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Towards an Integrated Environmental Compensation Scheme in Spain: Linking Biodiversity and Carbon Offsets

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Biodiversity offsets and carbon markets are both environmental compensation schemes, which have much in common despite their different origins and development. They need active markets to succeed with actual offer and demand, which are currently practically non-existent in Spain. The inclusion of land use and forestry activities in greenhouse gas accounting could encourage carbon sinks, stimulating the development of carbon markets. Conservation banking was incorporated into Spanish legislation in the 2013 Environmental Assessment Act, as a tool for biodiversity offsets, but the current situation is hindering its development. Combining carbon and biodiversity offsets in a global compensation scheme would provide great opportunities: ecologically, creating and protecting habitats and species; socially, creating employment and deriving financial resources to rural areas; climatically, reducing greenhouse gas (GHG) concentration levels; and politically, contributing to the compliance of GHG emission targets. Conservation banking is

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an appropriate candidate for this integration in Spain, as long as it is regulated flexibly, and different bank models are allowed that are able to integrate forest and agriculture production, conservation and compensation.

Keywords: Mitigation banking; carbon markets; climate change; biodiversity offsets; carbon offsets.

Introduction

There are currently two main environmental compensation schemes devoted to offset biodiversity damages or greenhouse gas (GHG) emissions, with different origins and development, which are usually implemented completely independently of each other.

Biodiversity offsets seek to balance losses of biodiversity with commensurate gains (Brownlie and Treweek, 2016), and are usually linked to environmental assessment processes of development plans and projects. Although there are different ways to implement this environmental compensation, the most important mechanism is probably mitigation banking, which was born in the United States (US) linked to the Clean Water Act of 1972 (GPO, 2016), to offset damages on wetlands. This scheme was first expanded to Canada and Australia, and more recently to European countries. In Spain, they are called conservation banks, and were included in the legislation in 2013 by the Environmental Assessment Act (BOE, 2013), although the regulations were not detailed. The implementation of biodiversity offsets in Spain has faced several problems such as poor planning, lack of precision, difficulties in land acquisition, or unexpected costs (Carrasco *et al.*, 2013). Also, from 2008, the economic crisis has stopped investment in civil works, the main source of demand for environmental compensation, and funding. A lack of demand is positive because it means no biodiversity destruction, or that other mitigation measures (preventive and corrective) are efficient, so offsets are not necessary. However, the current lack of demand is conjunctural, due to the crisis, and it is expected that a progressive improvement in economic conditions will lead to new investments in civil works, with an increasing demand for compensation that must be addressed.

Carbon offsets arise from the need to mitigate climate change, to stabilize atmospheric CO_2 concentration levels. This mitigation involves a combination of measures to reduce emissions and to increase absorption through agriculture or forestry as well as capture and storage. An interesting tool to offset GHG emissions are carbon markets. Compliance markets are based on the Kyoto Protocol (UN, 1998) and they do not necessarily imply a true offset, but only a trade scheme. However, voluntary markets offer GHG compensation through projects of

forestation, avoided deforestation or renewable energies throughout the world, but this supply is limited in Spain. Although there is an obligation to report the national GHG emissions annually (MAPAMA, 2016) in accordance with the United Nations Framework Convention on Climate Change (UN, 1992), the Kyoto Protocol (UN, 1998) and the EU Regulation 525/2013 (EU, 2013), there is no legal obligation to offset these emissions by promoters or producers. In addition, there is a scarce consideration of climate change in environmental impact assessment (Enríquez-de-Salamanca *et al.*, 2016), where no carbon offsets are required. Thus, virtually all GHG offsets made in Spain come from private initiatives, and have a limited scope.

Biodiversity and carbon sequestration are both ecosystem services (ES), as well as many others (see e.g. Maes *et al.*, 2013; La Notte *et al.*, 2017) but their offsetting schemes follow different strategies. This divergence comes from economic approaches, focused on the application mechanisms that ignore that both are interrelated ES, which can be integrated. Gómez-Baggethun and Muradian (2015) indicate that Market Based Instruments (MBI) include different economic instruments: actual markets (carbon trades), mixes between regulatory and trade-based instruments (biodiversity offsets) and instruments where the trade component is not present (Payments for Ecosystem Services, PES); the authors only consider regulated carbon trading and not voluntary carbon markets. Such vision focuses on the mechanisms, but not on the purpose, which is, in all cases, mobilising economic resources towards an actor (landowner, carbon market, mitigation bank) to promote certain ES. Therefore, the current distinction between mechanisms is established according to external economic criteria, which should be reconsidered.

Both compensation schemes have a limited development in Spain due to a common cause, the lack of demand for compensation. This paper discusses how this severe limitation can be reduced associating these two schemes with the same purpose, environmental compensation, despite their currently different forms of implementation.

Mitigation Banking

Mitigation banking is an MBI for biodiversity offsets; a bank offers compensation credits on certain habitats or species that can be acquired by a developer that has generated compensation debits, i.e., damage to biodiversity that need to be compensated. This mechanism is a hybrid form between market and regulatory instruments, because it is based on the rules imposed by public actors (Baggethun and Muradian, 2015; Vaissière and Levrel, 2015).

Since the late 1980s, environmental agencies, governments and organisations have embraced MBIs that comprise, among others, carbon markets, habitat banking, biodiversity offsets and PES, considering them flexible, cost-effective, and obtain resources from the private sector (Pirard, 2012; Gómez-Baggethun and Muradian, 2015). These mechanisms have supporters and detractors. Some authors consider that the environment is commodified, the expected ecological restoration is unsupported by evidence and the promise of compensation may increase permissiveness towards biodiversity damage (Robertson, 2004; Walker *et al.*, 2009; Maron *et al.*, 2012; McAfee, 2012). Other opinions raise limitations on biodiversity offsets, especially associated with the effectiveness of ecological restoration (Quétier and Lavorel, 2001; Morris *et al.*, 2006; Palme and Filoso, 2009; Curran *et al.*, 2014). Some studies focus on the effectiveness of mitigation banking (Fox and Nino-Murcia, 2005; Robertson and Hayden, 2008; Robertson, 2009). Boisvert (2015) notes that the positions for and against conservation banking, which are caricatured as market tools or as licences to kill endangered species or destroy their habitats, tend to obscure their characteristics.

Mitigation banking was born in the US in the 1980s, and since 1998, it has become the preferred compensatory mitigation alternative (EPA, 2016). In Spain, it was first cited in the Natural Heritage and Biodiversity Plan 2011–2017 (BOE, 2011), and legally recognized by the 2013 Environmental Assessment Act (BOE, 2013). In a tentative regulation draft, Spain is divided into 14 regions, and impacts should be compensated within each region; developers requiring compensation should use the closest bank possible, because credit prices increase depending on the distance to the bank. The Government and conservation NGOs have not reached an agreement, the latter arguing that biodiversity would be commodified, and consequently the draft has not yet been approved. The opposition to conservation banking in Spain has much to do with the vision of public and private roles in environmental conservation, traditionally a Government responsibility; private participation is suspected of having spurious interests, although much of the land that is protected is paradoxically privately owned.

Some aspects that could affect the development of conservation banking in Spain are as follows:

(i) **Technical and functional aspects.** There is a lack of practical experience. The extensive expertise gathered in other countries cannot be automatically copied because some aspects are inherent to the specific habitats and species to offset. Local problems can only be solved through the implementation of banks that should be accompanied by monitoring and feedback.

(ii) **Legal aspects.** Conservation bank regulations were developed in Anglo-Saxon countries, which are legally and socially different from Spain, and therefore can present imbalances in engagement with a Latin legal system (Vázquez, 2014).

(iii) **Economic aspects.** Banks need an active market, with offer and demand. In this sense, the market size and the rate of transformation of the territory, both have a positive influence (Pirard, 2012; van Teeffelen *et al.*, 2014). Currently Spain lacks both credits (compensation offer) and debits (compensation demand). Between 1990 and 2008, the investment in civil works, the main environmental compensation claimant, was significant, but even in this situation, the application of compensatory measures was much lower than expected in environmental assessments (Carrasco *et al.*, 2013). The economic crisis has reduced investment in civil works, creating an obstacle for the development of conservation banking, due to a lack of demand for compensation. Uncertainty over demand drives potential investors away, and may lead to a collapse of the market (Panayotou, 1994).

(iv) **Ecological aspects.** A major challenge in Spain is the important ecological variability; the territory is included in four biogeographical regions and has the richest biodiversity in the EU. Covering such diversity of habitats and species requires a large number of banks. These habitats and species are distributed irregularly across the different regions of Spain, each managed by a regional government, which complicates the development of a global compensation offer. Furthermore, very strict requirements in similarity of destroyed and restored habitats can inhibit the activity (Pirard, 2012; van Teeffelen *et al.*, 2014).

(v) **Administrative aspects.** Lengthy and costly administrative processes affect credit markets (Pirard, 2012; van Teeffelen *et al.*, 2014). This is important in Spain, with a Central State Government and 17 Autonomous Communities with environmental jurisdictions. An effective coverage of habitats and species requires an inter-regional compensation market, with smooth cooperation between administrations, which is not always easy.

Carbon Markets

A carbon market is an MBI in which an emitter who wants or needs to offset carbon emissions can purchase carbon credits. There are two carbon market types, compliance and voluntary. Compliance markets derive from the flexible financial mechanisms of the Kyoto Protocol (UN, 1998); the world's largest carbon market

is the EU Emissions Trading Scheme (EC, 2015b). In these markets, carbon credits may come from emission rights, and not necessarily from a true compensation, so this paper does not consider them. In voluntary markets, carbon credits represent the removal of one tonne of carbon dioxide-equivalent (CO_2e) from the atmosphere, a true carbon offset, or the avoidance of its emission, which is a more controversial case.

The main efforts to mitigate climate change should focus on the reduction of GHG emissions, but in addition, Member States can use carbon sinks (EC, 2012). The activities of land use, land use changes and forestry (LULUCF) that result in carbon capture and its storage in plant material are considered sinks. LULUCF activities can absorb and store CO_2 and avoid deforestation through a proper management and conservation. If it can be proven that these efforts result in carbon stored, carbon credits, potentially marketable, could be claimed (Vickers *et al.*, 2012). Consequently, many LULUCF activities, when properly managed, could be transformed into carbon markets, with several interesting opportunities, but also some important challenges (Table 1).

Table 1. Opportunities and challenges for carbon sequestration through land use, land use changes and forestry (LULUCF) activities.

Opportunities	Mitigate climate change by absorbing and storing CO_2 or avoiding deforestation. Processes can be accelerated and traduced to carbon credits marketable. Joint carbon sequestration with provision of sustainable products and income. Strengthen ecosystem value and linkage with PES. Poverty reduction (and unemployment) through PES, including carbon markets.	Landell-Mills (2002), Grieg-Gran *et al.* (2005), Pagiola *et al.* (2005), Canadell and Raupach (2008), Engel *et al.* (2008), Wunder (2008), Muradian *et al.* (2010), Milder *et al.* (2010), Vickers *et al.* (2012).
Challenges	Credibility; need international standards to provide legitimacy to compensation. No additionality of avoided deforestation in developed countries. Maximization of carbon credits runs the risk of causing biodiversity damages. Reduction of agricultural lands, decreasing food security, raising food prices. Occupation of less productive land, which retain most of the biodiversity. Permanence is essential for environmental compensation.	Matthews *et al.* (2002), Caparrós and Jacquemont (2003), Huston and Marland (2003), Pielke *et al.* (2003), Canadell and Raupach (2008), O'Connor (2008), Ovando and Caparrós (2009), Jackson and Baker (2010), Hall *et al.* (2012), GS (2013, 2014), VCS (2013, 2015), Xiong *et al.* (2014).

Table 2. Measures to mitigate climate change in LULUCF activities.

Sector	Measures
Forestry	Increase forest cover, restore vegetation, afforestation and reforestation.[a–e]
	R&D on paper of forest sector in GHG capture.[a]
	Measures to prevent forest fires.[a,d,e]
	Sustainable forest management and changes in management.[a–d]
	Protecting existing forests and avoidance of deforestation.[b–d]
	Production of long-lasting wood products and use of wood in construction.[b,e]
	Biomass to replace fossil fuels.[b–e]
	Ensure optimum shifts and reduce logging intensity.[d]
	Keep livestock out of the forest.[d]
	Planting different species.[d]
	Planting and protecting vulnerable areas.[d]
	Prevention of pests and plant diseases.[e]
	Maximize forest products.[d]
	Sustainable fertilization.[e]
Agriculture	Increase carbon absorption in agricultural systems[a]
	Energy efficiency.[b,c]
	New farming techniques.[b]
	Biofuel production.[b]
	Use of biomass for energy.[c]
	Better management of livestock.[b]
	Better use of fertilizers[b] and manure management.[c]
	Reduction of carbon and N_2O losses in soils.[c]
	Reduction of biomass burning and use of lime.[c]
	Increasing carbon stocks in long life agricultural products and agroforestry.[c]
	Management of wetlands for rice.[c]
Common	Encourage private sector participation.[a]
	Promote the Fund for Natural Heritage.[a]
	Develop an information system about carbon absorbed by LULUCF.[a]

[a]MMA (2007); [b]MAGRAMA (2015); [c]Trines (2006); [d]Vickers *et al.* (2012); [e]COSE (2008).

Funk *et al.* (2014) demonstrate that in Gisborne (New Zealand), a major part of the land could earn higher margins from carbon agriculture than from grazing. Balderas *et al.* (2010) indicate that in Mexico, payments in the initial years and lower transaction costs tend to favour the development of agroforestry reforestation projects. Traditionally LULUCF has been excluded from GHG accounting, but its inclusion in the 2030 EU Climate and Energy Framework (EC, 2015a) would encourage carbon offsets.

There are many recommendations on how to mitigate climate change through LULUCF activities (Table 2). Some measures in forestry are increasing forest

cover, forestation, prevention of forest fires, sustainable management, avoidance of deforestation, production of long-lasting wood products, use of wood in construction, use of biomass to replace fossil fuels, optimum shifts, reduction of logging intensity, keeping livestock out of forests, use of diverse species in forestation, prevention of plant pests and diseases, maximization of forest products or sustainable fertilization. Potential actions in agriculture are new crop techniques, energy efficiency, use of biofuel and biomass for energy, improve livestock management, better use of fertilizers, reduction of carbon and N_2O losses in soils, reduction of biomass burning and use of lime, promotion of long life agricultural products, and agroforestry.

The potential of LULUCF to offset GHG emissions is enormous. In Europe, LULUCF may contribute from 13% to 52% to the target of 20% GHG reduction by 2020, but would require 8–30% of EU-25 agricultural land to be afforested or converted to bioenergy crops (Ovando and Caparrós, 2009). In the US, payments of up to $50 per tonne of CO_2e could reduce GHG emissions by more than 700 million tonnes CO_2e per year, but imply a reduction of agricultural land area by 10% or more (Jackson and Baker, 2010). In Spain, although the climate limits the forestry potential (Nabuurs and Schelhaas, 2002), forests grow annually 20,911,786 tonnes of dry matter, and only 25.5% of it is extracted; taking only into account the main tree species, Spanish forests fix 75,143,536 tonnes of CO_2 annually, almost a quarter of the GHG emissions of the whole country (Montero *et al.*, 2005). There are also some favourable conditions for LULUCF, such as the high rates of land abandonment expected over the next 25 years in Europe (EFTEC and IEEP, 2010), the country size — the second largest in the EU — a large agricultural and forest area, and a population density lower than the EU average. Consequently, LULUCF activities have a great potential, which may be partially channelled through carbon markets.

An essential aspect in voluntary carbon markets is credibility, which explains the development of international standards, seeking to provide legitimacy to compensation units and prevent double counting (e.g. GS, 2013, 2014; VCS, 2013, 2015). There are some challenges in converting LULUCF activities into carbon credits, such as demonstrated additionality, respect for the environment, absence of social impacts and permanence. Additionality is a key concept in environmental compensation; compensatory measures should imply a positive change from the baseline in the desired aspect, which would not happen without its application.

Many voluntary carbon markets are based on avoided deforestation in developing countries, usually through REDD+ projects (reducing emissions from deforestation and forest degradation in developing countries), a mechanism developed by the Parties to the United Nations Framework Convention on Climate

Change (UN, 1992) designed to incentivise developing countries to reduce carbon emissions from deforestation and forest degradation (UN, 2016). There is no additionality in these practices in developed countries, where there are already solid legal frameworks for forest protection; in these countries, additionality implies a demonstrable carbon sequestration rather than maintenance of sinks.

The maximisation of carbon credits runs the risk of causing biodiversity damages, such as replacing vegetation of ecological interest by plantations of fast-growing exotic species with greater carbon absorption (Caparrós and Jacquemont, 2003; Canadell and Raupach, 2008; O'Connor, 2008; Hall *et al.*, 2012), changes in bird populations (Matthews *et al.*, 2002) or unexpected effects on soil carbon sequestration (Xiong *et al.*, 2014). Pawson *et al.* (2013) point out that plantation forests present significant risks to existing biodiversity. Begg *et al.* (2001) indicate the need to integrate environmental and social considerations into the flexibility mechanisms of the Kyoto Protocol (UN, 1998), equally applicable to voluntary carbon markets.

With regard to social impacts, carbon markets could imply a reduction of agricultural land, decreasing food security, raising commodity food prices, and forcing the occupation of less productive land, which retain most of the biodiversity (Huston and Marland, 2003; Canadell and Raupach, 2008; Ovando and Caparrós, 2009; Jackson and Baker, 2010), but if well-directed, they can link carbon sequestration with the provision of sustainable products and additional income for rural development (Canadell and Raupach, 2008). For example, agroforestry does not require full land use conversion (Flugge and Abadi, 2006; Trines, 2006; Balderas *et al.*, 2010; Bryan *et al.*, 2014).

There is currently a growing concern about the incorporation of ES in environmental assessment, both in strategic environmental assessment of plans and programmes or in environmental impact assessment of projects (e.g. Geneletti, 2013, 2015, 2016; UNEP, 2014; Geneletti, 2015), which is essential in the case of carbon sequestration to avoid environmental and social impacts, and also as a tool to promote compensation.

Permanence is essential for environmental compensation. When using sinks, if the vegetation is destroyed, the compensation will be lost. Marland *et al.* (2001) suggest that when emission reductions are not clearly permanent, such as forest sequestration, credits should be rented rather than sold.

Seeking Synergies: A Broad Compensation Scheme

An essential starting point is that biodiversity and carbon sequestration are both ES that usually converge in the same areas. Regardless of the mechanisms applied for

offsetting, in both cases, it is sought to strengthen these ES, usually through economic incentives. A second aspect is that when different ES coexist, they can be complimentary or compete, so a balance must be sought. In the case of biodiversity and carbon sequestration, competition may or may not occur, depending on the prioritised objectives; e.g. plantations of native species combine both objectives while fast-growing exotic species maximise carbon sequestration with a lower ecological value. The management of ES must be comprehensive to achieve an appropriate balance, and similarly the compensation based on ES, such as biodiversity or carbon sequestration, should also be integrated.

Although biodiversity offsets and carbon markets are developed independently, they have much in common. Both of them are environmental compensations for habitats, species or GHG emissions, and require a proper management of land and the protection or increase of vegetation. A difference is that while biodiversity offsets are highly selective in habitats and species, GHG offsets are poorly selective, seeking to maximize absorption or carbon stock, but this does not prevent their integration. Each scheme has its peculiarities, but there are many possibilities for developing and empowering both together (Table 3).

Several papers analyse the opportunities of carbon and biodiversity markets (Berkessy and Wintle, 2008; Díaz *et al.*, 2009; Freedman *et al.*, 2009; Midgley

Table 3. Particularities of conservation banks and carbon markets and joint possibilities.

Conservation banks	Carbon markets	Possibilities of both schemes together
Environmental compensations for habitats or species	Environmental compensations for GHG emissions	Join both environmental compensation objectives
Credits: habitats or species	Credits: carbon	Double counting for the same credit: habitats or species and carbon
Highly selective in habitats and species	Poorly selective: maximize carbon absorption or stock	Absorption potential sacrifice in exchange for greater specificity
Legal recognition in Spain since 2013	Not legal recognition	Taking advantage of legal recognition of banks to strengthen the scheme
Not specific standards, but can be adapted easily	Use specific standards	Complying with carbon standards in all cases
Provide strong guarantee of permanence	Not strong guarantee of permanence	Taking advantage of permanence guarantees of conservation banks
Funding especially from civil works	Funding especially from private companies	Joining both funding sources to obtain a greater economic support.

et al., 2010; Hall *et al.*, 2012; Rittenhouse and Rissman, 2012; Siikamäki and Newbold, 2012; Thomas *et al.*, 2013). The interest paid to this issue is particularly remarkable in Australia (Flugge and Abadi, 2006; Harper *et al.*, 2007; Dwyer *et al.*, 2009; Fensham and Guymer, 2009; Ngugi *et al.*, 2011; Witta *et al.*, 2011; Paul *et al.*, 2013; Bryan *et al.*, 2014; Renwick *et al.*, 2014). The advantages of combining agriculture and biodiversity conservation are also broadly analysed (e.g. OECD, 2001; FAO, 2008; Scherr and McNeely, 2008; SCBD, 2008; FAO, 2010; IUCN, 2011; Leibel, 2011; Pakeman, 2011); in fact, it is currently a priority objective of the EU's Common Agricultural Policy (EC, 2016). Considerable research has been devoted to ES of agri-environmental schemes or agroecosystems (e.g. Altieri, 1999; Swift *et al.*, 2004; Geneletti, 2007; Moonen and Bàrberi, 2008; Bradbury *et al.*, 2010; Power, 2010; Ribaudo *et al.*, 2010; Rega and Spaziante, 2013). Several documents propose the integration of biodiversity and forestry (e.g. Bawa and Seidler, 1998; FAO, 2003; Logan, 2007; IUCN, 2010; Forestry Commission, 2011; Kraus and Krumm, 2013), which is a basis for forest management in many countries, such as Spain. There are experiences on integrating biodiversity and carbon offsets (e.g. Rosa *et al.*, 2004; Charchalac, 2012), like the REDD+ projects cited above, and also on integrating GHG offsets and agriculture, for example in coffee crops (Duque *et al.*, 2013). Karrasch (2016) analyses different land management scenarios to address climate change in a coastal region of Germany, including one that allows combining agricultural use, enhancing biodiversity (creating ponds and restoring natural vegetation), and carbon sequestration through REDD FENS.

Consequently, there is no doubt about the convenience of integrating ES such as biodiversity, forestry and agriculture production or carbon sequestration, as the literature emphasizes. A broad and inclusive vision of all these ES is necessary with solid, practical and integrative mechanisms, such as the linking of carbon markets and conservation banks proposed in this paper.

In the forestry sector, there are management measures that can improve the increase in the absorption and the carbon stocks, with added ecological advantages. Forest lands in Spain retain much of the biodiversity and provide environmental services, although they often have a low economic productivity. Apart from the northern most area, Spain is not favourable for timber production, and forests usually have low income. Many forests could become conservation banks, providing biodiversity and GHG offsets, helping conservation and making them economically viable.

The agriculture sector has enormous potential for environmental compensation, both for biodiversity and climate change. Agricultural soils often suffer depletion of organic matter that can be solved through management measures such as no

tillage and the incorporation of agricultural waste. Agroforestry systems, like the Spanish *dehesa*, combine a sparse forest cover with crops or pasture, harmonizing agrarian production and carbon capture and maintenance. In Spain, there are huge crop areas where it is possible to introduce scattered trees, hedges and copses for carbon sequestration without affecting production, or with minimal losses that could be compensated by the sale of carbon credits. This involves reversing the current trend of agricultural intensification, which results in farm amalgamation and loss of hedgerows and woodlands (EFTEC and IEEP, 2010). Also, many crop areas maintain rich communities of steppe birds, whose conservation is a priority. Conservation banks including productive crops, fallows, uncultivated lands, agroforestry, hedgerows between properties and afforestation of marginal areas have an enormous potential as a way to diversify economic activity in rural areas, attracting investment, enhancing biodiversity and capturing carbon.

Potentially, any properly managed MBI could serve to integrate biodiversity and carbon offsetting. However, each mechanism has its strengths and weaknesses, which vary in importance. Voluntary carbon markets are agile and easy to establish, but focused on maximizing sequestration. In addition, although subject to international standards, there is no governmental control, so it is difficult to adapt them as an effective mechanism for biodiversity offsets.

MBI that would provide value to both carbon sequestration and biodiversity protection are PES, a flexible scheme that aims to support sustainable development through a greater appreciation of biodiversity and ecosystem values (Huberman, 2008). Carbon sequestration is a way to strengthen ecosystem value, so there is an evident link between carbon markets and PES. The relationship between PES, including carbon markets, and poverty reduction (Landell-Mills, 2002; Grieg-Gran *et al.*, 2005; Pagiola *et al.*, 2005; Engel *et al.*, 2008; Wunder, 2008; Milder *et al.*, 2010; Muradian *et al.*, 2010) or more widely between biodiversity and poverty alleviation (Roe and Geneletti, 2016), has been widely studied, and although it usually focuses on developing countries, the same idea is applicable to the reduction of unemployment, a big problem in Spain. The current problem of PES, at least in Spain, is the lack of a regulatory framework that adds solidity and credibility.

Conservation banks are a mixed regulatory and trade instrument that provide greater security than the other mechanisms because they involve the authorization and surveillance of environmental agencies. Therefore, they allow a guarantee of permanence, additionality, biodiversity protection and enhancement, and avoidance of social impacts, reducing the risk of environmental commodification. In addition, in Spain they already have a legal framework, which other MBI lack. They are, therefore, the best MBI for integrating biodiversity and GHG offsets, facilitating the adaptation to carbon market standards.

If an ecosystem provides many ES, it is logical that it should be valued to a greater extent. In this sense, a key to a successful integration of conservation banking and carbon markets would be the double counting of credits, by biodiversity and carbon (Berkessy and Wintle, 2008), which would bring additional value to the banks, reducing the risk of converting into pure carbon offsets.

Linking biodiversity and carbon offsets in Spain has a number of strengths and opportunities, but also weaknesses and threats (Table 4). The main strengths are the creation of a broader market that allows the development of a stable compensation scheme; giving an ecological sense to carbon sequestration by linking to biodiversity enhancement; permanence guarantees and public surveillance associated with conservation banking; linkage of different ES, such as biodiversity, carbon sequestration, productive uses, landscape or tourism; and an income diversification in rural areas, reducing the dependence on agricultural prices. On the

Table 4. SWOT* analysis of an integrated biodiversity and carbon compensation market in Spain.

	Helpful	Harmful
Internal origin	Strengths • Greater possibilities for environmental offsets. • Permanence guarantee and public surveillance. • Broader market, allowing the development of the compensation scheme with certain stability. • Ecological sense to carbon sequestration. • Harnessing the sequestration potential associated with biodiversity enhancement. • Linkage of different ecosystem services. • Possibility of incorporating productive uses. • Landscape and tourism improvement. • Possible way to channel other payments for environmental services. • Income diversification in rural areas and lower dependence on agricultural prices.	Weaknesses • Lack of confidence in private initiative for the protection of the environment. • Lack of experience and distrust of investors. • Lack of private initiative without public support or participation. • Reticence to implant banks until there is demand, causing a lack of supply. • Mismatch between demand and supply areas. • High specificity of habitats with scarce market. • Lack of land in more developed areas. • Lack of a demand forecast in the medium and long term, limiting future investments. • Risk of commercial wars between banks, affecting quality of service.

Table 4. (*Continued*)

	Helpful	Harmful
External origin	Opportunities • Land availability in Spain: large agricultural and forestry areas and lower population density. • Compliance of GHG emission targets. • Mobilization of economic resources to rural areas: rural development. • Unemployment reduction in rural areas. • Social support in rural areas if it implies an improvement of income and employment. • Possible linkage with other ecosystem services. • Higher requirements for biodiversity and carbon offsets in environmental assessment. • Possibility of linking agriculture aids, such as the EU Common Agriculture Policy. • New market for environmental consulting.	Threats • Very strict regulations, inhibiting integration. • Unequal interests of Autonomous Communities and lack of interregional coordination. • Political and social opposition if associated with a commodification of the environment. • Lack of demand: scheme unprofitable and risk of collapse if the demand is very irregular. • Slight or no requirements for biodiversity and carbon offsets. • Great ecological diversity in Spain, in habitats and species, requiring many banks. • Low plant growing under Mediterranean climate, and low carbon sequestration. • Low carbon sequestration in important habitats.

*SWOT: Strengths, Weaknesses, Opportunities and Threats.

other hand, possible weaknesses are a lack of confidence in private initiative; distrust of investors if there is no public participation; reticence to implant banks until there is an actual demand; lack of demand forecast in the medium and long term, which reduces investments; mismatch between demand and supply areas; high specificity in terms of habitat offsetting; scarce land availability in developed areas; or risk of commercial wars between banks, affecting the quality of the service.

External factors produce opportunities and threats. Among the opportunities, we highlight that large agricultural and forestry areas in Spain ensure land availability in most regions; the inclusion of the LULUCF sector in the accounting of global emissions (EC, 2015a) can promote compensatory actions to achieve GHG targets; the mobilization of economic resources to rural areas may reduce unemployment, a priority in Spain, favouring social support, and may create new markets for environmental consulting; a global compensation scheme could be

also a useful tool to link ES, and to channel PES or other funding sources, such as EU Common Agriculture Policy aids. The main threat is the current lack of demand in Spain for both compensation schemes, although a future increase is foreseeable; in terms of biodiversity, the low demand is due to a reduction of development plans and projects as a consequence of the economic crisis, which implies less current environmental damage, likely to be reactivated in the medium-term with the expected economic recovery; with regard to carbon, GHG reduction targets can promote compensation. However, a very irregular demand may produce a collapse of the market. Other difficulties should be the approval of strict regulations, which may inhibit the integration of both schemes; unequal interest of Autonomous Communities and difficulties for interregional coordination; the association of compensation with commodification of the environment, generating political or social opposition; the ecological diversity of Spain, which requires many different banks, with irregular demand; or the limitations due to a low carbon sequestration rate under Mediterranean climate, or in some important habitats due to their vegetal composition. The amount of demand may depend greatly on the requirements for biodiversity and carbon offsets included in environmental regulations and EA processes, which could be both an opportunity and a threat.

The broader market that emerges from linking carbon sequestration and biodiversity enhancement into the same mechanism, but also agricultural, livestock or forestry production, if not incompatible, could solve the financial constraints of environmental compensation. In this sense, the effect is synergistic, because the result of the sum of both compensation schemes could be the key for the success of the whole compensation system, an effect that exceeds the simple sum of demands. We do not propose to eliminate carbon markets and conservation banks and create a single scheme, but not to impede their integration.

Funding for the implementation of this broad environmental compensation market may come from different sources. On one hand, there is an actual demand for environmental compensation, mainly for biodiversity, associated with development projects such as transport infrastructure, water or energy, although the demand is much lower than a few years ago due to the reduction of public investment in these sectors. On the other hand, there is a demand for carbon credits, especially from private companies within their policies of social responsibility; this demand would increase if carbon offsets were required for major plans and projects in environmental assessment. The inclusion of the LULUCF sector in the 2030 EU Climate and Energy Framework (EC, 2015a) could boost GHG emission offsets and carbon markets, as an aid to achieve national emission targets. The Common Agricultural Policy funds could also finance agrienvironmental banks, and the Carbon Fund for a Sustainable Economy in Spain could be reviewed to finance biodiversity enhancing

sink projects. Another way of funding may come from PES. Financial difficulties for bank implementation could be reduced with the support of the Official Credit Institute (ICO), tax exemptions, fiscal benefits, job creation help schemes, or technical assistance. The success of this market would be very difficult without strong public involvement, at least in the initial stages, which is what happened in the US with the mitigation banks, until its profitability was demonstrated.

The opportunities for biodiversity and carbon offsets in the forestry and agricultural sectors are broad and diverse. For this reason, regulations should also be flexible, to accommodate all these possibilities. The US mitigation banks, for example, focus on specific areas dedicated to compensation; such a model would make it difficult to integrate production and compensation. The definition of compensation areas should not necessarily involve small intensive sites; in many areas, large banks with multiple uses and compensation possibilities, as well as income diversity, are likely to be more effective.

Finally, there is a barrier associated with the Spanish and European in general-tradition, where the protection of the environment depends on the State, and there is a lack of confidence in private initiative in this field. This has led in practice to a standstill of the conservation banks by the pressures of sectors that consider them a commodification of the environment, and can lead to regulations that inhibit the integration of both compensation markets, and even more of productive sectors. Conservation banking is the only MBI which may provide technical rigour in the design and strict supervision of the Environmental Agencies, necessary to guarantee efficiency and to convey confidence to the citizens.

Conclusions

The demand for environmental compensation is practically non-existent in Spain. The lack of demand for biodiversity offsets is mainly due to low investment in civil works, which is the main compensation claimant, while the lack of GHG compensation is because it is voluntary, and not a mandatory requirement. However, this is a conjunctural situation; the foreseeable growth in civil works investment associated with economic recovery or the application of more protectionist criteria for biodiversity or GHG offsets would significantly increase the demand for compensation. Therefore, it is necessary to have flexible compensation mechanisms ready that are able to respond quickly to these changes.

Environmental offsets need an active market in order to succeed, and a good way to increase this demand is by linking biodiversity offsets and carbon markets. Conservation banks can be an opportunity to combine both compensation schemes. Allowing conservation banks to work simultaneously as carbon markets

could be the key to ensuring enough market activity, providing at the same time an ecological sense to carbon credits, which must necessarily maintain or improve the biodiversity. Unifying environmental compensation into a common mechanism could be the key to its success.

The advantages of a global compensation system would be relevant; ecologically, creating and protecting habitats and species; socially, creating employment and deriving financial resources to the rural areas; climatically, reducing GHG concentration; and politically, helping to comply with GHG emission targets. Conservation banking is a potentially appropriate tool for the integration of biodiversity and carbon offsets in Spain, but to succeed, flexible regulations should be implemented allowing different conservation bank models, integrating forest and agriculture lands, and production, conservation and compensation.

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