



Mainstreaming ecosystem services through reformed European agricultural policies

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Abstract

Agroecosystems are vital for supplying ecosystem services to human society, but most modern farming practices impact detrimentally on the environment. Public agricultural support policies have been critically important in influencing the transformation of the farm sectors; however, few of them have been dedicated to enhancing ecosystem services beyond agricultural commodities. The largest agricultural support system worldwide, the European common agricultural policy (CAP), has now come to a critical point, as major decisions concerning its design and implementation after 2013 are about to be taken. The debate on this reform process presents a unique opportunity to trigger a transition from commodity-based subsidy policies to policies centered on efficient provision of ecosystem services from agricultural land. To prompt such discussion, we formulate key recommendations informed by a review of ecosystem services literature and address verifiable links to human well-being, nonmarket valuation for balanced services provision, treatment of ecosystem services bundles, site-specific and regionalized approaches, matching spatial scales for different ecosystem services, funding permanence for payment schemes, strong monitoring and adaptive approaches to tackling uncertainties, and coherent cross-sectoral policy design. If these issues were to be considered in formulating and implementing future CAP, it might become an exemplar for redirecting agricultural policies elsewhere in the world toward sustainability.

Introduction

Covering between 28% and 37% of the global land area, agricultural ecosystems are vital for supplying ecosystem goods and services to human society (MA 2005) and of crucial importance for biodiversity conservation (Perrings *et al.* 2006). Agriculture-related ecosystem services include pollination of agricultural crops; natural pest regulation; provision of water, soil, and genetic diversity; and climate and air regulation (MA 2005). In particular, important cultural services such as local people's sense of place, social relations, and cultural heritage values are intimately entangled with farming landscapes (Schaich

et al. 2010). However, while agricultural improvements have greatly increased global food supply, many of them are having inadvertent detrimental impacts on other ecosystem services and biodiversity (Norris 2008). Intensified agriculture has led to diminished water availability and quality, reduced carbon sequestration, and increased eutrophication worldwide (MA 2005). Furthermore, agriculture has been identified as a key pressure on biodiversity, causing habitat loss, degradation, and fragmentation as well as excessive nutrient loads (CBD 2010). Key environmental impacts are increased use of fertilizers and pesticides, as well as intensified animal production systems, sediment runoff from erosion, and

loss of traditional landscape mosaics (McIntyre *et al.* 2009). An assertive response to reverse these impacts requires transformative changes in science, policies, and markets (Reganold *et al.* 2011). However, there is ongoing controversy over whether these challenges are best tackled by “land sparing”—where setting aside strictly protected natural areas is combined with highly intensive farming—or by “land sharing”—integrating agricultural production and biodiversity protection on the same land (Phalan *et al.* 2011). For the past 20 years, European agricultural policies have subscribed to the “land sharing” notion, reflected in the common goal of enhancing agricultural multifunctionality by rewarding farmers for simultaneously producing standard commodities and fostering farmland biodiversity.

With an estimated U.S.\$253 billion worth of subsidies for agricultural producers in OECD countries in 2009 (OECD 2010), public agricultural policies have had decisive influence on agricultural land management (McIntyre *et al.* 2009). The largest agricultural support system worldwide, the common agricultural policy (CAP) of the European Union, had a producer-support budget of U.S.\$121 billion in 2009 (OECD 2010). After several stepwise improvements, the CAP has now come to a critical point, as voices for a paradigmatic change of funding priorities have grown louder. In particular, the global economic crisis and high agricultural commodity prices represent an opportunity for a fresh, forward-looking approach to food and agricultural policy, with a frequently expressed imperative to target public money for agriculture directly to the provision of public goods. These include farmland biodiversity, soil functionality, agricultural landscapes and rural vitality—features that are often associated not only with natural, but also with important social and cultural dimensions such as sense of place, rural tourism and recreation, or cultural heritage (Cooper *et al.* 2009).

In October 2011, the European Commission (2011a) presented a set of legal proposals concerning the design of the CAP for the 2014–2020 period. We argue that this ongoing reform process—which is expected to be finalized by the end of 2013—offers a unique opportunity to trigger a transition from commodity-based subsidy policies to policies based on the efficient provision of ecosystem services from agricultural land in Europe. First, we review the development and, in particular, the environmental aspects of the CAP and the current proposals for its reform. Second, we distill the key insights from the ecosystem services literature into recommendations for the design of agricultural policy responses to confront the ongoing degradation of ecosystem services. Third, we examine the prospects for integrating ecosystem services into the CAP. We intend to review the potentials of the

ecosystem services approach in the topical debate on agricultural policy reform, aiming to stimulate discussion, rather than provide in-depth analysis of the broad subject of payments for ecosystem services.

The common agricultural policy and the proposal for its reform

Public policies, understood as decisions and actions of governments or government-mandated organizations, have taken influence on land management throughout history (Oskam *et al.* 2010; Primdahl 2010). Interventions target to influence human decisions and practices and approach farmers, either in their roles as (1) producers (e.g., through agricultural subsidies), (2) landowners (e.g., through land-use zonation), or (3) members of a rural community (e.g., through collaborative planning; Primdahl 2010). Public policy interventions include control measures, economic instruments, market facilitation, facilitation of public–private partnerships and conservation trusts, and research and extension services (Oskam *et al.* 2010). EU policies are based on treaties and specified in regulations and directives. They are frequently implemented at lower levels of government, e.g., by member states or regions, and involve multilevel decision-making and frequent interactions with other policy fields (e.g., environment, energy, spatial planning; Oskam *et al.* 2010; Primdahl 2010).

The CAP is the most important agricultural policy mechanism that exerts influence on agricultural landscapes throughout the EU (Cooper *et al.* 2009). In its beginnings, it responded to the economic crisis of the 1930s and World War II by increasing agricultural production and production efficiency, improving standards of living for farm families, and ensuring food supply. Policy measures of the early CAP comprised mainly direct payments to farmers and price guarantees coupled with commodity production. By the late 1980s, these policies had led to significant intensification, environmental problems, production surpluses, and international trade disputes, because of their distorting effect on world commodity prices (Dinan 2010). The MacSharry Reform of 1992, followed by the 1999 decisions on Agenda 2000, took account of agricultural overproduction as well as a rising awareness about environmental issues by introducing price reductions, farm-income compensation, set-aside obligations to restrict total production, agri-environmental measures, and a more market-oriented approach (Dinan 2010). The latest CAP reform of 2003 introduced the “decoupling” of payments from agricultural production; “cross-compliance” by linking payments to obligatory minimum environmental and animal welfare standards, and a

consolidation of rural development policies. The CAP is divided into two “pillars”: (1) market support measures and direct aid to farm enterprises and (2) rural development policies (including agri-environmental policies).

Though European agricultural policies do not explicitly use the ecosystem services concept, the potential role of agriculture as a provider of multidimensional environmental public goods has been acknowledged (Cooper *et al.* 2009). However, financial endowment for incentives promoting public goods has remained low; in 2008, only 4.3% of the total EU agricultural budget was granted to agri-environmental schemes, seen as the most important public goods delivery mechanism. In the context of the current reform debate, the European Parliament noted that “the market has failed to [...] reward farmers for protecting the environment and other public goods” and has therefore called for the provision of “proper economic incentives for farmers to optimize the delivery of ecosystem services” (European Parliament 2010). Although agri-environmental schemes within the CAP share most features of payment schemes for ecosystem services provision (PES), such as the voluntary character and conditionality of payments (Wunder *et al.* 2008), they have some important peculiarities. First, they exclusively target farmers as providers of ecosystem services. Second, PES schemes ideally link payments to market demands, thus reflecting the value that society ascribes to expected environmental benefits. In contrast, agri-environmental remunerations are usually per-hectare payments calculated as compensation for additional costs and loss of income incurred by induced changes in land-use practices. Third, agri-environmental schemes are exclusively financed by public funds (Dupraz *et al.* 2010).

The European Commission (2010) has identified three challenges to be addressed by the CAP for the 2014–2020 period: food security, environment and climate change, and maintenance of viable rural areas. Environment including climate change, and rural development are priorities widely agreed upon in the scientific community. In contrast, addressing food security by raising production is more controversial, and some voices have argued that most famines are caused by deficits in food distribution, rather than by insufficient food production (Fischer *et al.* 2011). For increased PES, the most important aspect of the European Commission’s (2011b) legal proposals is the introduction of a “greening” component. By dedicating 30% of direct payments to “greening”, the Commission aims to ensure “that all EU farmers in receipt of support go beyond the requirements of cross-compliance and deliver environmental and climate benefits as part of their everyday activities” (European Commission 2011b). For this, farmers will have to comply with three mandatory principles:

- (1) Crop diversification: To improve the resilience of agroecosystems, farms will need to cultivate at least three crops on their arable land, none accounting for more than 70% of the land, and the third at least 5% of the arable area,
- (2) Maintenance of permanent pasture: To strengthen retention of soil carbon and grassland habitats, land claimed as having been permanent pasture for at least five years must be preserved (with some exceptions).
- (3) Establishment of ecological focus areas: To deliver water and habitat protection, farms will have to dedicate at least 7% of farmland (excluding permanent grassland) as “ecological focus areas”, such as field margins, hedges, trees, fallow land, landscape features, biotopes, buffer strips, and afforested areas.

An important objective within this rural development support program will be the “restoration, preservation, and enhancement of ecosystems” through continuation of agri-environmental schemes. The actual legislative procedure in which the European Parliament and the Council of Ministers will negotiate the reform proposals begins in spring 2012, with an agreement expected about 1 year later. After finalization by the European Commission and the preparation of required measures by EU member states, the new CAP regulations will enter into force by the beginning of 2014.

Key features of paying farmers for ecosystem services

Defining, classifying, measuring, valuing, and reinforcing ecosystem services is highly complex, and a large number of issues need to be considered to enable successful integration into agricultural policies. Aware of this challenge and of the limited scope of this policy perspective, we target our analysis on the following key properties of ecosystem services, as acknowledged in seminal publications (e.g., MA 2005; Farley & Costanza 2010; Kinzig *et al.* 2011): By definition, ecosystem services comprise a direct, significant, and verifiable contribution to human well-being (1). As the dominant economic paradigm does not adequately account for these benefits, many ecosystem services are currently underpriced and have therefore been degraded (2). There can be synergies, but also trade-offs, between single ecosystem services (3). Ecosystem services are highly site specific (4) and are generated at various spatial scales (5). Many ecosystem services act across long time scales (6). Considerable uncertainties predominate around the amount of PES, the relationship between ecosystem functioning and service provision, and the impact of human intervention on ecosystem

Table 1 Features of effective payment schemes for ecosystem services

Key ecosystem services properties	Design features	Measures for potential integration into agricultural policy
Contribution to human well-being	Tailoring to specific ecosystem services Outcomes orientation	No payments without the provision of public ecosystem goods or services Fostering use of outcomes-oriented remuneration within payment schemes
Inadequately valued by markets	Nonmarket and deliberative evaluation methods	Integration of nonmarket and deliberative valuation approaches
Trade-offs between services	Management of ecosystem services bundles	Funding agri-environmental measures coupled to provision of overlapping ecosystem services Encouragement of whole-systems approaches
Site-specificity	Regionalized payments	Regionalized target formulation and measurement designs for the provision of ecosystem services according to landscape context and diversity
Generated at different spatial scales	Scale matching	Cooperative agreements between farmers
Acting across long time scales	Funding continuity	Linking the degree of cofinancing to the economic capacity of the member states Fixed national allocations for member states
Uncertainty	Adaptive management and institutions	Periodic evaluation of target achievement and side-effects generated and review of existing target systems Increased flexibility for member states to react to future developments in ecosystem services provision
Sensitive to cross-sectoral policies	Policy coherence	Developing coherence with international agreements, other EU policies, and national biodiversity strategies

services generation (7). Ecosystem services are sensitive to cross-sectoral policies (8). Based on these properties, we identify the following policy features (summarized in Table 1) as crucial for furthering the CAP reform process.

PES must be linked to verifiable benefits for human well-being

Most importantly, the ecosystem services approach implies that resources be targeted specifically for those services that are relevant for the benefit of society and that are in short supply due to ecosystem degradation. Consequently, no payments from the CAP should be granted without a verifiable provision of public ecosystem services. This clearly needs to go beyond the cross-compliance mechanism of the past. Existing compensation payments at the local level are frequently directed toward specific demands for ecosystem services and can give pointers for future CAP design (Pruckner *et al.* 2007). Here, outcome-oriented approaches to payments for ecosystem services can increase efficiency and ensure that the targeted public ecosystem service is actually provided. However, development of appropriate indicators for monitoring services provision and of valuation methods to determine premium levels is only

just beginning, in particular for many cultural ecosystem services (Wätzold & Schwerdtner 2005; Tallis *et al.* 2008).

Nonmarket valuation methods schemes must be fostered for balanced provision of all ecosystem services categories

Current economic paradigms, policies, and their inherent valuation approaches have created societal preferences for provisioning services (i.e., commodity production) whereas regulating, cultural, and, in particular, supporting services are perceived as being less important (Rodríguez *et al.* 2006). Commodity markets frequently do not consider the full social costs of production, and regulating, cultural, and supporting services are usually not traded in markets. Therefore, measures for the societal value of ecosystem services appear to be either lacking or inadequate (Kinzig *et al.* 2011). Nonmarket valuation methods are a promising means of approaching this market failure and are increasingly being applied to assess a (local) public's valuation of various ecosystem services (Randall 2007). Deliberative valuation procedures are based on social rationality and communicative processes. Therefore, they have (compared to assessments of individual preferences) the potential to better

account for the complexity and interdependence of ecosystem services, their often incommensurable value dimensions, and poor knowledge about the respective ecosystem functions on the part of a local public. The concrete form of these procedures needs to be case specific, and the following critical issues need to be addressed (Vatn 2009): Who should participate? How should participation be organized? What data and values are to be considered? How is information to be conveyed to participants? How should conclusions be reached?

PES must be designed to foster multiple bundles of ecosystem services to minimize trade-offs

To minimize trade-offs, multiple ecosystem services should be managed as interconnected bundles in a sustainable, integrated manner (de Groot *et al.* 2010; Raudsepp-Hearne *et al.* 2010). On agricultural land, prospects for enhancing multiple ecosystem services are good, as many services can be produced jointly along with agricultural products. However, most currently existing payment schemes, in particular those for biofuel production, encourage the provision of a single ecosystem service, regardless of potentially negative interactions with other services (Plieninger & Bens 2007). Future agricultural policies must ensure that payment schemes consider multiple ecosystem services. Trade-offs can also be avoided by directing agricultural support toward whole-systems approaches to sustainable farming, for example, “high nature value” farming or “eco-functional intensification” that at same time deliver environmental, social, and cultural benefits. Here again, the systematic integration of deliberative appraisal methods in the design, implementation, and evaluation processes would allow for the provision of well-balanced bundles of ecosystem services, thus reducing trade-offs across space, time, and the ecosystem services themselves (Rodríguez *et al.* 2006).

Targets must be defined regionally, respecting the site specificity of ecosystem services provision

The site specificity of many ecosystem services can be accounted for by introduction of regionalized payments, through which financial investments can be more effectively targeted to “high-payoff areas” for PES. Such payments allow for consideration of regional differences that may result in high opportunity costs for farmers in some areas, for example leasehold costs, and can also increase farmer participation as an additional benefit. However, regionalized approaches are accompanied by

higher transaction costs than the prevailing centralized approaches, as monitoring, enforcement, and decision making are much more complex (Schleyer & Plieninger 2011). Obstacles to implementing decentralized approaches include lack of expert knowledge and time resources within administrations, publics insufficiently sensitized to agri-environmental issues, power issues, and path dependencies (Eggers *et al.* 2008). But a number of models have shown promising levels of cost effectiveness, including compensation schemes for ecosystem impacts through infrastructure projects via regionalized catalogues of eligible measures (Schaich & Konold 2012).

Payments must match the spatial scales of ecosystem services provision through collective management at landscape scale

Incentives need to match the appropriate spatial scales at which ecosystem services are to be provided (Hein *et al.* 2006). Many ecosystem services, such as water purification, flood mitigation, and aesthetic values, are delivered at landscape rather than at farm scale. Therefore, payments need to encourage coordinated action across farm boundaries (Goldman *et al.* 2007). In the past decade, collective approaches to the agri-environment have gained increasing scientific and political interest (Hagedorn 2002). Farmer groups that integrate environmental conservation into land management at regional scale (environmental cooperatives) increase the ecological effectiveness of agri-environmental policies through scale and enlargement, appeal to farmers’ self-interest in implementing nature conservation, and make use of local ecological knowledge. Mainstreaming collective management approaches into EU agricultural policies also reduces farm-related, private and public transaction costs (Sutherland *et al.* 2012).

PES require a long-term funding perspective and performance-based cofinancing strategies

As ecosystem services such as carbon sequestration are delivered across long time scales, long-term continuity of funding is required. Funding permanence would be enhanced if EU-priority agri-environmental measures were to be fully financed by the EU or if the degree of cofinancing could be linked to the economic capacity of each member state. A switch to fixed national allocations for the member states would further secure funding continuity, as it would help avoid situations where member states choose tools simply to maximize their financial returns from the EU.

PES must be periodically evaluated to tackle uncertainties in ecosystem provision through adaptive management

Due to the uncertainties surrounding PES follows, there is a need for adaptive institutions and management approaches that can respond to unexpected impacts and continuously improve the performance of policies. Decision making in adaptive management needs to be based on the best available information, which can be a difficult requirement, as the various EU member states and administrations use different monitoring schemes, and scientific information is not generally accessible or geared toward policy makers or practitioners. Moreover, monitoring systems for some dimensions of goods and services provided by agricultural landscapes are lacking or just about to develop, e.g., regarding cultural heritage or aesthetic services. Therefore, we argue for greater emphasis on consistent monitoring systems that include social and cultural components, periodic evaluation of target achievements and side effects generated, subsequent review of existing target systems for agri-environmental measures, and supporting institutions fostering exchange between scientists and policy makers. Regarding the adaptive capacity of financial resources, the European Commission plans to introduce a mechanism allowing member states to switch resources between the two pillars of the CAP (European Commission 2010). This “two-way valve” can increase the flexibility of member states to react to unforeseen developments, but also requires assurance that this flexibility does not undermine long-term funding continuity.

PES must be coherent with other policies to avoid competing incentives

The envisioned incentives for ecosystem services will be interacting with efforts to develop new agricultural systems and technologies and with other public policies. Therefore, they will be most effective as part of a coherent set of public policies and less effective when other policy instruments provide opposing incentives. Coherence of the CAP is particularly necessary for international agreements signed by the EU (e.g., UN Framework Convention on Climate Change) and other EU policies (e.g., Habitats Directive), but also for the particular National Biodiversity Strategies and Action Plans of member states. At the same time, PES should not be overloaded with socioeconomic objectives that are out of the scope of ecosystem services delivery, such as income transfers (Kinzig *et al.* 2011). A positive development of the CAP reform process should be that the “greening” of direct payments

and limitation of state-guaranteed prices and production-oriented payments attempt to be more in line with international trade negotiations than the current system.

Conclusions

The large proportion of agricultural land and its potential for improvements in ecosystem services make it “difficult to see how global ecosystem services can increase without significant improvements in ecosystem services from farming” (Porter *et al.* 2009). Therefore, the policy perspective outlined here calls for bringing the core insights of ecosystem services research into the CAP reform process. This review merely scratches the surface of many important and interrelated issues. A larger debate informed by ecosystem services research is crucial during ongoing legislative negotiations and in the “post-2013 CAP phase,” because agricultural support schemes represent potentially powerful instruments for the provision of ecosystem services at a financial scale far above any other payment schemes for ecosystem services, including global carbon markets. But so far, most support schemes have not been targeted to effectively enhance ecosystem services beyond agricultural commodities.

The stated intention of the European Commission to devote 30% of first pillar payments to “greening” is a landmark decision and involves an estimated rise from U.S.\$3.9 billion to U.S.\$11.8 billion on PES expenditures (BirdLife Europe 2011). However, from our perspective, the proposed underlying policy mechanisms are too simplistic in their design and ignore the science of ecosystem services, as they do not account for key features such as links to human well-being, balanced provision of ecosystem services, treatment of ecosystem services bundles, site specificity and regionalization, appropriate spatial scales, funding permanence, tackling uncertainties via adaptive approaches, or cross-sectoral policy coherence. Consequently, the proposed mechanisms are likely to fall far short of delivering real improvements in PES. To promote crop diversity, to maintain permanent grassland, and to establish focus areas will certainly contribute to increased flows of some ecosystem services in agricultural landscapes. For example, there is ample evidence on the capacity of ecological focus areas to provide above- and below-ground ecosystem services (Tscharnkte *et al.* 2005). But these three measures should not be considered the only viable means of ecosystem services management, and their real benefits depend strongly on how they are implemented in practice. In some cases, for instance, maintaining intensively managed pasture may not result in any biodiversity or

climate-change benefits. Likewise, crop diversification can be reached through cultivating wheat, barley, and oats, but growing these together would still result in a largely homogenous cereal landscape. Further, farms that already composed of 7% (or more) of ecological focus areas have no incentive to increase landscape heterogeneity beyond what would occur in the absence of the “greening component” (McCracken 2011).

Our recommendations need to be seen in the light of an overall debate around the World Trade Organization (WTO) process toward trade liberalization, in which two disparate paradigms have emerged (Potter 2010). A neoliberal policy model, adopted by countries such as Australia, maintains that land managers (not necessarily farmers) should be contracted to supply scarce ecosystem services to markets (not necessarily in joint production with agricultural goods). Support schemes would be fully decoupled from farming, and agricultural production would be subjected to the forces of global markets and competition. In contrast, a “working lands” model assumes that the only way to ensure PES is to preserve farming and that policy linkages to agricultural production need to be maintained. Proponents argue that exclusive reliance on market-based mechanisms and free trade undermines the multifunctionality of farming landscapes. This side further suggests that decoupling ecosystem services management from agricultural production ignores the integrity of farmers’ land-management practices, with negative impacts on the social and cultural values of landscapes and on rural quality of life. It is indeed challenging to target effective PES while sustaining farmers as major ecosystem stewards. Some of our recommendations (e.g., enhancement of ecosystem services bundles, accounting for site specificity, consideration of systems approaches) may help to balance these concerns. Although application of targeted payment schemes for ecosystem services seems of particular relevance for regions with high-intensity farming, whole-systems approaches may be more appropriate in marginal areas where multiple ecosystem services are provided through low-input farming.

It is now time to amend the Commission’s proposals through more serious consideration of ecosystem services insights, notably in regard to the implementation of the Commission’s proposed measures. If this succeeds, the reform process bears the potential to become an exemplar for redirecting farm policies elsewhere in the world toward sustainability. In particular, it might productively inform the renewal of the U.S. Farm Bill, for which major reforms toward more sustainable agricultural systems have been likewise proposed (Reganold *et al.* 2011).

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References

- BirdLife Europe. (2011). Common Agricultural Policy (CAP) reform: radical re-think needed to make the CAP really deliver for the environment. Available from: [http://www.cap2020.ieep.eu/assets/2011/9/5/Tests of greening-BirdLife-PDF 1.pdf](http://www.cap2020.ieep.eu/assets/2011/9/5/Tests%20of%20greening-BirdLife-PDF%201.pdf). Accessed 12 January 2012.
- CBD. (2010). *Global biodiversity outlook 3*. Convention on Biological Diversity, Montréal.
- Cooper, T., Hart, K. & Baldock, D. (2009). *Provision of public goods through agriculture in the European Union, Report prepared for DG agriculture and rural development*. Institute for European Environmental Policy, London.
- de Groot, R.S., Alkemade, R., Braat, L., Hein, L. & Willemen, L. (2010). Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. *Ecol. Complex*, **7**, 260–272.
- Dinan, D. (2010). *Ever closer union: an introduction to European integration*. Macmillan, London.
- Dupraz, P., van den Brink, A. & Latacz-Lohmann, U. (2010). Nature preservation and production. Pages 352–362 in A. Oskam, G. Meester, H. Silvis, editors. *EU policy for agriculture, food and rural areas*. Wageningen Academic Publishers, Wageningen.
- Eggers, J., Mettepenningen, E. & Beckmann, V. (2008). Assessing local action groups and auctions as institutional alternatives for designing and implementing agri-environmental measures in the EU—results from an expert survey. *Agrarwirtschaft*, **57**, 325–333.
- European Commission. (2010). *The CAP towards 2020: meeting the food, natural resources and territorial challenges of the future*. COM(2010) 672 final, Brussels.
- European Commission. (2011a). *CAP reform—an explanation of the main elements*. MEMO/11/685, Brussels.
- European Commission. (2011b). *Proposal for a regulation of the European Parliament and of the Council establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy*. COM(2011) 625 final/2, Brussels.
- European Parliament. (2010). *Resolution of 8 July 2010 on the future of the Common Agricultural Policy after 2013*. File 2009/2236(INI), Strasbourg.
- Farley, J. & Costanza, R. (2010). Payments for ecosystem services: from local to global. *Ecol. Econ.*, **69**, 2060–2068.

- Fischer, J., Batory, P., Bawa, K.S. *et al.* (2011). Conservation: limits of land sparing. *Science*, **334**, 593–593.
- Goldman, R.L., Thompson, B.H. & Daily, G.C. (2007). Institutional incentives for managing the landscape: inducing cooperation for the production of ecosystem services. *Ecol. Econ.*, **64**, 333–343.
- Hagedorn, K. (2002). *Environmental cooperation and institutional change: theories and policies for European agriculture*. Edward Elgar, Cheltenham.
- Hein, L., van Koppen, K., de Groot, R.S. & van Ierland, E.C. (2006). Spatial scales, stakeholders and the valuation of ecosystem services. *Ecol. Econ.*, **57**, 209–228.
- Kinzig, A.P., Perrings, C., Chapin F.S., III *et al.* (2011). Paying for ecosystem services—promise and peril. *Science* **334**, 603–604.
- MA (Millennium Ecosystem Assessment). (2005). *Ecosystems and human well-being: synthesis*. Island Press, Washington, DC.
- McCracken, D. (2011). *Greening of the CAP beneficial for biodiversity?* SAC Rural Policy Centre, Ayr. Available from: <http://www.sac.ac.uk/ruralpolicycentre/hottopicdiscussion/rpchottopics/greeningcapbiodiversity>. Accessed 12 January 2012.
- McIntyre, B.D., Herren H.R., Wakhungu, J. & Watson, R.T. (2009). *International assessment of agricultural knowledge, science and technology for development (IAASTD): North America and Europe (NAE) Report*. Island Press, Washington, DC.
- Norris, K. (2008). Agriculture and biodiversity conservation: opportunity knocks. *Conserv. Lett.*, **1**, 2–11.
- OECD. (2010). *Agricultural policies in OECD countries at a glance*. Organisation for Economic Co-operation and Development, Paris.
- Oskam, A., Meester, G. & Silvis, H., editors. (2010) *EU policy for agriculture, food and rural areas*. Wageningen Academic Publishers, Wageningen.
- Perrings, C., Jackson, L., Bawa, K. *et al.* (2006). Biodiversity in agricultural landscapes: saving natural capital without losing interest. *Conserv. Biol.*, **20**, 263–264.
- Phalan, B., Onial, M., Balmford, A. & Green, R.E. (2011). Reconciling food production and biodiversity conservation: land sharing and land sparing compared. *Science*, **333**, 1289–1291.
- Plieninger, T. & Bens, O. (2007). How the emergence of biofuels challenges conservation. *Environ. Conserv.*, **34**, 273–275.
- Porter, J., Costanza, R., Sandhu, H., Sigsgaard, L. & Wratten, S. (2009). The value of producing food, energy, and ecosystem services within an agro-ecosystem. *Ambio*, **38**, 186–193.
- Potter, C. (2010). Agricultural liberalization, multifunctionality and the WTO: competing agendas for the future of farmed landscapes. Pages 17–30 in J. Primdahl, S. Swaffield, editors. *Globalisation and agricultural landscapes*. Cambridge University Press, Cambridge.
- Primdahl, J. (2010). Globalisation and the local agricultural landscape: current change patterns and public policy interventions. Pages 149–167 in J. Primdahl, S. Swaffield, editors. *Globalisation and agricultural landscapes*. Cambridge University Press, Cambridge.
- Pruckner, G.J., Hackl, F. & Halla, M. (2007). Local compensation payments for agri-environmental externalities: a panel data analysis of bargaining outcomes. *Eur. Rev. Agric. Econ.*, **34**, 295–320.
- Randall, A. (2007). A consistent valuation and pricing framework for non-commodity outputs: progress and prospects. *Agric. Ecosyst. Environ.*, **120**, 21–30.
- Raudsepp-Hearne, C., Peterson, G.D. & Bennett, E.M. (2010). Ecosystem service bundles for analyzing tradeoffs in diverse landscapes. *Proc. Natl. Acad. Sci. USA*, **107**, 5242–5247.
- Reganold, J.P., Jackson-Smith, D., Batie, S.S. *et al.* (2011). Transforming U.S. agriculture. *Science*, **332**, 670–671.
- Rodríguez, J.P., Beard T.D., Jr., Bennett, E.M. *et al.* (2006). Trade-offs across space, time, and ecosystem services. *Ecol. Soc.*, **11**, 28. Available from: <http://www.ecologyandsociety.org/vol11/iss1/art28>. Accessed 20 April 2012.
- Schaich, H., Bieling, C. & Plieninger, T. (2010). Linking ecosystem services with cultural landscape research. *GALA*, **19**, 269–277.
- Schaich, H. & Konold, W. (2012). Remuneration of ecological services in forestry—New options for compensation measures in forests? *Naturschutz und Landschaftsplanung* **44**, 5–13.
- Schleyer, C. & Plieninger, T. (2011). Obstacles and options for the design and implementation of payment schemes for ecosystem services provided through farm trees in Saxony, Germany. *Environ. Conserv.*, **38**, 454–463.
- Sutherland, L.-A., Gabriel, D., Hathaway-Jenkins, L. *et al.* (2012). The ‘neighbourhood effect’: a multidisciplinary assessment of the case for farmer co-ordination in agri-environmental programmes. *Land Use Policy* **29**, 502–512.
- Tallis, H., Kareiva, P., Marvier, M. & Chang, A. (2008). An ecosystem services framework to support both practical conservation and economic development. *Proc. Natl. Acad. Sci. USA* **105**, 9457–9464.
- Tscharntke, T., Klein, A.M., Kruess, A., Steffan-Dewenter, I. & Thies, C. (2005). Landscape perspectives on agricultural intensification and biodiversity—ecosystem service management. *Ecol. Lett.*, **8**, 857–874.
- Vatn, A. (2009). An institutional analysis of methods for environmental appraisal. *Ecol. Econ.*, **68**, 2207–2215.
- Wätzold, F. & Schwerdtner, K. (2005). Why be wasteful when preserving a valuable resource? A review article on the cost-effectiveness of European biodiversity conservation policy. *Biol. Conserv.*, **123**, 327–338.
- Wunder, S., Engel, S. & Pagiola, S. (2008). Taking stock: a comparative analysis of payments for environmental services programs in developed and developing countries. *Ecol. Econ.*, **65**, 834–852.