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Making the best of both worlds: Can high-resolution agricultural administrative data support the assessment of High Nature Value farmlands across Europe?

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ABSTRACT

Worldwide, the role of farmlands for biodiversity conservation and the delivery of multiple ecosystem services has been widely acknowledged. In the European Union (EU), societal demands to include environmental conservation concerns within the Common Agricultural Policy (CAP) have resulted in the recognition of the importance of maintaining High Nature Value farmlands (HNVf).

HNVf constitute complex social-ecological systems, which owe their nature conservation value to the maintenance of specific, mostly low-intensity farming systems, supporting high levels of species and habitats dependent on agricultural practices. Even though HNVf assessment in space and time is essential to evaluate the effectiveness of Rural Development Programmes, the diversity of rural landscapes across EU, the scarcity of data on farming systems, and the lack of common methodological guidelines has hampered the implementation of HNVf mapping and monitoring across Europe. Thus, there is a pressing need to develop and test methodological approaches that may support HNVf assessment across the EU.

The Integrated Administration and Control System (IACS) which is mandatory for all EU Member States constitutes a system for the management and control of CAP payments to farmers. Essentially, IACS comprises high-resolution, spatially explicit information on the type and intensity of agricultural land-use. Even though such data exhibits high thematic, spatial and temporal resolution, IACS has seldom been used, due to significant access restrictions. Here, the potential to use IACS data to support the assessment of HNVf was evaluated within the German Federal State of Lower Saxony by implementing a recently developed methodological framework. Sets of indicators known to be essential for identifying potential HNVf and underlying farming systems (expressing landscape structure and composition, farming systems, and crop diversity), were derived from IACS. Spatial patterns of indicators were analyzed at two different scales to delineate the potential distribution of HNVf across Lower Saxony.

Results highlighted that most regions in Lower Saxony were characterized by intensive farming practices including high livestock density, high share of intensive crops and low density of linear elements. Only 3% of the Utilized Agricultural Area (UAA) of Lower Saxony potentially constituted HNVf, with the majority of HNVf coinciding with mosaics of arable and/or permanent crops and semi-natural features under less intensive farming practices. Semi-natural grasslands, partially under agri-environment scheme management contracts, covered roughly 1% of the UAA and were mostly intermingled with other farmland habitats in extensively managed agricultural landscapes.

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In the context of the EU-wide HNVf assessment, IACS constitutes an important source of data, characterized by a high spatial, thematic and temporal resolution of data collected annually. Whilst having the potential for use in HNVf assessment, some challenges remain, especially due to significant access restrictions. Nevertheless, IACS constitutes a powerful tool to evaluate the extent and condition of HNVf across the EU countryside. Making use of IACS data in such a way could provide a stepping-stone towards achieving a more effective balance between the management and control of CAP support payments and the growing societal demands related to the maintenance and enhancement of farmland biodiversity and ecosystem services.

1. Introduction

Globally, an expansion and intensification of agricultural land has occurred in the last century (Wade et al., 2008), with negative impacts on the environment and related natural resources, such as biodiversity and ecosystem services (Millennium Ecosystem Assessment, 2005; Aviron et al., 2009; Shackelford et al., 2015). Driven mainly by economic, political and demographic processes, agricultural land in Europe has been facing two opposite trajectories: either abandonment of economically marginal remote and upland areas or the intensification of farming practices in the more productive lowland areas (MacDonald et al., 2000; Stoate et al., 2009; Baudron and Giller, 2014; Beilin et al., 2014; van Vliet et al., 2015).

While intensive, high-yield agriculture is considered to be among the most damaging human-related activities to wildlife (Tilman et al., 2002; Balmford et al., 2012; Shackelford et al., 2015), the importance of extensively managed farmland for biodiversity maintenance and long–term conservation, and the provision of ecosystem services, e.g., carbon sequestration, aesthetic landscapes, and support of biodiversity, has also been acknowledged (Swinton et al., 2007; Power, 2010). Farming has been shaping European landscapes for centuries or even millennia and up to 50% of all species rely, to some extent, on agricultural ecosystems and habitats, including endemic and threatened species (Bignal and McCracken, 1996; Halada et al., 2011; Lomba et al., 2014). The role of traditional, low-intensity farmland for the maintenance of natural capital and protection of the countryside has thus been debated, ultimately developing into the 'High Nature Value farmlands' (HNVf) concept (Egan and Mortensen, 2012; Plieninger and Bieling, 2013; Renwick et al., 2013; Lomba et al., 2014; Lomba et al., 2015; Strohbach et al., 2015).

The HNVf concept was developed within the European Union (EU) to characterize agriculture-dominated landscapes where high nature and/or conservation value is dependent on the continuation of specific low-intensity farming systems (Beaufoy et al., 1994; Andersen et al., 2003; Lomba et al., 2014). These farming systems constitute complex socio-ecological systems resulting from a long-term relationship between human activity and the surrounding environment (Plieninger and Bieling, 2012; Plieninger and Bieling, 2013). The intrinsic nature value of HNV farmlands is due to the prevalence of low-intensity farming practices and either a high proportion of semi-natural vegetation e.g. pastures and meadows (referred to as HNVf type 1; Oppermann et al., 2012), or the presence of small-scale elements in the agricultural landscapes, such as field margins, hedgerows and tree lines (referred to a HNVf type 2; Andersen et al., 2003). In addition, some intensively managed farmlands have been considered as HNVf type 3 due to their importance for the maintenance and survival of some populations of agriculture-dependent species with conservation interest (e.g. farmland birds and reptiles; Andersen et al., 2003).

In recognition of EU efforts towards sustainable rural development and land stewardship (Plieninger and Bieling, 2013), HNVf was included in the Common Monitoring and Evaluation Framework (CMEF) for the rural development policy within the context of the EU Common Agricultural Policy (CAP; EC, 2006). Their role for biodiversity conservation, provision of ecosystem services and public goods generated has also been highlighted within the EU Biodiversity strategy to 2020 (EEA, 2015). Nevertheless, the recent mid-term assessment of the EU Biodiversity strategy to 2020 reported that no relevant progress has been made towards the improvement of the conservation status of most agriculture-dependent species and habitats. The assessment recommended that greater and more effective efforts are urgently needed to increase the contribution that farmlands, including HNVf, make to the maintenance and enhancement of biodiversity in the European Union (EU) countryside (EC, 2015; EEA, 2015).

Whilst the assessment of HNVf indicators is mandatory across the EU, the diversity of rural landscapes, the scarcity of (suitable) datasets on biodiversity, land cover and land-use, and the lack of common guidelines and/or approaches for mapping HNVf are important obstacles towards its successful implementation (see e.g. Peppiette, 2011; Lomba et al., 2014; Strohbach et al., 2015).

Following the EU guidelines (Paracchini et al., 2008; EENRD, 2009), Lomba et al. (2015) recently described a multi-step spatially-explicit framework to assess the extent of HNV farmlands in the EU countryside. In short, such approach builds on the spatially-explicit assemblage of indicators informing on the social-ecological dimensions underlying the nature value of such farming systems, namely landscape structure and composition, and the extensive character of farming practices (Lomba et al., 2014; Lomba et al., 2015). In addition, it has been recommended that indicators considered for HNVf assessment should be derived from the best spatial and/or temporal resolution available for the target area (Lomba et al., 2015). Whilst this methodological framework has been shown to have a great potential to operationalize the HNVf concept, some important challenges remain, such as its application to other social-ecological contexts, datasets and scales across the EU countryside. Here, one of such challenges is tackled through the implementation of the aforementioned framework using indicators derived from the Integrated Administration and Control System (IACS) database.

IACS, which was established in the early 1990s (EEC, 1992), mainly consists of high resolution, annually-updated farm-level information (e.g. livestock) and parcel-level information (e.g. crop type; Keenleyside et al., 2012), and associated Land Parcel Identification System (LPIS), an spatially-explicit identification system for agricultural areas (EC, 1996; Sagris and Devos, 2009) Despite its availability across EU Member States, IACS data has seldom been used as a spatially-explicit dataset for indication and monitoring of HNVf, mainly due to access restrictions put in place to protect land manager privacy (Lomba et al., 2014; Strohbach et al., 2015). To-date, Steinmann and Dobers (2013) have analyzed patterns of crop rotation and sequence across the federal state of Lower Saxony based on IACS. The same database has been used by Nitsch et al. (2012) to assess land-use change between grasslands and arable land. In addition, Ribeiro et al. (2014) used IACS data to model HNV