and, therefore, different local opportunity costs, it may result in ineffective, inefficient and inequitable policy (Matthews, 2013; Tangermann, 2011). Direct payments should be defined more transparently in terms of the income supporting objective and the ecological objective (Matthews, 2013).

Amongst rural development measures of CAP Pillar 2, those supporting Integrated Pest Management contribute to reducing pressures on freshwater bodies and to increasing pollination through reduced use of pesticides (Bengtsson et al., 2005; Tuck et al., 2014). However, the introduction of cross-compliance and greening requirements in Pillar 1 makes the spending for IPM (*e.g.* for reduction and appropriate timing in pesticide use) less justifiable. IPM could be included among the environmental requirements of Pillar 1. This would free-up funds for other, more effective, agri-environmental payments such as organic agriculture and the establishment of buffer strips along water courses (Pe'er et al., 2014; Stutter et al., 2012). This could also help to fund the Green Infrastructure Strategy, as an innovative instrument for the conservation of habitats favourable to biodiversity and pollinator species (Liquete et al., 2015; Pe'er et al., 2014).

In general, agri-environmental policy design under the CAP Pillar 2 has been largely based on action-oriented measures (*i.e.* farmers are required to adopt specific management practices) horizontally implemented (*i.e.* valid all over the EU agricultural land) rather than based on result-oriented measures (*i.e.* compensation paid on the achievement of positive ecological impacts) addressing specific agro-ecosystems. The political, economic, ecological and social reasons for this are well understood (*e.g.* opportunity to enrol for the majority of farmers, farmers' acceptance, high transaction and monitoring costs of result-oriented measures, success or failures in achieving an ecological target depending on causes other than the on-farm management practices such as climate, diffuse pollution, or the performance of neighbouring farms). However, there is also evidence suggesting that the effectiveness of action-oriented measures is lower than that of result-oriented measures (Berendse et al., 2004; Burton and Schwarz, 2013; Hodge et al., 2015; Stoate et al., 2009). By adopting a result-based agri-environmental policy, measures could be targeted more towards specific agro-ecosystems and socio-ecological systems, therefore enhancing their effectiveness. In Western Europe, there is mounting evidence from well-functioning result-oriented schemes that are already implemented (see Fig. 4) even if their implementation did present a number of challenges (Keenleyside et al., 2014b; Russi et al., 2016).

Some of the major challenges are the culture of farmers, peer pressure and risk-averse behaviour of farmers for enrolling into such measures and the higher transaction and monitoring costs compared to the action-oriented AEMs. However, in many cases these challenges can be overcome or at least mitigated by careful design and management. For instance, Burton and Schwarz (2013) propose designing result-oriented measures with a significant "proportion" of the base payment allocation, so as to account for the greater risks of not achieving a desired ecological outcome. These authors also suggest upscaling result-oriented measures by providing premium payments for ecological results which go beyond the outcome-related thresholds. The challenge of high transaction and monitoring costs can be addressed by issuing

[6] The grassland butterfly indicator (1990-2011) is based on population trends in 19 European countries, 17 out of which are EU Member States (EEA, 2013); the common farmland birds indicator (1990-2011) is based on population trends in 27 European countries (EEA, 2015a).

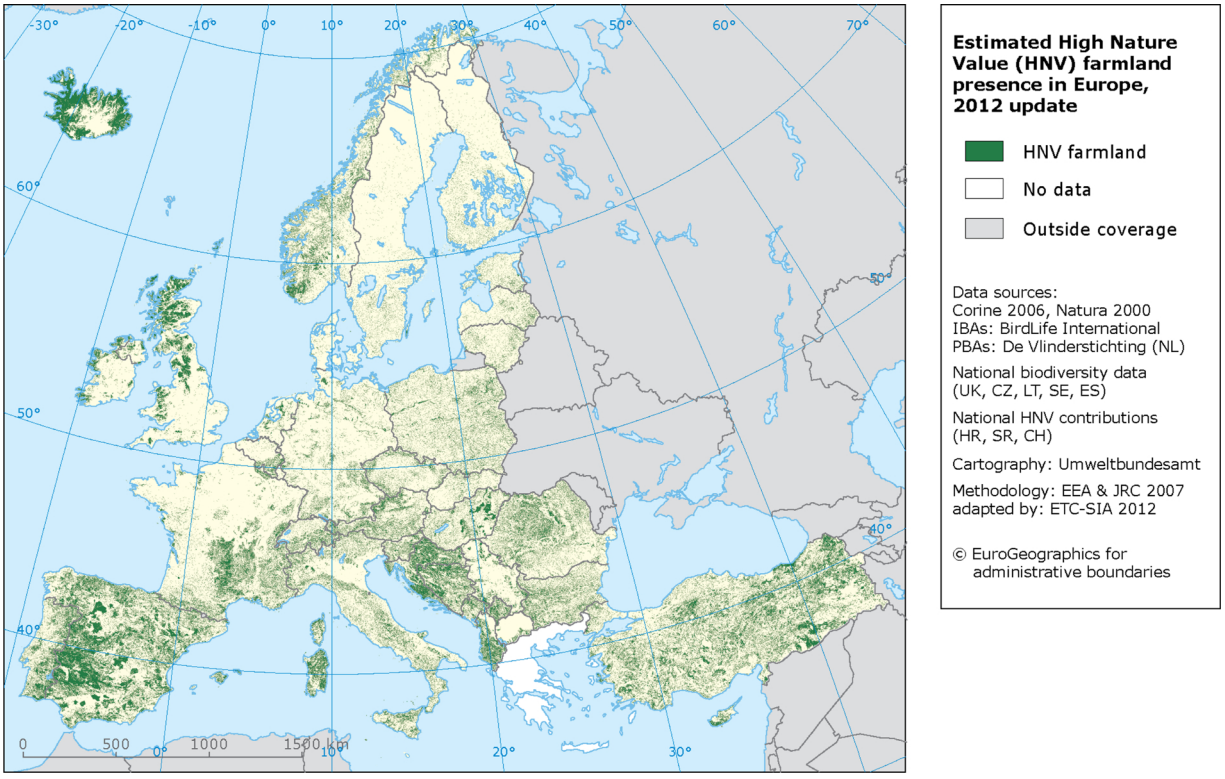

Fig. 3. Likelihood of HNVF presence in Western and Central Europe in 2012 (Greece not included). Source: EEA (2015b).

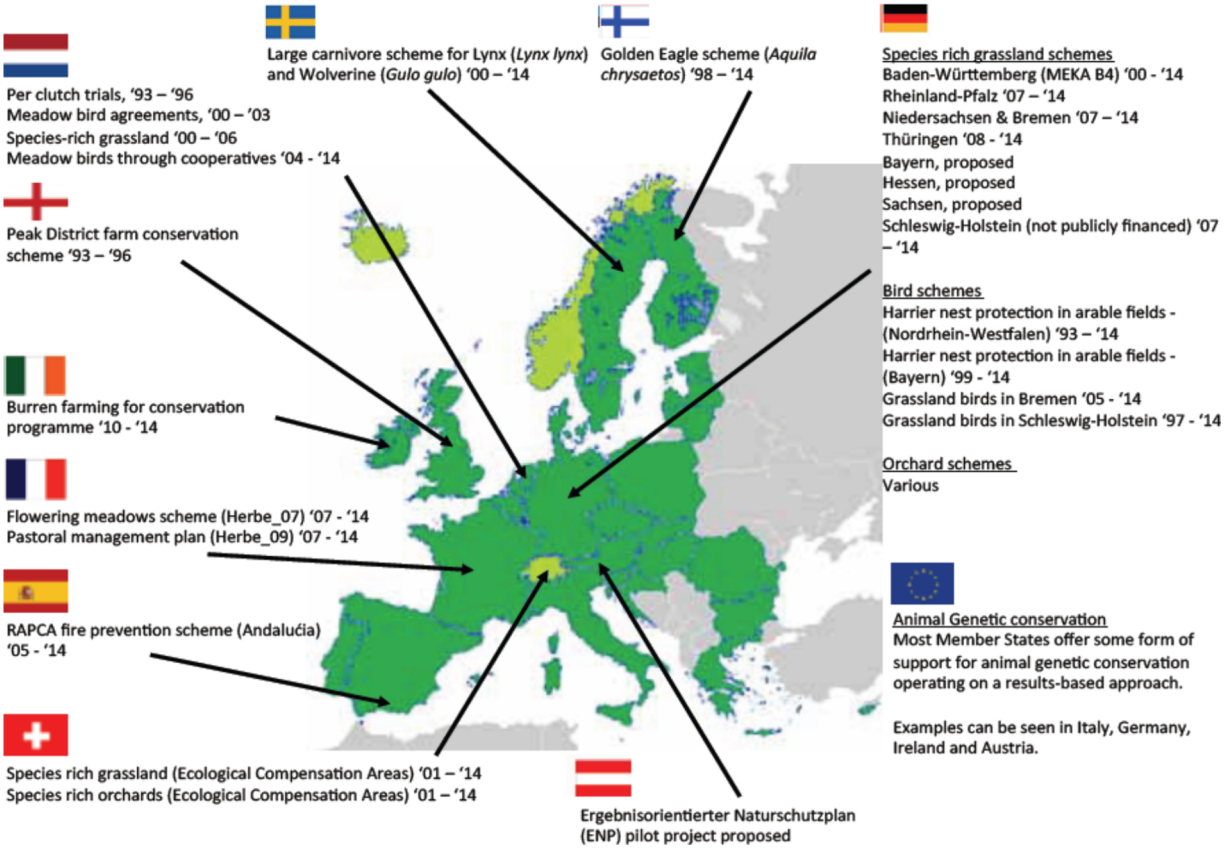

Fig. 4. Examples of result-oriented payment schemes implemented in Western Europe. Source: Keenleyside et al. (2014b).

contracts with farmers at the landscape level, through collaborative agri-environmental schemes. Although this approach may have to face initial reluctance of farmers to adopt a measure which results depend also on the performance of neighbouring farms, and could risk "free rider" attitudes (Prager, 2015), collaborative result-oriented AEMs present many advantages. In fact, once trust and common interests are well-established within the farming community, transaction and monitoring costs can be significantly reduced. This can be achieved by carrying out a single negotiation between a representative of farmers and the institution administering the result-oriented measure and by having farmers doing the monitoring themselves (McKenzie et al., 2013; Prager, 2015). Moreover, beside reducing transaction and monitoring costs, a collaborative agri-environmental scheme may also enable critical territorial extension to deliver extra ecosystem services (*e.g.* maintenance of agricultural practices, traditional landscape, cultural heritage, territorial identity and conservation of endemic species) for which single farms are too small (Berendse et al., 2004; Fleury et al., 2015; Van Zanten et al., 2014; Prager, 2015). Furthermore, farmers who adapt practices to local agro-ecosystems have the opportunity to demonstrate their special land-management skills, notably *via* promotion of ILK (Burton and Paragahawewa, 2011), to develop the most efficient and effective practices for their territorial context (Burton and Schwarz, 2013), and to strengthen the cohesion of local communities thanks to a strong collaborative approach (Prager, 2015).

A finer targeting of AEMs to the local socio-ecological context is also required for HNVF. Here farms are essentially disadvantaged by their low profitability compared to more intensive agricultural areas, and hence depend more on CAP support. Unfortunately, many farms in HNVF, particularly in Central Europe, are not eligible or unable to receive direct payments from Pillar 1 and agri-environmental payments from Pillar 2 (Keenleyside et al., 2014a; Sutcliffe et al., 2015). This is because of high administrative costs, small size, lack of financial capital, non-inclusion in the agricultural land categories defined by the EU, or insufficient payment entitlements based on low historical support records. This situation further exacerbates the loss of ILK and abandonment of traditional agricultural land, both of which are fundamental for maintenance of long-term farmland biodiversity in Europe (Fischer et al., 2012; Molnár et al., 2016). Besides benefiting from a better fine-tuning of AEMs to ILK, farmers managing HNVF could also take advantage of the opportunities offered by rural tourism being attracted to traditional agricultural landscapes. Market opportunities for small to medium-sized farms located in HNVF could be further enhanced by promoting short food supply chains such as on-farm selling of local products to visitors, farmers' markets and online and networking of farmers (Simoncini, 2015).

It is worth noting that during the 2007–2013 programming period, only half of the EU Member States have included Natura 2000 payments and related measures in their rural development plans. According to the European Commission (European Commission, 2016a), reasons for this vary from legal constraints (England) to the small number of approved management plans (Romania and Slovenia) (European Commission, 2016a). In other cases, Natura 2000 payments have been implemented only in agricultural (Portugal, Spain-Aragon) or forestry areas (Germany-Mecklenburg-Western Pomerania) and rarely in both cases (Bulgaria, Slovakia and Estonia) (European Commission, 2016a). The lack of adoption of Natura 2000 payments in national and regional Rural Development Plans by Member States, and the low enrolment by farmers, need to be addressed by a multifaceted strategy. This should include increasing awareness of the positive Natura 2000 effects among national governments and the general public, advice and training to farmers, better tailoring of the measures to the local context, improving monitoring and reporting, and studying the promotion of a result-based "biodiversity conservation premium".

4.3. Social and information-based instruments

In France, around 70% of the Protected Denomination of Origin products originate from HNVF (Stoate et al., 2009). The design of an innovative eco-labelling EU scheme, for those agricultural products coming from HNVF and Natura 2000 areas, could be an opportunity to allow European consumers to contribute to biodiversity conservation while buying traditional and high-quality food. However, a strategy to enhance the sustainability of HNVF should also consider non-economic benefits such as motivations of farmers, their ILK, their socio-ecological context and life style, and their need for social and political recognition (EIP-AGRI Focus Group, 2016; Fischer et al., 2012; von Glasenapp et al., 2011; Gómez-Baggethun and Reyes-García, 2013; Iniesta-Arandia et al., 2015; Bérard and Marchenay (2006)).

In relation to social and information-based instruments, information and training for farmers is crucial for the management of biodiversity and provision of ecosystem services in farmland. In fact, the lack of advice and training for biodiversity conservation within the framework of Natura 2000 has been highlighted as a major shortcoming for its uptake (European Commission, 2016a). A study reviewing the social aspects of Natura 2000 (European Commission, 2016b) found that "the limited participation of stakeholders, the negative perceptions of the network and a lack of consideration of the local context hinder the network's effectiveness", and that these need to be tackled by increasing public awareness. Advisory services on the provision of public goods (*e.g.* biodiversity, cultural, territorial and relational values generated by local food production, processing, selling and consumption) could be enhanced (European Network for Rural Development, 2013) and the resulting advantages for farmers and civil society should be clearly explained (Fleury et al., 2015).

4.4. Integration of policy instruments

Our assessment has shown that different policy instruments are often implemented to achieve the same objective. However, this is done in isolation or without a proper integration between them, which, if pursued, could enhance their synergies and result in increased effectiveness.

This is the case of the 2013 CAP Reform which explicitly underlines the policy rationale to achieve the delivery of public goods through both pillars of the policy (European Commission, 2013b). Still, the policy integration could be substantially further improved. In fact, this policy architecture envisages the use and integration of different policy instruments (see Fig. 5a). This strategy is implemented by obliging farmers to respect cross-compliance requirements (some of which are based on EU environmental legislation such as the Water Framework Directive and Nitrate Directive) to be eligible for 70% of direct payments, and of greening requirements to be eligible for the remaining 30% of direct payments under Pillar 1. Once farmers have respected both cross-compliance and greening requirements, they are eligible to enrol in voluntary AEMs with payments under Pillar 2 for agricultural practices which go beyond cross-compliance and greening requirements (European Commission, 2013b). Furthermore, administrative penalties may be applied as in cases of non-compliance with eligibility criteria, commitments or other obligations resulting from the application of agricultural legislation (Regulation (EU) No 1306/2013).

This policy architecture could be adapted to mainstream biodiversity and ecosystem services into the CAP (Fig. 5b). This could be done by fine-tuning the cross-compliance and greening requirements to better approximate the level of ecological thresholds or tipping points in agro-ecosystems. In fact, biodiversity conservation and the delivery of selected ecosystem services are bound to the respect of proper ecological thresholds in specific agro-ecosystems. Above this reference level, payments for AEMs measures could be tailored even more to specific local conditions by allowing farmers to choose between action- or result-based agri-environmental payments to enhance biodiversity

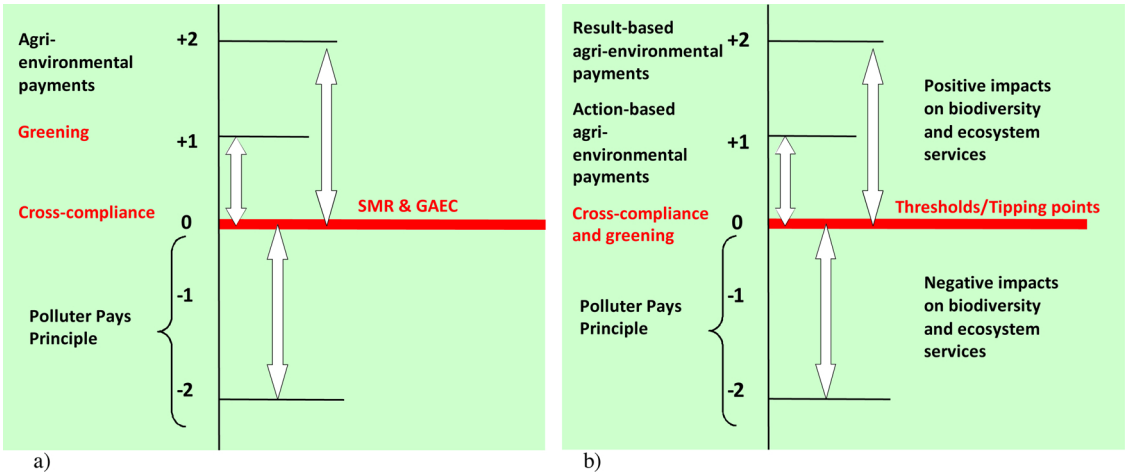

Fig. 5. 5a) Integration of different agri-environmental policy instruments introduced by the CAP 2013 Reform; 5b) Example of integrating further policy instruments with additional benefits for biodiversity conservation and the sustained delivery of ecosystem services in the policy mix. Legend: SMR: Statutory Management Requirements; GAEC: Good Agricultural and Environmental Conditions. Source: adapted from Ring et al. (2018).

and ecosystem services delivery beyond thresholds or tipping points (Fig. 5b).

The effectiveness and efficiency of result-oriented AEMs could be further enhanced by issuing territorial contracts for groups of farmers to reach the critical mass necessary to deliver biodiversity conservation and selected ecosystem services (*e.g.* maintenance of traditional agricultural landscape) and at the same time reducing transaction costs.

5. Conclusions

This assessment of governance of the agricultural sector in Western and Central Europe has been based on a review of existing scientific and grey literature carried out within the framework of the IPBES Regional Assessment for Europe and Central Asia. We specifically focused on the major constraints and opportunities for mainstreaming biodiversity and ecosystem services into the CAP, in order to provide a valuable basis to make better-informed decisions regarding agricultural policies.

Due to the growing complexity of society, reflecting conflicting interests of different stakeholders and the increasing awareness that world resources are limited, the arsenal of policy instruments available for the governance of agricultural land and resources use has been extended over time. This includes more detailed regulatory instruments (*e.g.* ecological requirements), economic and financial instruments (*e.g.* direct payments, agri-environmental-climate payments, *etc*.), and social and information-based instruments (*e.g.* the HNVF concept, eco-labels, certification schemes), providing opportunities for the mainstreaming of biodiversity and ecosystem services. However, despite the increased variety of available policy instruments that support biodiversity and ecosystem services delivery, the effectiveness, efficiency and equity outcomes of the CAP have not been improved yet. Main reasons are a lack of consideration of territorial and time dimensions in policy instruments, as well as the private/public dichotomy of biodiversity and ecosystem services. This lack of coherence can be detected, to different degrees, both within and between policy instruments. For instance, in the last 2013 CAP reform it is possible to envisage a tentative integration between the CAP Pillar 1 regulatory instruments (cross-compliance, greening) and economic instruments (direct payments). However, this integration appears to be done by looking more at political and economic acceptability by relevant stakeholders, rather than at its environmental effectiveness (*e.g.* too loose and general cross-compliance and greening requirements). This lack of attention to environmental effectiveness of policy instruments is shown also in Pillar 2 by the general design and implementation of action-based AEMs and the absence of measurable environmental objectives to be achieved through their implementation.

In conclusion, a number of factors could increase the effectiveness, efficiency and equity of policy instruments to mainstream biodiversity conservation and ecosystem services into the CAP. These include: raising awareness on the contributions of biodiversity and ecosystem services to human well-being; the setting of clear and coherent objectives simultaneously addressing multiple ecosystem services; a more explicit disclosure of trade-offs and synergies between different objectives; more balanced and transparent funding between production of agricultural commodities and delivery of public goods (Pe'er et al., 2014). A more defined focus on biodiversity conservation and ecosystem services delivery at landscape level, taking into account ecological processes and tipping points, and a better combination of policy instruments would further increase the impact of the CAP interventions. To which degree these policy options are locally feasible and how they can be implemented in Western and Central Europe requires further scientific analysis and political debate. The results of this assessment could be useful to scholars, experts, practitioners and policy decision makers who carry out such analyses. We need urgently to better understand the challenges and opportunities for mainstreaming biodiversity and ecosystem services in the EU's Common Agricultural Policy, and to commit to a better-informed process of institutional design.

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Appendix

Table A1.

Table A1
Highlights of main policy objectives, instruments, status and trends of delivery, and key findings for selected ecosystem services in agricultural land in Western and Central Europe (adapted from the IPBES regional assessment report on biodiversity and ecosystem services for Europe and Central Asia, Chapter 6, Ring et al., 2018).

Ecosystem Services	Main Policy Objectives	Main Policy Instruments	State and Trends of biodiversity and selected ecosystem services	Key Findings: Constraints	Key Findings: Opportunities
Food	Long-term food security in the EU; growing global food demand; sustainable production.	*Regulatory e.g.* cross-compliance, and greening requirements; *Economic: e.g.* World markets; subsidies such as farm direct payments; *Social and information-based:* quality product certification.	Food self-sufficiency but imports for some products →	Difficult traceability of some food chains (*e.g.* meat) Competition with other ecosystem services Stenmark et al. (2016) estimated that in 2012 in EU-28, food wastes amounted to 88 million tons of which 53% was attributable to households, 19% to processing, 12% to food service, 11% to production and 5% to wholesale and retail.	Cross-compliance and greenings reference levels better defined if accounting for local ecological and agronomic requirements; Possibility to increase modulation from Pillar 1 to Pillar 2 Incentivise short food supply chains Reducing industrial meat production due to its environmental impacts and large dependency on imports; Promoting extensive livestock farming and pastoralism Halting land grabbing, land degradation and sealing
Energy (Biomass-based)	EU Directive 2009/28/EC on renewable energy (RED) sets a 20% share of energy from renewable sources to be achieved by 2020.	*Regulatory:* RED (art. 17, 18, 19) mandatory sustainability criteria for biofuels and bio-liquids; RED excludes land categories, with high biodiversity value, from being used for bio-fuel production; Common Agricultural Policy CC requirements; *Economic:* RD measures supporting production of biomass for bio-energy; Energy and CO2 prices	Supply not at risk ↗	Possible intensification of energy crops production with direct and indirect impacts on biodiversity and trade-off with other contributions from nature to people (*e.g.* food production); Emissions from transportation of biomass from sites of production to be consumed far away Competition with other ecosystem services	Important source of energy for remote rural areas Local production and consumption of bio-based energy is usually more sustainable than having biomass travelling long distances.
Regulating Fresh Water quality	Surface water bodies to reach Good Ecological Status by 2015	*Regulatory* (*e.g.* WFD, Nitrates Directive, CAP Pillar 1, CC, greening); *Economic*: Pricing policy (Full Cost Recovery of water services)	Self-purification as a service delivery is decreasing ↘ *Water quality* increasing due to limitation of pollutants from policies but still at risks of insufficiency for surface water ↗	Need to further improve CC, efficiency of nitrogen use, waste water management and full compliance with the Nitrates Directive (EEA, 2015c). Need to restore riparian vegetation.	Clear policy targets and territorial approaches such as, respectively, Good Ecological Status and river basin plans, allows better monitoring and feedback for amelioration of policies; Establishing green infrastructure strategy
Climate regulation	Objectives of RD linked to climate 1) Restoring, preserving, enhancing agriculture & forestry ecosystems; 2) Promoting resource efficiency and the shift towards a low carbon & climate resilient economy.	*Regulatory e.g.* CC, and greening requirements *Economic*: RD measures supporting establishing of semi-natural areas, CO_2 sequestration, promoting reduced emissions and energy use efficiency; Energy and CO_2 prices.	Sufficient in extensive agricultural land (also because of forest surface increases) → Not sufficient in intensive agricultural land →	Use of fossil fuels, chemical inputs, and deep ploughing, intensive rearing of cattle are among the main factors contributing greenhouse gases emissions from agriculture	Possibility for European Union member States to use some RD measures of Common Agricultural Policy Pillar 2 to address climate emissions and CO_2 sequestration Greening conservation of grassland and ecological focus area could have some positive effects on carbon sequestration if thresholds are set at an appropriate level; Emissions from agriculture are decreasing.
Pollination	to produce diversified, high-quality food while conserving natural resources and biodiversity	*Regulatory* (*e.g.* Framework Directive on the sustainable use of pesticides, CAP Pillar 1, CC, greening); *Economic* (PES such as AEM for IPM & organic agriculture).	Insufficient delivering ↓	Too loose and general reference levels by CAP CC and GR of the CAP Pillar 1	Green Infrastructure Strategy could be an innovative instrument for the conservation of habitats favourable to pollinators species but it is still under development; Referenced level in CC requirements should match actual IPM and agri-environmental payments should be allowed only for organic agriculture (see also responses in IPBES, 2016b).
Habitat & Biodiversity			Insufficient delivering ↓		

(*continued on next page*)

Table A1 (*continued*)

Ecosystem Services	Main Policy Objectives	Main Policy Instruments	State and Trends of biodiversity and selected ecosystem services	Key Findings: Constraints	Key Findings: Opportunities
	EU Biodiversity Strategy 2020; To halt the loss of biodiversity by 2020; Achi Biodiversity Targets;	*Regulatory (e.g.* habitats and species Directives; WFD; CAP Pillar 1 CC and Greening); *Economic* (AEM such as Natura 2000 payments) *Social and information-based:* HNVF concept		Too loose and general reference levels for supplying also public goods by CC and GR of CAP Insufficient funding of instruments targeted to habitat & biodiversity, Insufficient political commitment at national and local levels; Severe under-funding of Natura 2000 areas and HNVF by insufficient implementation of locally relevant AEM; Insufficient advisory services for farm biodiversity management	CC and GR tailored on agro-ecosystem typologies; Increasing advisory services for farm biodiversity management; Establishing green infrastructure strategy Enforcing the delivering of management plans for biodiversity conservation in order to receive compensations; Design of local result-oriented AEM; Adequate compensation to the income forgone (and to ecological added value);
Physical & Psychological experience	Not identified	*Economic* (*e.g.* rural tourism demand; AEM on encouragement of tourism activities); *Social and information-based:* some LEADER initiatives; HNVF concept, farmers' indigenous and local knowledge	Increasing in traditional agricultural landscape↗ Insufficient in areas of agriculture intensification→	Missing thoroughly official statistics data on rural tourism at European Union level; Risk of tourism congestion in some areas and absence in others Competition with other contributions from nature to people	Increasing offer and demand for recreational activities and rural tourism; The private character of rural tourism business is linked to the delivering of other public goods such as maintenance of traditional landscapes and cultural heritage;
Heritage	Protection, management & planning of landscape in EU (Council of Europe, 2000) Directive 2006/144/EC lists conservation and development of HNVF as a priority for RD 2007/2013.	*Regulatory (e.g., national laws);* *Economic (e.g. AEM on Conservation of rural heritage);* social and information-based (e.g. geographical indications, some LEADER initiatives) *Social and information-based*: labelling, HNVF concept, farmers' indigenous and local knowledge.	Increasing awareness but still insufficient in intensive agricultural areas ↗ Insufficient maintenance of indigenous and local knowledge→	Homogenization of culture and tastes; Costs of maintenance of traditional rural infrastructure; Difficulties on making HNVF concept operational because of lack of data and different methodologies used to identify HNVF (Beaufoy and Cooper, 2009; EEA, 2012; Keenleyside, Beaufoy, et al., 2014a); Low profitability of HNVF Difficulties in accessing CAP payments by small farms in HNVF.	Understanding motivations of farmers managing HNVF; Societal recognition of the importance of farmers managing HNVF; Increasing solidarity between farmers and the public; Developing short food supply chains (*e.g.* Quality product market niches, On-Farm direct selling, Farmer markets, delivering box schemes, e-commerce); Establishing a EU labelling for agricultural products from HNVF and Natura 2000 areas.

Legend: Trend of ecosystem services delivering, ↑= strongly increasing, ↗= increasing, →=stable, ↘= decreasing, ↓=strongly decreasing.
Abbreviations: CAP = Common Agriculture Policy; RD = Rural Development; CC = Cross Compliance; GR = Greening Requirements; AEM = Agri-Environmental Measure; HNVF = High Nature Value Farmland; PES = Payment for Ecosystem Services; IPM = Integrated Pest Management; RED = Renewable Energy Directive; WFD = Water Framework Directive; IPBES = Intergovernmental Platform for Biodiversity and Ecosystem Services.

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