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Space–time process and drivers of land abandonment in Europe

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ABSTRACT

Farmland abandonment in Europe is a major problem because of environmental, socioeconomic and landscape implications. In this paper, a general view of the extent of abandoned land, the stages of abandonment and the drivers that manage this process in Europe is presented. A scientific literature review shows an abandonment at the beginning of the 19th century, although the largest abandonment in terms of area took place in the mid-20th century. This abandonment had a far greater impact on mountain areas because of rural depopulation as well as biophysical constraints. Since the last decades of the 20th century, abandonment driven by the CAP in European Member States and by the end of the communist regime in Central and Eastern Europe has been taking place. This abandonment affects peripheral marginal areas due to biophysical or socioeconomic conditions. Semi-arid areas in Southern Europe have also seen an important extent of abandoned land over the last few decades. The literature draws on the ongoing abandonment from the following decades, and 3–4% of current farmland is considered to be affected.

It is noted that, among the drivers, external factors (migration, socioeconomic model, public policies, etc.) act as enhancers that emphasize land abandonment. However, internal causes (agro-ecological and socioeconomic factors and also the features of agricultural holdings) control the dynamics and the extent of this phenomenon. The international literature about land abandonment in Europe is vast, and most of the specialized production is devoted to the effects of land abandonment, while few works determine the extent, stages and drivers of land abandonment. Finally, it is necessary to review the grey literature to obtain more quantitative information on the amount of abandoned land in Europe.

1. Introduction

Land abandonment represents one of the major land cover and land use changes in Europe since the 19th century, especially in mountainous areas and semiarid environments (MacDonald et al., 2000; Marty et al., 2003; Tasser et al., 2007; Sitzia et al., 2010; San Román Sanz et al., 2013). Ramankutty and Foley (1999) estimate that approximately 1.5 million square kilometres have been abandoned on a global scale. The main consequence of land abandonment is the beginning of plant succession, leading to revegetation in vast areas, which provokes environmental, landscape and socioeconomic impacts (MacDonald et al., 2000; Shröter et al., 2005; Muñiz et al., 2006; Hobbs and Cramer, 2007; Gellrich et al., 2007; Höchtl, et al., 2005; García-Ruiz and Lana-Renault, 2011; Komac et al., 2013; Lasanta et al., 2015). These impacts affect not only the abandoned area and its local population but also society as a whole, which feels the impact in the production of goods and services by agricultural land as they are threatened by the abandonment (Mottet et al., 2006; Viviroli et al., 2007; Millennium Ecosystem Assessment, 2003).

In this context, several international institutions (UNESCO, The European Landscape Convention, the Institute for European Environmental Policy, IEEP, the European Union through the CAP, etc.) have applied measures to preserve traditional landscapes, as they are considered to be a key factor for sustainable development. They look for ways to harmoniously integrate social, economic and environmental factors in space and time (Pinto Correia, 2000; Pereira et al., 2005; Sayadi et al., 2009; Kizos et al., 2010; Agnoletti, 2014). The scientific literature discusses what to do with this abandoned farmland as well.

Some authors are in favour of managing abandoned fields in an active manner to maintain a mosaic landscape that is very diverse, heterogeneous, and of great environmental and cultural value (Tarolli et al., 2004; Conti and Fagarazzi, 2005; Stoate et al., 2009; Lasanta et al., 2009; Pelorosso et al., 2011; Lasanta et al., 2015). In addition, the negative impacts of land abandonment and subsequent revegetation are avoided. Lasanta et al. (2015) summarize these impacts: (i) uniform landscapes through the loss of farmland; (ii) a higher risk of starting and propagating fires because of increased plant biomass from plant succession (Pausas, 1999; Mouillot et al., 2003; Vega-García and Chuvieco, 2006; Viedma et al., 2006); (iii) reduced biodiversity in the medium and long term, at the same time as open spaces disappear with the advance of scrub and forest, causing the disappearance of

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species adapted to man-made environments (Laiolo et al., 2004; Marini et al., 2008; Van Auken, 2009); (iv) a reduction in river flows and less water in basins, relating to lower runoff coefficients due to increased vegetation (higher interception and consumption), which is very important in Mediterranean areas where water is a scarce resource (López-Moreno et al., 2008; García-Ruiz, et al., 2011); (v) the loss of cultural landscapes and management techniques required for their conservation, as they constitute an almost perfect symbiosis between nature and human management; (vi) the loss of arable land and pastures, which could be essential for the sustainable development of mountain communities.

Others authors are more keen to have passive management and do not control the plant succession process to regenerate the forest and other natural habitats (rewilding) because of their benefits concerning biodiversity and ecosystem services (Ruecker et al., 1998; Andréassian, 2004; Gillson et al., 2011; Rey Benayas et al., 2007; Rey Benayas and Bullock, 2012; Navarro and Pereira, 2012).

Whatever the stance adopted, the sustainable management of abandoned farmland requires the consideration of its extent, the space–time process of abandonment, as well as its drivers because it is a complex process in which local, global, environmental and human factors interact with each other (Allison and Hobbs, 2006; Rey Benayas et al., 2007; Verburg et al., 2007). It is essential to know such issues to establish successful planning and management policies in marginal areas. Land abandonment is expected to continue over the next few decades (Rounsevell et al., 2006; Nowicki et al., 2007; Pointereau et al., 2008), so it is interesting to know the history of land abandonment to anticipate the future paths and to develop opportunities to stop or redirect the process, limiting the negative effects (Strijker, 2005).

In spite of its significance, there are few studies that focus on topics such as the abandonment process, the extent of abandoned land and the drivers of abandonment, apart from some local studies (Lasanta, 1988; Lasanta et al., 1989; Strijker, 2005; Helming et al., 2011; Corbelle-Rico et al., 2012). Recently, an attempt was made to undertake studies on different scales, regional, national or supra-national using remote-sensing, Geographical Information Systems (GIS) and cartography (Hill et al., 2008; Stellmes et al., 2013; Weissteiner et al., 2011). The bibliographical review of this subject found the following studies: Kosmas et al. (2015) which looked for drivers at a regional scale based on ten cases throughout Mediterranean region, Eastern Europe, Latin America, Africa and Asia. Van Vliet et al. (2015) analysed 137 cases of land use changes in Europe (intensification and de-intensification, including land abandonment). Such studies provide interesting information, but the period studied is very short, since the 80s, which is a limitation. However, in searching the relevant literature, it is possible to find historical information about the space–time process of land abandonment and the drivers that condition and explain such a process.

A review of current land abandonment knowledge in Europe is presented in this paper. Our main objective is to determine the extent of the abandoned land, the space–time abandonment process and the drivers that determine such a process.

2. Methods

The Scopus Data Base was searched to carry out this literature review. A search made on 3 September 2015, including "land abandonment" and "Europe", resulted in 207 documents, of which 173 were articles, 13 were conference papers, 11 were reviews, 4 were articles in press and 2 were books. The larger volume of documents refers to Mediterranean Europe (Spain, 50; Italy, 36; France, 21; Greece, 13; Portugal, 8) and Western Europe (Netherlands, 36; Germany, 29; United Kingdom, 21; Belgium, 11), although there are studies on land abandonment in most European countries. Because many of the studies are local or regional and do not appear in the international literature, a search was made in the library of the Pyrenean Institute of Ecology (Higher Council for Scientific Research, Spain). This library concentrates more than 9000 books and 1400 scientific journals, most of which have been published since 1960 by European universities or research centres oriented to Environmental Science, Agricultural and Biological Science, Social Sciences, and Earth and Planetary Sciences.

To determine the main drivers of land abandonment, an electronic search of the scientific literature was performed using the Scopus data base, including "land abandonment" and "drivers". The search resulted in 78 documents (62 articles, 6 reviews, 5 conference papers, 4 articles in press and 1 book chapter), of which 61 were published between 2010 and 2015 and the rest between 2002 and 2009.

Out of a total of 78 documents, 71 are related to Europe and the rest mainly to the United States. The documents about Europe focus mainly on the Mediterranean basin: Spain (18), Italy (9), France (9), Portugal (9) and Greece (6). The remaining documents are mostly distributed through Germany, the United Kingdom, the Netherlands and Switzerland. The 78 documents reported little information on land abandonment drivers, except the publications of Rey Benayas et al. (2007) and García-Ruiz and Lana-Renault (2011). Thus, the literature included in Scopus was searched for "land abandonment" (682 documents on the 3 September 2015) and in the library of the Pyrenean Institute of Ecology (Higher Council for Scientific Research).

3. Results

3.1. The stages of farmland abandonment and the extent of abandoned land

From a temporal perspective, land abandonment has been taking place during the two last centuries, first affecting mountainous areas. The abandonment process was not very intense on plain spaces during most of the 20th century. On the one hand, the areas with the greatest potential for agriculture allowed agricultural specialization processes as well as an increase in productivity because of mechanization and the use of fossil energy. On the other hand, flatlands benefited from transport and infrastructure. However, in the few last decades, political changes in the countries of Eastern Europe or European Union Common Agricultural Policy reforms (CAP) have led to the marginalization of areas that were in full production until only 2–3 decades ago (Lesschen et al., 2007; Keenleyside and Tucker, 2010). In summary, three stages can be identified in the process of land abandonment: ancient abandonments in the mountains, land abandonment related to CAP and recent abandonments in countries of Eastern Europe.

a. *Land abandonment in the European mountains*. The first land abandonments recorded by the literature took place in France during the early decades of the 19th century (Debussche et al., 1999; Taillefumier and Piégay, 2003; Chauchard et al., 2007). The process spread to other Western European countries in the early decades of the 20th century. In these countries, wide expanses of land, especially in mountain areas, were abandoned by rural emigration to cities and industrial sites. It is an abandonment in response to the collapse of mountain societies (García-Ruiz and Lana-Renault, 2011). However, it must be highlighted that in some mountains, the abandonment of slopes happens at the same time as intensification in agriculture at the bottom of the valleys where pasture surfaces for cattle feed are grown (García-Ruiz and Lasanta, 1990; Van Eetvelde and Antrop, 2004; Mottet et al., 2006).
It is difficult to know the exact extent of land abandoned in the European mountains. There are no studies spanning Europe, and there are not even studies at the country level that can show a temporal perspective. There are only some regional or local studies, especially in the Mediterranean mountains. This is largely due to the absence, until the 1980s, of a cartographic source, such as remote sensing, which makes it possible to analyse large areas quite quickly. The studies carried out have been particularly supported through