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Reshaping agri-environmental subsidies: From marginal farming to large-scale rewilding

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Abstract

Despite continued discussion about market distortions and environmental impacts, agricultural subsidies continue to be a key component of European Union policy. About 10% of the agro-forestry subsidies are targeted at supporting agri-environment schemes, and at supporting farming in Less Favoured Areas (LFA) such as mountain regions. One of the main justifications for these agri-environmental subsidies towards marginally productive land is that they promote the conservation of biodiversity by maintaining low-intensity farming practices. Here, we critically examine this assumption and argue instead for a two-tier

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approach to Europe's agri-environmental policy based on inherent land fertility and spatial scale: (i) at a local, single-farm scale, fertile agricultural land should preferentially be intensively but sustainably farmed with a focus on high yields, (ii) while simultaneously and at larger, regional scales, less-productive land, and especially protected areas, may be ecologically restored into 'wild' and resiliently functioning ecosystems. As such, agri-environmental subsidies towards fertile land should support the implementation of measures that benefit biodiversity while allowing, and even helping, the achievement of high agricultural yields. In contrast, agri-environmental and LFA subsidies towards marginal land and protected areas should also promote rewilding and the management of natural succession. In order for this approach to be successful, a higher proportion of the Common Agricultural Policy subsidies would need to be allocated to environmental goals.

Zusammenfassung

Trotz der anhaltenden Diskussion um Marktverzerrungen und Umwelteinflüsse bleiben Agrarsubventionen eine Schlüsselkomponente der EU-Politik. Rund 10% der Agroforstsubventionen zielen auf die Finanzierung von Agrarumweltprogrammen und die Unterstützung der Landwirtschaft in benachteiligten Gebieten wie z.B. Gebirgsregionen. Ein Hauptargument für diese Agrarumweltförderungen auf Grenzertragsflächen ist, dass sie den Erhalt der Biodiversität durch extensive Bewirtschaftung begünstigen. Wir untersuchen diese These kritisch und treten stattdessen für einen zweistufigen Ansatz in der Gemeinsamen Agrarpolitik ein, welcher die Bodenfruchtbarkeit und den räumlichen Maßstab einbezieht: (i) Auf der lokalen Ebene des einzelnen Betriebes sollten fruchtbare Ackerflächen vorzugsweise intensiv aber auch nachhaltig bewirtschaftet werden und auf hohe Erträge abzielen, während (ii) gleichzeitig auf der übergeordneten, regionalen Ebene weniger ertragreiches Land und insbesondere geschützte Gebiete zu "wilden" und widerstandsfähigen Ökosystemen renaturiert werden können. Demnach sollten Agrarumweltsubventionen auf fruchtbaren Flächen Maßnahmen finanzieren, welche die Biodiversität fördern und gleichzeitig hohe Erträge ermöglichen. Im Gegensatz dazu sollten Agrarumweltprogramme und Subventionen für benachteiligte Gebiete bei Grenzertragsstandorten und Schutzgebieten auch die Wiederverwilderung und das Management von natürlicher Sukzession fördern. Damit dieser Ansatz erfolgreich sein kann, müsste ein höherer Anteil der Subventionen aus der Gemeinsamen Agrarpolitik dem Erreichen von Umweltschutzzielen gewidmet werden.

Keywords: Agricultural policy; Agri-environment schemes; Aichi targets; Farmland biodiversity; Land sharing; Land sparing; Land-use policy; Protected areas; Rewilding; Restoration

Introduction

One of the Aichi targets of the Convention on Biological Diversity for 2020 is that "...incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts..." (CBD Decision X/2). Another Aichi target sets goals for ecological restoration: "By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through...restoration of at least 15 per cent of degraded ecosystems..." Although these targets are ambitious and may take more than one decade to be fully met, they require action now (Perrings et al., 2010; Tittensor et al., 2014). Here, we propose a rethinking of the agri-environmental subsidies (AES) of the Common Agricultural Policy (CAP) of the European Union (EU) in order to address these targets synergistically.

We first critically examine the paradigm that biodiversity protection requires the human management of semi-natural landscapes and low-intensity farming areas (Blondel, 2006), and we argue that rewilding may eventually support similar or higher levels of biodiversity, at least at large spatial scales (Navarro & Pereira, 2012). We next discuss how much of the current AES are targeted at halting natural succession and we present cases in which they are working as perverse subsidies, being negative both for biodiversity and ecosystem services. We argue that the fast adoption of the concept of 'multifunctional' agriculture by policy makers has been boosted by its potential to justify continued subsidies for farmers whilst avoiding criticisms of protectionism (Potter & Burney, 2002). Finally, considering the current dynamics of farmland abandonment in Europe (Verburg & Overmars, 2009), we develop a proposal to shift subsidies towards supporting both rewilding across marginal land regions (Navarro & Pereira, 2012) and biodiversity protection across intensively farmed areas. The aim of our proposal is to be thought-provoking and foster discussion about the desired direction of future management options for marginal farmland. Our proposal goes beyond the conceptual dichotomy of the competing 'land sparing' and 'land sharing' models, with 'land sparing' promoting intensive high-yield farming in order to protect adjacent natural habitats, and 'land sharing' integrating conservation and farming on the same land (Green, Cornell, Scharlemann, & Balmford, 2005; Phalan, Onial, Balmford, & Green, 2011). In line with recent criticisms of overly simplistic land-use trade-off analyses within this 'sparing/sharing' framework,

our proposal considers agricultural production as a whole, including produce other than food too. Also, it conceptualizes not only supporting, provisioning and regulating ecosystem services but cultural ecosystem services too (e.g. cultural heritage values; see Tengberg et al., 2012) for both intensive agro-ecosystems and marginal land. Furthermore, our proposal conceptualizes biodiversity as a whole without a narrow focus on a few taxa particularly biased towards tolerance to agricultural disturbance. It also moves beyond the landscape/ecoregion scale in order to capture the heterogeneity of European landscapes, and it includes environmental history and socio-economic realities of human–natural systems (Fischer, Hartel, & Kuemmerle, 2012; Tscharntke et al., 2012; Grau, Kuemmerle, & Macchi, 2013; Fischer et al., 2014). Because the 'sparing' and 'sharing' models should not necessarily be mutually exclusive (Scherr & McNeely, 2007; Fischer et al., 2008; Adams, 2012; Lusiana, van Noordwijk, & Cadisch, 2012; Macchi, Grau, Zelaya, & Marinaro, 2013; Scariot, 2013), we merge them here by including spatial scale into the framework, and we argue for 'land sharing' at the farm-scale and 'land sparing' at the regional and/or sub-continental scale. Although 'land sharing' typically lowers farm yields (Balmford, Green, & Phalan, 2012) and is hence seen as conflicting with agricultural production, we envisage small-scale, low footprint 'land sharing' measures – such as key resources that benefit pollination, pest control and resilience to wind damage (e.g. wild flower strips and hedgerows) – that actually help increase yields on intensive farmland (Kleijn, Rundlöf, Scheper, Smith, & Tscharntke, 2011; Bommarco, Marini, & Vaissière, 2012; Fischer et al., 2012; Tscharntke et al., 2012). Nevertheless, more research is needed into the details of composition and configuration of such yield-increasing 'land sharing' resources and this for different crop settings and regions. Such research will be essential in order to adequately plan 'sharing' and 'sparing' strategies that are truly compatible within our two-tier approach. Although we envisage rewilding some farmland, we remark that our approach is not likely to result in lower agricultural production at the EU-scale: further intensification of fertile land is likely to more than compensate for any production losses on marginal land, given that such areas are currently characterized by uneconomic, low yields oriented towards local consumption only, and by an increasing amount of land parcels withdrawn from cultivation anyway.

Biodiversity may be resilient to farmland abandonment

In Europe, agriculture is frequently seen as essential to maintaining biodiversity (Blondel, 2006). Low-intensity farming systems, also known as High Nature Value (HNV) farmland, are characterized by high levels of biodiversity (Bignal & McCracken, 1996; Halada, Evans, Romão, & Petersen, 2011). Hence, their abandonment is perceived as a threat to biodiversity (MacDonald et al., 2000), and conservation goals in Europe are often set to match extensive farmland biotopes and early successional habitats, such as heathland and meadows (Halada et al., 2011). However, although the alpha diversity of HNV farmland and semi-natural grasslands can be very high (e.g. semi-natural calcareous grasslands: Rösch, Tscharntke, Scherber, & Batáry, 2013) in comparison with natural forests, this pattern varies across taxa: closed-biotope groups, such as saproxylic insects, many species of which are now regionally extinct in Western Europe, reach highest diversity in natural forests (Grove, 2002; Paillet et al., 2010; Thorn et al., 2015), whereas open-biotope groups, such as grasshoppers, reach highest diversity in semi-natural grasslands (Marini, Fontana, Battisti, & Gaston, 2009). Moreover, local diversity patterns associated with extensive farming practices not only vary among, but also within taxa. For example, a study on breeding birds in Hungary showed that whilst farmland abandonment had adverse effects on farmland specialist birds, overall breeding bird diversity was nonetheless higher in abandoned compared to extensively managed grasslands (Verhulst, Báldi, & Kleijn, 2004).

We recognize the biodiversity value of HNV farmland, but we argue that at relatively large spatial scales, natural land may provide similar or higher levels of biodiversity (Navarro & Pereira, 2012). For instance, it has been argued that many open-habitat species are fully dependent on agricultural activities such as mowing and livestock grazing (Moreira & Russo, 2007; Halada et al., 2011). However, many such species also occur in natural open habitats, including forest gaps created by disturbances, grasslands maintained by wild grazers (Vera, 2000), and areas where tree growth and density is limited by climate or other abiotic factors (Thomas, 2009). As such, the negative impacts of ecological succession on abandoned farmland may have been overstated and biodiversity may be resilient to farmland abandonment. For instance, macro-moths had higher species richness in a forested than in a nearby extensively managed agricultural landscape, a difference that steadily increased with spatial scale (Merckx, 2015), and xylobiont Diptera on fallen beech logs became more diverse over time, indicating that dead wood becomes a more rewarding and more heterogeneous food resource with time (Hövemeyer & Schauermann, 2003).

At relatively large spatial scales (>100 km^2), and given time, 'abandoned' systems may be characterized by highly varied land use covers, including gradients of open to closed biotope types. Such systems display higher overall diversity than the diversity of each of their subsystem biotopes, and conservation schemes should capture this spatial and temporal complexity (Macchi et al., 2013). If sufficient heterogeneity at larger spatial scales is assured, beta diversity patterns in renaturalized ecosystems will be able to compensate for local reductions in alpha diversity (Merckx, 2015). Reintroducing large herbivores in such rewilded ecosystems could make these systems more self-managing in this respect, as large herbivores are able to generate structurally varied vegetation with mosaics of closed forest and

wood/pasture vegetation in temperate Europe, and thereby ensure the basis for high levels of biodiversity (Sandom, Ejrnæs, Hansen, & Svenning, 2014). In fact, rewilding aims at managing ecological succession to restore natural ecosystem processes, including disturbances which promote beta diversity (Navarro & Pereira, 2012). Given these expected higher levels of beta diversity in rewilded regions compared to extensively farmed regions, we believe that rewilding may be a valid alternative to farming on land that is marginally productive for agriculture. In addition, for species prone to human–wildlife conflict, including priority species in the Habitats Directive, farmland abandonment is an opportunity for comeback (Deinet et al., 2013).

Nevertheless, more research is needed on the resilience of biodiversity to farmland abandonment and on how rewilding and extensive farming compare in terms of biodiversity and ecosystem services across spatial and temporal scales. Moreover, these socio-ecological systems require interdisciplinary analysis: some questions are mainly ecological (e.g. does rewilding promote beta diversity), others are essentially social (e.g. what is the public perception of abandonment). In this regard, we hypothesize that the often-reported positive association between biodiversity and extensive agriculture in Europe is the result of a shifting baseline process (Pauly, 1995) due to Europe's widespread and long history of farming.

AES lock marginal land as farmland

The CAP – EU's agricultural subsidy system – corresponded to about €53 billion in 2012, which is about 42% of the total EU budget (EC, 2014). This system supports a largely industrialized agriculture that is responsible for only 1.6% of the EU's GDP, with payments distributed according to the total amount of land, especially benefiting large estates (BBC, 2013). More than 70% of this money is available as direct income support ('Pillar I'), about 20% is available through the Agricultural Fund for Rural Development ('Pillar II'), and the remaining money is allocated towards market support payments (EU, 2011). Payments under Pillar I are subject to 'cross-compliance' conditions relating to minimal environmental, food safety and animal welfare standards and to maintaining land in cultivable condition. AES, corresponding to more than 6% of the CAP budget, are situated within Pillar II, with payments subject to the provision of a variety of measures to manage biodiversity and countryside character over and above the 'cross-compliance' duty of care (EU, 2013). Other important subsidies under Pillar II are the LFA subsidies, which are targeted at fighting land abandonment in areas with natural handicaps, and which account for around 4% of the CAP budget (EU, 2013). Many of the LFA overlap with Natura 2000, and some AES have been specially targeted at Natura 2000 areas (EU, 2013).

This two-pillar subsidy system, like older versions of the CAP, maintains trade barriers in order to protect the market advantages derived from a heavily subsidized and intensive agriculture (Dibden, Potter, & Cocklin, 2009). Its trade-distorting effects have been contentious within World Trade Organization talks (Potter & Burney, 2002). However, in order to defend their position, supporters of the subsidies increasingly use the 'multifunctionality' concept, which points to the contribution of agriculture not only in terms of producing food, but also in terms of food security, rural development, sustaining rural landscapes, generating employment and environmental protection (Potter & Burney, 2002). For example, the European Commission states "Today's farmers therefore have two roles – producing our food and managing the countryside. In the second of these they provide public goods" (EC, 2012).

The role of farmers in managing ecosystem services is indeed important. Farmers have excelled at managing multifunctional landscapes, with one of the best examples coming from the Portuguese Montado and the Spanish Dehesa (Bugalho, Caldeira, Pereira, Aronson, & Pausas, 2011). These agro-forestry systems are dominated by cork-oak and holm-oak woodland, which produces cork as a forestry product and acorns for livestock breeding. In between trees, farmers seed pastures and cereals. The biodiversity of these systems is very high and they have retained many of the main characteristics of the original vegetation. Also, many of these farms are economically viable because of this multifunctionality and because of their large operational spatial scale (Pinto-Correia, Ribeiro, & Sá-Sousa, 2011).

This does not imply that all Southern Iberia should be necessarily managed as Montado/Dehesa systems, or more generally that multifunctional landscape management is the ideal management strategy in every landscape in Europe. Some areas have steep slopes, lack farmers or have other socio-ecological limitations that prevent the viability of agro-forestry operations. Furthermore, in some regions, such as some protected areas, the management goals may prioritize strategies aiming at the restoration of ecosystems dominated by natural processes.

Unfortunately, current policies and subsidies emphasize the ubiquitous maintenance of farming and active management of the landscape, without identifying and targeting areas where rewilding marginal farmland may be beneficial for biodiversity and ecosystem services. These policies have two perverse effects. First, they promote the maintenance of agricultural practices in areas that could often be considered degraded from the point of view of several ecosystem services. For instance, the typically high stocking densities associated with livestock farming prevent the recovery of forest ecosystems, reduce soil quality through compaction and erosion and negatively affect grassland arthropod diversity (van Klink, van der Plas, van Noordwijk, WallisDeVries, & Olff, 2014). Second, they distort land prices, artificially increasing the market value of marginal farmland. Consequently, conservation bodies wanting to acquire marginal land are often outcompeted by farmers, and even if conservation bodies do acquire land, they often opt to keep land

in a cultivable condition, i.e. as farmland, by mimicking farming practices, in order to cash in the available farming subsidies since CAP rules forbid 'land abandonment'. For example, the two largest land-owning voluntary bodies in the UK, the Royal Society for the Protection of Birds and the National Trust, get £4.8 million and £8 million a year, respectively, for owning farmland (Monbiot, 2011). Furthermore, whilst subsidies may delay abandonment, they are unlikely in the long run to achieve their goal of halting and reversing this process; not only is farmland abandonment a process prone to self-enforcing socio-ecological regime shifts (Figueiredo & Pereira, 2011), incentive payments can never fully compensate the direct benefits that people received from the environment in traditional farming communities (Fischer et al., 2012).

Reshaping AES

The agri-environmental policy in Europe suffers from two problems. On the one hand, many of the CAP's AES are allocated to support extensive practices and halt ecological succession on marginal farmland. On the other hand, the remaining amount of AES and the cross-compliance regulations seem insufficient to address the ecological problems of intensive farming. We believe it is helpful to make a clear distinction between the desirable policy paths for fertile agricultural land on the one hand, and less fertile, marginal agricultural land on the other. So, we propose:

- *Fertile land*: The dominant land-use should preferentially remain intensive farming, with AES applied to pay landowners for foregone profit due to habitat restoration and habitat management costs. Although current AES are generally failing to halt declines in farmland biodiversity (Kleijn et al., 2011), they could be optimized. For instance, evidence-based AES approaches to habitat creation on intensively managed farmland achieved large increases in numbers of plant, bee and bird species (Pywell et al., 2012). A 'payments by results' approach may further increase AES efficiency (Schroeder, Isselstein, Chaplin, & Peel, 2013). Keystone habitat resources, which are resources whose effects on biodiversity and ecosystem services (e.g. pest control, pollination, shelter, soil protection and water storage) far exceed their spatial footprint (Manning, Fischer, & Lindenmayer, 2006), seem appropriate tools to combine intensification with biodiversity/ES provision. For example, pollen/nectar strips, hedgerow trees, ponds and floristically enhanced grasslands may function as keystone resources – at the very least for (bumble)bees, moths or damsel- and dragonflies – and they are compatible with intensified agricultural systems (Carvell, Meek, Pywell, Goulson, & Nowakowski, 2007; Merckx, Marini, Feber, & Macdonald, 2012; Raebel et al., 2012; Woodcock et al., 2014). Moreover, effects of keystone resources are likely to be larger in structurally simple landscapes, such as intensive farmland, than in marginal land with typically high levels of landscape heterogeneity (Tscharntke, Klein, Kruess, Steffan-Dewenter, & Thies, 2005; Batáry, Báldi, Kleijn, & Tscharntke, 2011). Although more research is needed, we believe that AES, if targeted to 'land sharing' measures that support keystone habitat structures for ecosystem functioning and resilience, can thus help achieve increased agricultural yields on intensively farmed land. For instance, measures to recreate more diverse grasslands increased hay crop yields (Bullock, Pywell, & Walker, 2007), and the establishment of small patches of native flowers increased yields of a pollinator-dependent crop (Carvalheiro, Seymour, Nicolson, & Veldtman, 2012). Globally, more than 75% of the 115 leading crop species benefit from animal pollination, thereby contributing to an estimated 35% of global crop production (Klein et al., 2007). Not only does animal pollination increase the yield of these crop species (Klein et al., 2007; Gallai, Salles, Settele, & Vaissiere, 2009), but quality too. For instance, Klatt et al. (2014) found that (wild) bee pollination improves the shape, weight and shelf-life – and hence the market value – of strawberries, contributing €1.05 billion to the European strawberry market per year. Apart from helping to boost yields, such 'land sharing' measures may simultaneously help to slow down or reverse broad-scale declines of farmland biodiversity (Davey et al., 2010; Perkins, Maggs, Watson, & Wilson, 2011; Merckx et al., 2012), and as such help achieve a more sustainable agricultural intensification (Tilman, Balzer, Hill, & Befort, 2011; Pywell et al., 2012).
- *Marginal land*: Farm subsidies are often the only reason why farming less-productive land remains economically attractive to land-owners. The financial burden of these subsidies on society has been justified by some ecosystem services provided by farmed marginal land. However, farming marginal land may, but does not necessarily result in the best possible outcome with regard to biodiversity and the whole set of ecosystem services. Moreover, intervention to support or mimic extensive farming practices is difficult, with relatively small changes in farming practices often causing significant effects on local biodiversity (Konvicka et al., 2008; Phalan, Balmford, & Green, 2012). As such, we propose to disconnect subsidies for marginal land from farming activities. Doing so will make farming less economic to owners of marginal land, which will reduce land prices, and hence reduce competition for land with other societal players, bringing opportunities for ecosystem restoration. Nevertheless, for some regions extensive farming systems could deliver the most valuable outcome, and these regions should then best be managed as such. A possible approach to select these regions is to run trade-off analyses using biodiversity and a large set of ecosystem services. However, the same analyses but applied to other regions, especially protected areas, may indicate that rewilding former farmland could result in larger net benefits.

At the scale of regions and upwards, such a two-tier approach may retain (or restore) more biodiversity, and hence more of its associated ecosystem services too, than the current approach. Our two-tier approach fits the 'land sparing' concept at large spatial scales, whereby marginal land is 'spared' and ecologically restored whilst further improvements are made to farming efficiencies on fertile land. But at the farm-scale, the AES in intensive farmland correspond to a 'land sharing' strategy.

In summary, the current subsidy system should be redesigned so that owners of fertile land are encouraged to take up effective AES options, whilst owners of marginal land are financially encouraged to either take up rewilding options (Hodgson, Kunin, Thomas, Benton, & Gabriel, 2010) or continue extensive farming practices for those cases (e.g. some cultural heritage landscapes) where extensive farming systems may deliver the most valuable outcome in terms of biodiversity and ecosystem services. Rewilding measures may, for example, entail financial compensation per ha of land left untouched and financial compensation for the planting of woodland nuclei (Rey Benayas & Bullock, 2012; Zahawi, Holl, Cole, & Reid, 2013). The development of such rewilding subsidies would allow governments to continue to address the social problems that many of these marginal lands face, by direct transfer of funds, and could be linked to incentives to develop other economic activities such as wildlife-based tourism, bringing new entrepreneurs and dynamics to the region. Such a transformation, with direct people-nature links, may be a more sustainable means than the 'preservation strategy' of AES to counteract the currently decoupled social and ecological systems within rural communities of marginal areas (Fischer et al., 2012). For such a scheme to be successful, the proportion of CAP subsidies dedicated to agri-environmental and LFA subsidies would have to increase from its current proportion of ca. 10%. One contribution to achieve this is by capping direct income subsidies and transferring these funds to AES and LFA. For example, capping the amount a single farmer can receive at €300,000 a year would allow a yearly transfer of €186,000,000 while affecting the direct income support of only a tiny amount of claimants (EC, 2011).

Concluding remarks

On marginal land, where farming is uneconomic, the subsidy cost of maintaining a semi-natural landscape via extensive farming practices needs to be weighed against the resulting environmental and biodiversity benefits. These paid-for benefits then need comparing with the benefits in terms of biodiversity and ecosystem services obtained via rewilding. We hypothesize that rewilding will outperform farming in such trade-off analyses in many, but not necessarily all cases, and we call for research to identify such cases. In general, it is to be expected that rewilding will increase regional population densities of late-successional species, whilst reducing regional densities of early-successional, open-habitat species. Under a rewilding scenario, it is hence vital to allow high levels of heterogeneity and to identify and monitor those species where a cessation of traditional farming practices is likely to endanger them, and to provide adequate conservation management for such species.

The rewilding option for marginal land seems to fit better with current demographics, showing a yearly 2% decline in the number of European farmers. Since 1961, Europe's rural population declined by 28%, whilst urban populations increased, trends projected to continue at least till 2045 (FAOSTAT, 2013). Intermediate scenarios indicate that European farmers will abandon 100,000–290,000 km^2 of mostly semi-natural grasslands and remote or mountainous areas with poor soil quality between 2000 and 2030 (Verburg & Overmars, 2009). So, although Europe is a densely populated continent, these rural–urban migration trends result in highly variable population densities across Europe, offering scope to recreate ecosystems that function more naturally within some of these low-density areas. Moreover, a subsidy system to halt such a strong socio-economic trend is highly artificial, and it only partially addresses the underlying reasons why people are abandoning the poverty-trap of marginal land, characterized by resource scarcity, low return on investment, lack of opportunities, reduced social services, low productivity of small-scale parcels, limited opportunities for mechanization and intensification, and limited access to education and employment (Figueiredo & Pereira, 2011; Navarro & Pereira, 2012).

On fertile land, the higher levels of biodiversity and heterogeneity obtained via small-footprint 'land sharing' will in turn increase farmland resilience (Bengtsson et al., 2003; Tscharntke et al., 2005), which is beneficial under climate change scenarios. Because the current sustainability of industrial agricultural systems is highly questionable (Tilman, Cassman, Matson, Naylor, & Polasky, 2002; Tscharntke et al., 2005; Perfecto & Vandermeer, 2010) these 'land sharing' measures could thus help achieve a more sustainable intensification of agriculture (Godfray & Garnett, 2014). Nevertheless, in order to be fully effective, it is likely they will need to be accompanied by tools to change farmers' attitudes (de Snoo et al., 2013). Because uncertainties remain, we call for more theoretical and ecological research, especially on land-use trade-offs analyzed at regional and/or sub-continental scales and taking into account environmental heterogeneity, biodiversity distribution, agricultural suitability, ecosystem services and socio-economics (Grau et al., 2013; Macchi et al., 2013). We also call for more research on the effects of temporal and spatial scale on biodiversity levels (Navarro & Pereira, 2012). For example, modelling exercises should not only include altitude and latitude as factors impacting velocity of ecosystem restoration, but the history of land use too as this factor influences restoration potential through time (Lindborg & Eriksson, 2004; Dullinger et al., 2013).

We hope that our proposal, to shift part of the EU agro-forestry subsidies towards supporting rewilding on some

marginal land and sustainable intensification across intensively farmed areas, may result in two effects: (i) to foster discussion about management and land-use options for both marginal and intensive farmland; (ii) dependent on the outcome of such a discussion, to contribute eventually towards meeting two Aichi targets in a synergistic manner: target 3 on the discontinuation of environmentally harmful subsidies, and target 15 on the restoration of degraded ecosystems.

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