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Using the French LPIS database to highlight farm area dynamics: The case study of the Niort Plain

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ABSTRACT

Decreases in the number of farms over the last decade have led to an increase in mean farm size and a fragmentation of the land on the remaining farms. These changes can influence the management of cropping systems by farmers, generally leading to a decrease in crop diversity at the landscape scale and a homogenization of agricultural practices between fields, to reduce logistic costs. At the landscape scale, these changes can modify agricultural pressure on natural resources (e.g. water, soil, biodiversity), by creating hotspots of fields subject to intensive management. Consequently, natural resource management, mostly at the local scale, requires new monitoring tools dedicated to local farm dynamics.

This work aimed to characterize farm area dynamics between 2007 and 2013 on the Niort Plain, a sensitive area located in the South-West of France that is subject to water and biodiversity issues. Changes in farm area were characterized, taking into account not only farm size, but also the spatial distribution of the islets included in the land pattern. The LPIS database, which provides quasi-continuous broad coverage of the French agricultural areas, was used to analyze changes in farm area, through characterization of the annual changes in farm area and their effects in terms of land fragmentation and farm size distribution.

Six types of farm area dynamics were characterized: the enlargement of farms with and without a reconfiguration of the land use pattern, a decrease in the utilized agricultural area (UAA) of farms with and without a reconfiguration of the land use pattern, and a stable UAA with and without reconfiguration of the land use pattern. We found that 5.5% of the farms were either split into smaller units or stopped seeking CAP subsidies during the period considered. Two patterns predominated: a stable farm area and enlargement of the farm area. Farms of many different initial sizes displayed enlargement, generally through the acquisition of islets from another farm that was split up.

Farm dynamics had a limited impact on the fragmentation of farm land. Farm enlargement led to a slight increase in the dispersion of islets from the farm center.

The procedure developed here for the characterization of farm area dynamics is particularly suitable for application at the temporal scales used by planners working on environmental programs. By monitoring farm area dynamics, planners could also set specific devices to enable them to focus either on the total number of farms or exclusively on a subset of farms of strategic importance for the management of natural resources due to their area dynamics, location or aggregation in the environment.

1. Introduction

In recent decades, the number of farms in France and in Europe has decreased and farm size has increased, with an intensification of agricultural production. This trend towards increasing farm size is unlikely to continue into the next decade. However, it has led to an increase in farm efficiency due to economies of scale (Bartolini and Viaggi, 2013). In France, the number of farms fell from 1,017,000 in 1988 to 490,000 farms in 2010. This decrease in farm number was associated with an increase in mean farm size, from 28 ha in 1988 to 58 ha in 2010 (French Agricultural Census, 1988 and 2010). Other European countries, such as the Netherlands (van Apeldoorn et al., 2013), have reported similar farm size dynamics. In France, this increase in farm size concerns the entire distribution of farm sizes (Piet et al., 2012). However, there are differences between French regions. For instance, in the East and South-East of France, farms with a large UAA are increasing in area at the expense of small farms, altering the overall distribution of farm sizes. This expansion of large farms at the expense of smaller ones may affect

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production system diversity, with small-scale production systems (fruit and vegetables or pastoral systems, for example) disappearing in favor of large-scale production systems (cereals, sugar beet or maize) (Piet et al., 2012). It may also affect the number of farmers involved in resource management that the local authorities have to work with.

Farm area can be described by in terms of the total area covered by the farm and its fragmentation (Thenail and Baudry, 2004). Farm size and structure affect both the functioning and performance of the farm. Farm consolidation is designed to ensure that farms consist of plots of appropriate shape and size for viable functioning. Farm enlargement may affect the fragmentation of land in the field pattern. In a context of high competition for land, the parcels acquired for farm expansion may be located at some distance from the farmstead, increasing the dispersal of the parcels belonging to a given farm (Croix, 1997). The size of the parcels and the distance between them and farm buildings affect labor and transport costs, with possible consequences for farm profitability (Gónzalez et al., 2007). For example, greater fragmentation may lead to higher production costs, and costs associated with the organization and control of the production process (Latruffe and Piet, 2014). It may also place constraints on the technical options open to farmers. The structure of the farm area also plays a key role in the spatial allocation of crops (Thenail and Baudry, 2004), which depends partly on the accessibility of parcels to agricultural machinery and the distance between the parcels and storage buildings (Joannon et al., 2006). Cereal farms organize the allocation of their crops to the field pattern as a function of the fragmentation of the land, to optimize the logistics of farm work (Morlon and Trouche, 2005). On dairy farms, the location of cash crops and forage crops depends on the distance between fields and farm buildings (Marie et al., 2009). Land fragmentation also influences the farmer's technical decisions, by leading to the definition of groups of parcels as a function of their proximity (Aubry et al., 1998). For example, fertilization practices, which are often adjusted to the needs of crops and parcel conditions, can also be organized to optimize movement between parcels (Soulard et al., 2002). However, increases in land fragmentation can also have a positive impact, by increasing the diversity of soil quality and growing conditions and making it possible to grow a greater diversity of crops on the farm area (Di Falco et al., 2010).

For local authorities responsible for resource management, it is worth monitoring farm area dynamics, because they can influence the management of cropping systems (nature and/or corresponding area), thereby having an indirect effect on natural resources (Martin et al., 2014). For example, farm enlargement can lead to an increase in field size and a local decrease in crop heterogeneity, which can affect biogeochemical processes, such erosive run-off (Souchère et al., 2010), or ecological processes (Tscharntke et al., 2005; Concepción and Díaz, 2011). The dynamics of farm enlargement in sensitive areas, such as catchment areas, may also affect the number of farmers potentially involved in environmental protection and the proportion of the sensitive area associated with each farm (Durpoix and Barataud, 2014; Barataud et al., 2014). An understanding of the dynamics of farm area and its consequences for land fragmentation could help local authorities to manage environmental issues more effectively.

Research into the evolution of farms has generally focused on the capacity of farms to adapt in a restricted environment (García-Martínez et al., 2009; Ryschawy et al., 2013). Most of these studies investigated changes in farming systems and farm size. Long-term case studies (e.g. 15–50 years) have revealed dynamics of farm enlargement or shrinkage, based on comparisons of farm UAA between two distant dates. However, it is very time-consuming to interview farmers from each farm in a rural area to collect the information required for the characterization of these dynamics, and this approach is therefore not feasible for local authorities responsible for resource management (Biarnès et al., 2004). Databases for agricultural censuses and structural surveys have been used to assess long-term patterns of change in farm size, land fragmentation and farm size distribution in France (Piet et al., 2012). Latruffe and Piet (2014) used the Land Parcel Identification System (LPIS) database to analyze the relationship between land fragmentation and farm performance in the Brittany region of France. It proves broad coverage of French territory each year, and can be used to carry out analyses at farm level, for farms receiving CAP subsidies.

The objective of this work was to characterize farm area dynamics over a seven-year period on the Niort Plain, a sensitive area located in South-West of France that is subject to water and biodiversity issues. We used the LPIS database, which provides quasi-continuous, broad coverage of agricultural areas in France, to study changes in farm area over the seven-years period of the study by: characterizing annual changes in farm area and their consequences for land fragmentation and farm size distribution. Land fragmentation was characterized with descriptors reflecting not only fragmentation *per se*, but also the dispersion of parcels in the land use pattern. We estimated four indicators frequently used to evaluate fragmentation and dispersion: the number of islets belonging to each farm (Morlon and Trouche, 2005; Piet and Cariou, 2014) and mean islet area (Piet and Cariou, 2014) were used as land pattern fragmentation indicators, and the mean distance of islets to the farm center (Marie et al., 2009; Morlon and Benoît, 1990; Piet and Cariou, 2014) and the mean Euclidean distance between the centroids of each pair of islets for a given farm (Piet and Cariou, 2014) were used as indicators of the dispersion of parcels within the land use pattern.

2. Material and methods

2.1. Study area

The Niort plain is located towards the south of the French NUTS3 region Deux-Sèvres, which is part of the French NUTS2 region Poitou-Charentes (integrated into a larger region called "Nouvelle Aquitaine" in 2016). The Niort plain covers 39 municipalities (70,969 ha) and an agricultural area of 53,000 ha. In this small agricultural area, the farming systems are diversified: cereal systems, mixed crop-livestock systems (goat, sheep, dairy cattle and meat) or livestock that are structured according to a pedoclimatic gradient North-East/South West. Although mixed crop-livestock systems still predominate in this area (Schaller, 2011), they have been showing a trend towards specialization in cereals in recent years. The Niort plain is subject to water and biodiversity issues: it includes two priority water catchment areas for the Water Framework Directive (2000/60/EC) and is classified as a vulnerable zone under the Nitrates Directive (91/676/EEC) and as a Natura 2000 site (designated according to Birds Directive 79/409/EEC) (Fig. 1). There are also human pressures on the land in the periphery of the Niort conurbation, where there is competition for land between urban and agricultural uses.

2.2. The French LPIS database

The French LPIS, which provides data for France for the study period considered here (2007–2013), contains spatially explicit information about both farm area structure and land cover, unlike other similar databases, such as Corine Land Cover (Heymann et al., 1994) and Teruti-Lucas (Bousquet et al., 2013). The French LPIS is updated yearly, at the national scale, on the basis of the farmers' CAP declarations (European Council Regulation no. 1593/2000–European Commission, 2000). This makes it possible to analyze processes over annual time intervals, with a high resolution for open wide spaces. Datasets of this type are more generally available in the other countries of the European community, in the framework of the Land Parcel Identification System (LPIS), although diverse approaches have been developed for LPIS implementation (Kay and Milenov, 2008). The LPIS database has been used for various purposes, including rural planning (Verhoeve et al., 2015), and studies on land-use changes in various countries, such as France (Fuzeau et al., 2012), Austria (Schönhart et al., 2011), Belgium (Leteinturier et al., 2006), Sweden (Trubins, 2013) and Ireland