

EVOLUTION OF LAND ABANDONMENT IN THE EASTERN REGION OF MURCIA

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I. INTRODUCTION

Changes in land use have been a constant feature of Mediterranean agriculture throughout history (García-Ruiz, 2010). Neither is the abandonment of cultivated land a new phenomenon, although it is beginning to be regarded as a problem in Mediterranean countries with a long agricultural tradition. Socio-economic changes and semiarid conditions have led to the increase in land abandonment, which, in some cases, has even been lent official encouragement (Corbelle and Crecente, 2008).

I.1. Causes of land abandonment

According to Pointereau *et al.* (2008), the factors that determine the risk of abandonment are of a geographical, agro-ecological, demographic, socio-economic nature and may also be in response to national or European level policies. In short, all these factors may be grouped into two categories, one with an anthropic component and the other strictly physical in nature.

García Ruiz and Lana Renault (2011) distinguish two forms of agricultural land abandonment: spontaneous and induced. The first is a direct decision on the owner's part encouraged by changes in rural society. Interest in maximizing profitability, together with adverse environmental conditions including aridity and soil degradation lead the grower to stop cultivating the land. This process has led to the concentration of agricultural activity in valleys and on gentle slopes, while hillier areas are abandoned. In the south-east of the Iberian Peninsula, this phenomenon has been aggravated by the semiarid conditions, the edaphological effects of the widespread irrigation of soils in the 1970s and the increasing scarcity of water resources. In contrast, what the authors termed induced abandonment is the result of national and, par-

ticularly, European agricultural policy. The Common Agricultural Policy (CAP), which aims to regulate the market in the case of agricultural products, has encouraged the withdrawal of agricultural land from production (Baudry, 1991). In the study area abandonment has mainly been the consequence of the first mentioned cause, since few owners have accepted CAP funds.

I.2. Consequences of land abandonment

The consequences of land abandonment is a cause of concern to the scientific community, both for the increase in the same and the lack of knowledge of its possible environmental effects (Ruiz Flaño et al., 1991). In the Mediterranean region, many publications have attempted to assess the direct or indirect impact of land abandonment (García-Ruiz and Lana-Renault, 2011).

For some authors land abandonment is considered as an influential factor in soil degradation, while others suggest that the practice opens up the possibility of the recovery of natural systems (Padilla Blanco, 1998; Kosmas et al., 2008) as long as the vegetation recovers in the short and medium. Several studies have shown that plant cover may substantially increase after abandonment, leading to an improvement in the soil's characteristics as a result of an increased organic matter content, water holding capacity, aggregation and structural stability, and also improved hydraulic conductivity (Belmonte et al., 1999; Bonet, 2004; Ruecker et al., 1998; Martínez-Fernández et al., 1996; Romero Díaz et al., 2012; Robledano et al., 2012).

In semiarid areas, however, as is the case under study, where the soils are already degraded, the vegetation will recover more slowly or not at all. The soils in question will have been turned and cultivated for years, gradually losing their organic matter and structure. If abandoned with no conservation measures taken, soils in semiarid climates and with an erosion-prone lithology will suffer strong physical and biological degradation processes as erosion and desertification phenomena exercise their influence (Romero Díaz, 2003).

I.3. Objectives

The main aim of this study was to evaluate previously cultivated areas of the eastern part of the province of Murcia which have been abandoned in recent decades, taking the years 1956, 1981, 2002 and 2011 as reference to analyse the evolution of the same.

II. STUDY AREA

The area analysed comprises the municipalities of Abanilla and Fortuna, with a total area of 385 km² and an average height of 385 m.a.s.l. The most northern sector, the highest and most mountainous, belongs to the outer zones of the Betic Cordilleras. Below these heights extends a Neogene-Quaternary basin, cut by various "ramblas" (Belmonte Serrato and Romero Díaz, 2007).

The climate is semiarid, with scant rainfall (less than 3000 mm per year), which is irregular in nature and sometimes torrential (> 150 mm in 24 hours). The mean annual

temperature is 19 °C, with very warm summers and mild winters. Estimated evapotranspiration is 952 mm, meaning that there is a pronounced water deficit in excess of 650 mm (Belmonte Serrato and Romero Díaz, 2007).

The lithology is varied: limestones and dolomites in the mountain ranges; detritic formations in the foothills of the northern sierras; marls, limestones and gypsum in the Neogene-Quaternary depression, where the badlands modelled from these materials are of particular note, with numerous rills, gullies and “ramblas”, accompanied by evident processes of piping (Romero Díaz et al., 2007). According to the FAO, the predominant soils are: Regosols (36.3%), CalcisolS (34.4%) and Leptosols (27.4%) (Ortiz Silla, 2007). As regards the potential vegetation, the northern sector is dominated by a dry ombrotype of “mesoMediterranean carrascal manchego”, while a semiarid ombrotype predominates in the south with a “thermoMediterranean” of bushes and thyme .

In short, the edaphic, lithological and plant cover conditions of this area suggest environmental conditions that are very unfavourable for agricultural activities, which, in turn, go a long way to explaining the reasons for which these lands have been abandoned. However, other aspects are also relevant in this respect such as the demographic and socioeconomic changes that have taken place in the study area over recent decades.

From 1900 to 1970 the population of both municipalities considered and the eastern part of the province of Murcia rose slightly. However, this was followed by a sharp decrease as many people, especially those related in some way with agriculture, left the area. This is reflected in the digitized land abandonment figures recorded for the same years. The population began to increase again at the beginning of the XXI century, due to non-Spanish immigrants, especially of German and British nationality, who moved into the area for the fine weather. In 2013, 18% of the population of the study area was non-Spanish and, of these, 72% were European (CARM, 2013).

Approximately 55% of the area is occupied by crops, mainly citrus. From 1989 to 2013, the area dedicated to crops declined, while the area dedicated to pasture, forestry and other activities increased, which may account for a large part of what are now considered abandoned lands.

III. METHODS

III.1. Cartography

Through the WMS (Web Map Service) offered by Cartomur (the Cartography Service of the Land Planning Authority of the Province of Murcia and IMIDA (Murcia Institute for Agricultural Research and Development) aerial images were obtained as a cartographic base for the study. The orthophotos corresponded to the years 1956, 1981, 2002 and 2011. In the case of 1981, the absence of photographic documents led us to use a rectified version for 1987 to at least localize the oldest case of abandonment at this time. The remaining cartographic information was obtained from the Geocatalogue of the Murcian Department of Agriculture and Water, a tool which facilitates access to different sources of geographical information available on line and catalogued by SIGA (Geographical and

Environmental Information System of the province of Murcia). Other layers of information were also obtained from the Spanish National Geographical Institute.

III.2. Cartographic digitalization of land abandonment by teledetection

The mapping analysis was carried out using free software tools for processing geographical information systems (GIS tools). The software used was gvSIG. Each of the orthophotos (scale 1:3000) was treated using a grid to determine the spatial distribution of abandoned lands. In the case of the 1956 and 1981 orthophotos, it was more difficult to locate the abandoned lands since the photographs were in black and white. Especially difficult was 1956 because of the quantity of land cultivated and the low quality of the images. This task was less complicated in the case of 1981 since abandonment was evident from the darker shades and the disorder and general untidiness of the abandoned lands. However, in the 2002 and 2011 orthophotos the difficulty was not in locating the abandoned lands (clearly visible) but in distinguishing land recently allowed to lie fallow from that which had been abandoned. In this case, we decided that land that had been fallow for more than two consecutive years (based on the orthofoto for 2009) would be classified as abandoned. It should be emphasised that it is easy to make an error because of the number of different scenarios possible in an area dedicated to agricultural activity as a result in part of changes in an agricultural policy which leads to alternating land uses.

It should be noted that the results obtained by observation of the orthophotos were, in most cases, verified in the field.

IV. RESULTS AND DISCUSIÓN

IV.1. Quantification and evolution of land abandonment

After digitalising the information, the different shapes of abandonment were evident for the different years, revealing how and where abandonment had occurred.

Four abandonment maps were constructed, one for each year studied. From these the notable increase in abandonment was evident from 1956 to 2011. The number of polygons counted increasing from 221 in 1956 to 3,037 in 1981, 8,199 in 2002 and 10,045 in 2011. Translating polygons into area meant that the total area abandoned in 2011 was 5,646 ha, which represents 14.6% of the study area and 34% of the area previously dedicated to crops (figures for 2013). In other words, during the last 50 years the area abandoned has risen from 0.6% of the total in 1956 to 14.6% in 2011. Between 1956 and 1981 (25 years) there was an increase of 1,934 ha, and between 1981 and 2002 (21 years) an increase of 2,150 ha.

IV.2. Spatial distribution of land abandonment

If we superimpose the shape of abandonment over the relief map, it can be seen that from 1956-1981 the phenomenon affected mountainous areas or those close to the same, but also agricultural land with a less pronounced slope. It is only in recent times, with the arrival of the Tagus-Segura transfer canal that productivity has increased in the lower level

parts of the zone under study, which is a contributory factor to the abandonment of higher ground that previously had been cultivated in the search for the greatest cultivatable area possible since agriculture in those times was not intensive in nature. From 1981 to 2011 the area abandoned has grown mostly in gently sloping areas, presumably as a result of changes in agricultural policy and market factors. In terms of the two municipalities that interest us here, Abanilla had 3,544 ha of abandoned land (15% of its total extension) and Fortuna 2,100 ha (14%).

As can be seen, until the 1970s and 80s, ceasing to cultivate the land was not such a pronounced practice as it has been in the last thirty years. In the first stage, land abandonment was associated with land productivity, changes in consumption and new agricultural techniques that made agriculture a much more intensive business. Since 1981 and Spain's subsequent entry into the European Union, abandonment has increased, not only due to the above reasons, but also reasons related with the European CAP.

IV.3. Age of land abandonment

Assuming possible errors, it was estimated that in 2011, 56.8% of the total land abandoned had been so for 10-30 years and 18.7% for more than 30 years. The areas abandoned for the longest time correspond to mountainous areas that did not suffer from the agricultural practices to which they were submitted and so have, in most cases, allowed plant colonisation processes to proceed as time progressed. More recent land abandonment has been a phenomenon affecting lower ground, especially in the marly depressions, where vegetal recovery is very slow (or absent) and processes of erosion, especially piping, are in strong evidence, increasing pre-existing areas of gullies and ravines.

It is also important to emphasise how lithology and soil type affect abandonment, as has been seen in other areas of the province of Murcia (Romero Díaz, 2003; Romero Díaz, et al., 2012; Robledano et al., 2014). On predominantly limestone lithologies and on Calcisols and Leptosols, which in the study area tend to coincide with mountainous zones, their poor accessibility and low pressure on their resources, has largely permitted, albeit slowly, the regeneration of the natural plant cover. In this situation, abandonment has improved the edaphic characteristics of the soils to withstand erosion by increasing the organic matter and nutrients content, and improving the soil structure. By contrast, the Calcáric Regosoles developed on marly lithologies have experienced substantial erosion processes, which occurred almost immediately after abandonment. In these poor and degraded soils recovery of the vegetal cover has been scant or even non-existent, despite the passage of many years since abandonment.

V. CONCLUSIONS

The eastern zone of the province of Murcia counts with large areas of abandoned land and has seen a steady increase in the same since 1956. In recent decades abandonment has been provoked by the low productive capacity of the soil and a general decrease in yields. This process was later fomented by EU agricultural policies, particularly by the subsidies provided for certain crops, although the set-aside policies of the CAP have had little incidence.

After exhaustive analysis of the areas that have been abandoned using SIG tools, it was calculated that about 15% of the study area had been abandoned by 2011. In the same year, more than half of the abandoned plots (56.8%) had been abandoned for more than ten years. These figures are the key for future investigations into the repercussions of land abandonment as a function of the time elapsing since cultivation ceased.

It has been seen that the areas abandoned had been dedicated to dryland agriculture, particularly non-citrus fruit trees, especially almond, vine and olive.

The wide tracts of the zone that have been abandoned, mostly in areas subject to strong erosion processes, should act as a warning to regional authorities concerning the measures that are necessary to mitigate degradation processes, which involve the loss of quantities of soil. These measures must be taken urgently to ensure that the area as a whole remains sustainable from a production and conservation point of view.