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A fading mountain world? Landscape change driven by the economic and socioecological fabric of the Pyrenean area around Cadí-Moixeró Natural Park (1900-2020)

Ferran Canudas

KEYWORDS: **mountain economies, ecological and social transitions, landscape change, rurality.**

JEL CODES: **O13, Q01, Q57, R14.**

Industrialization and the subsequent transition to a tourism-based economy, together with the globalization of the agri-food system, have transformed how natural resources are used, the relationship between the local population and the landscape, and the biodiversity of mountainous areas. This article analyses the agrarian and environmental history of the area surrounding Cadí-Moixeró Natural Park, in the Catalan Pyrenees, from the early twentieth century to the present day, through oral testimonies, old photographs, demographic and socioeconomic data, and a GIS-based map analysis of changes in land use and the location of the resident population. The results show that economic tertiarization and the end of integrated productive land management have given rise to a forest transition towards less landscape diversity. This threatens the entire range of landscape ecosystem services that make the area appealing for a more diversified and sustainable mountain tourism model.

¿Un mundo montañoso que se desvanece? Cambio paisajístico impulsado por el tejido económico y socioecológico del espacio pirenaico al Parque Natural del Cadí-Moixeró

PALABRAS CLAVE: **economías de montaña, transiciones ecológicas y sociales, cambio de paisaje, ruralidad.**

CÓDIGOS JEL: **O13, Q01, Q57, R14.**

La industrialización y la posterior transición hacia una economía basada en el turismo, junto con la globalización del sistema agroalimentario, han transformado el uso de los recursos naturales, la relación entre la población local y el paisaje y la biodiversidad de las zonas montañosas. Este artículo analiza la historia agraria y ambiental del entorno del Parque Natural del Cadí-Moixeró, en el Pirineo catalán, desde principios del siglo XX hasta la actualidad, a través de testimonios orales, fotografías antiguas, datos demográficos y socioeconómicos, y un análisis cartográfico basado en SIG de los cambios en el uso del suelo y la ubicación de la población residente. Los resultados muestran que la terciarización económica y el fin de la gestión productiva integrada del territorio han dado lugar a una transición forestal hacia una menor diversidad paisajística. Esto amenaza toda la gama de servicios ecosistémicos paisajísticos que hacen que la zona sea atractiva para un modelo de turismo de montaña más diversificado y sostenible.

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1. INTRODUCTION

For centuries, European mountain economies have shared common traits that have set their economies and demographics apart from those of their respective lowlands (McNeill, 1992). In the transformation towards capitalism, liberal states applied a series of successive policies in mountainous areas designed to change their communal institutions and natural resource management methods to ensure that they benefited the capitalist economies and societies undergoing industrialisation and urbanisation that were sweeping through the rest of the territory in the 19th century (Vaccaro, 2008). Throughout the 20th century, mountainous areas had a tendency towards "deagrarianization" and to follow patterns and transformations that were strongly determined by the socioeconomic evolution of metropolitan areas (García Ruiz *et al.*, 1996; Tulla *et al.*, 2003; López-i-Gelats, Milán & Bartolomé, 2011). They became tourist destinations and places where leisure consumers with enough money purchased second homes (Arqué Garcia & Mateu, 1982; Marsden, 1999; Armesto, Gómez & Cors, 2018; Schirpke *et al.*, 2019). Historically, these socioeconomic transformations have shaped the composition and structure of the landscape in a closely related, mutually dependent manner (Marull *et al.*, 2023; Tello, 1999, 2013; Walsh, 2005; Pèlachs *et al.*, 2009; Gassiot & Pèlachs, 2017). The socioecological focus of this research seeks to link social agrarian history to environmental and landscape history as interwoven elements that have evolved in tandem. Landscape analysis in environmental history is a growing, hybrid research area that encompasses the social and natural sciences with new as well as diverse methodological and epistemological approaches (Cronon, 1983, 1996; McNeill, 1992; Marcucci, 2000; Farina, 2000; Boada & Saurí, 2002; Grove & Rackam, 2003; Tello *et al.*, 2005; Badia *et al.*, 2008; Armiero, 2011; Marull *et al.*, 2014). The aim of this paper is to analyse the social and ecological history of the towns and landscapes of Cadí-Moixeró throughout the 20th century and up to the present day. This analysis will help identify periods of change, analyse the causes, and observe the impacts. The working hypothesis is that the mountain economy and society studied has shifted from activities associated with the land to tourism over the last century. This has led to the abandonment of traditional land uses and knowledge, which has had a major impact on the composition and environmental state of the landscape. Since social, cultural and economic processes have played a key role, we can also analyse these landscape changes as a territorial expression of those driving forces.

In the first half of the 20th century, the agrarian activities of the economic and social model of the Catalan Pyrenees that stemmed from liberal agrarian transformations and the growing demand for food, timber, fibres and other materials and energy in industrialising urban areas were still very much based on long-standing practices such as transhumance, the production and export of cheese and other dairy products, work-horse rear-

ing and some subsistence farming, except for apples and potatoes, which were exported (Ferrer, 2017). However, traditional transhumance began to decline (Vilà, 1958, 1991; López-i-Gelats *et al.,* 2016) as the lowlands developed agricultural specialisation and intensification processes.

In the second half of the 20th century, the role of the Pyrenees as a supplier of food, livestock, timber and other natural resources began to shift, which gave rise to a growing "deagrarianization" process in rural mountain economies (López-i-Gelats, 2010; Vaccaro & Bertran, 2007). This transformation was a common feature of Spanish rural society as a whole, especially between 1950 and 1990 (Collantes, 2007; González de Molina *et al.,* 2020). However, this abandonment of mountain agriculture was a much swifter, more profound process in mountain areas, especially in the highest and steepest parts of Europe (García Ruiz *et al.,* 1996). In the Alps, for example, 40% of farms were abandoned between 1980 and 2000 as a result of the drop in profitability (Cocca *et al.,* 2012). The reasons for this were varied and included the common agricultural policy (CAP), agricultural mechanisation, technological developments (MacDonald *et al.,* 2000) and migration to industrialised areas and large towns (Collantes, 2005). The intensification of agricultural land uses, with the arrival of machinery and agrochemicals, triggered a process in which mountain areas moved towards a market-based economy (Arqué *et al.,* 1982; García Ruiz & Lasanta, 1990). This capitalisation of agriculture led to the end of animal traction as a source of farm power and the replacement of wood fuel with fossil fuels as energy sources (Boada, 2013). This led to the abandonment of traditional livestock and forestry activities (García Ruiz *et al.,* 1996) in less accessible environments where mechanisation was more challenging (Tulla, 2019; Guirado, 2007; Tasser, Ruffini & Tappeiner, 2009). In turn, Spain's accession to the European Economic Community in the 1980s had a direct effect on the viability of cows' milk production due to the introduction of milk quotas, which resulted in the closure of a large part of the farms and the concentration, increase in scale, and mechanization of those that have remained (Mármol, 2014; Parajuá, 2022).

In the Pyrenees, as the rural exodus and the cessation of agrarian activities intensified, the economy was increasingly geared towards tourism and second homes (Collantes, 2001; Ayuda & Pinilla, 2002). In the late 1970s, mountain areas began to undergo economic tertiarisation based primarily on winter tourism, which despite contributing to maintaining a certain resident population in some main centres linked directly or indirectly to the services derived from tourism, it has also accelerated the deagrarianization and depopulation of the smaller, remote and difficult-to-access centres (Schirpke *et al.,* 2019; Sanz Menéndez, 1985). The winter tourism sector, along with construction of second homes, prompted an explosion in tourist accommodation throughout the Pyrenees, which

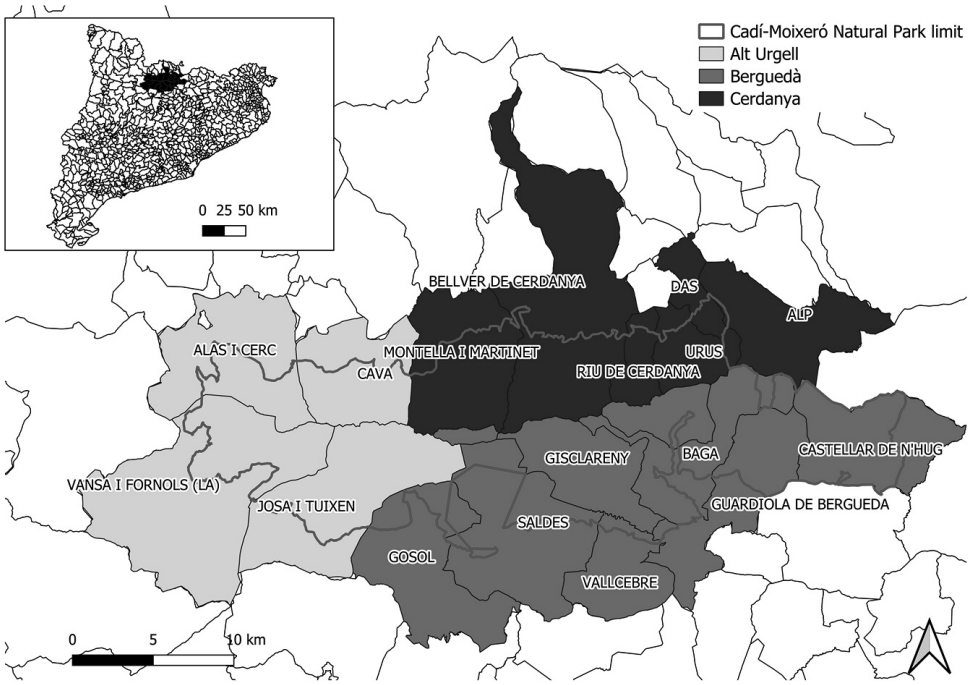
led to a gentrification process that drove up the prices of main residences and had a profound and direct impact on the local population (Gómez, Armesto & Cors, 2019). This economic transformation led to social restructuring, and the influence of urban (*i.e.*, non-agricultural) interests and lifestyles began to grow on rural areas (López-i-Gelats, Tàbara & Bartolomé, 2009a): recreational activities, agritourism, hiking and other activities that often clashed with the traditional practices and knowledge of the local population (García Ruiz *et al.*, 1996; Fernández Giménez & Fillat, 2012). Meanwhile, a series of conservation policies were developed in the early 1980s with the aim of preserving landscapes (Vaccaro, 2008). During this period, the Catalan government enacted the Law on Natural Areas (1985) and the Plan for Areas of Natural Interest (1992) shortly after creating Cadí-Moixeró Natural Park in 1983 (Vaccaro, 2008). Although a large part of the protected areas were located in mountainous terrain and more isolated from human settlement (Aigüestortes and Estany de Sant Maurici, 1955; Pedraforca, 1982; Cadí-Moixeró, 1983), at the same time other types of landscapes were protected closer to more highly frequented and historically more modified areas (Volcanic Zone of the Garrotxa, 1983; Delta de l'Ebre, 1983; Aiguamolls de l'Empordà, 1983; Poblet, 1984; Delta del Llobregat, 1987) This boom in conservationist policies was motivated as a response to the environmental impacts of Franco's developmentalism (Gil-Farrero, 2023) and also by a change in social perception about rural mountain landscapes. What had previously been regarded as a productive region came to be seen as a place for contemplation (Guirado, 2011; Vaccaro & Beltrán, 2007), where the beauty of the landscape and the conservation of its natural assets were perceived as objects of commodified consumption (Marsden, 1979; Santamaria, Vaccaro & Beltrán, 2014), associating the field as a space of purification for urban visitors (Lapping, 2006). Despite the fact that the conception of nature as an untouchable element, virgin and unmodified by man dates back to the romanticism of the 19th century (Gil-Farrero, 2020) and the wilderness ideology coming from the United States (Cronon, 1996; Grove & Rackam, 2003), it becomes a key point in the creation of protected areas, closely linked to the development of tourism, which a romantic vision of nature and rurality (Guirado, 2011): unspoiled landscapes detached from human activity that must be protected. In the 21st century, the service sector remains the economic backbone of the Pyrenees, underpinned by winter tourism, hiking and leisure tourism (Tulla *et al.*, 2003; Prat, 2022).

The article is divided into five parts: an introduction to the location and context of the study area, a description of the methodology and information sources, the main results obtained, and the conclusions.

2. STUDY AREA

The study area for this research consisted of all municipalities in Cadí-Moixeró Natural Park, which was declared a protected area through the Decree of the President of the Catalan Government published in the Official Gazette of the Catalan Government (DOGC) on 24 August 1983. It is a mountainous region in the Catalan Pre-Pyrenees that includes 17 municipalities belonging to the *comarcas* of Berguedà, Alt Urgell and Cerdanya. It consists of 85,317 hectares, 41,060 (48%) of which lie within Cadí-Moixeró Natural Park.

MAP 1
Study area of Cadí-Moixeró: *comarcas* and settlements, 2021



Source: prepared by the author based on data from the Databank for Catalonia at the Demographic Studies Centre (Centre d'Estudis Demogràfics), https://ced.cat/en/infraestructures/databank-for-catalonia/

The mountains of Cadí and Moixeró, joined by the saddle of Tancalaporta, form a mountain range that stretches for over 30 kilometres, with the Vulturó (also known as the Puig de la Canal Baridana) as the highest point (2,648 metres above sea level). The steep relief of the mountain range forms a complex structure, with channels, cliffs and escarpments on its north face. This orographic and geological formation consists primarily of Devonian limestones and carbonaceous shale with an irregular, complex terrain, features

that make it ideal for a wide range of habitats and biodiversity. The great plain of Cerdanya forms a unique habitat in the Pyrenees, where flat terrain is very scarce. Nestled between the Serra del Cadí and Ensija mountain ranges lies Pedraforca, a mountain that has become a great national symbol and was declared a Natural Site of National Interest (PEIN in Catalan) in 1982. It is also part of Cadí-Moixeró Natural Park.

According to data from the Statistical Institute of Catalonia (IDESCAT), in 2022 there were 9,828 inhabitants in the 17 municipalities that make up Cadí-Moixeró; 44% of these people lived in the two main centres of Bellver de Cerdanya and Bagà (Table 1). These are the two most important towns in the region. Historically they have served as *subcomarca* capitals and have absorbed many of the people who have abandoned the most isolated, and most poorly communicated farming villages. Therefore, the region's settlements are generally very small and dispersed and the year-round resident population is small. It also includes Catalonia's least populous municipality (Gisclareny, with 28 inhabitants).

TABLE 1

Municipalities and demography of Cadí-Moixeró villages, 2022

Municipalities	Inhabitants
Alàs i Cerc	329
Alp	1,717
Bagà	2,167
Bellver de Cerdanya	2,176
Castellar de N'Hug	176
Cava	51
Das	267
Gisclareny	28
Gósol	233
Guardiola de Berguedà	918
Josa i Tuixent	105
La Vansa i Fórnols	166
Montellà i Martinet	615
Riu de Cerdanya	100
Saldes	298
Urús	214
Vallcebre	268

Source: Databank for Catalonia at the Demographic Studies Centre (CED).

Cadí-Moixeró has unique ecological and sociocultural features that help explain why it was categorised as a protected natural area early on. It is also one of the most underex-

plored mountain environments in terms of landscape change, despite the fact that it is home to biodiversity hotspots which provide many important ecosystem services (Jiménez Olivencia *et al.,* 2021). After a complex past, which we will present through statistical data, land use maps, oral testimonies and old photographs, the main economic activity that still maintains certain contingents of resident population is now the services activity, with hiking and snow tourism as the key players.

3. METHODOLOGY

The working methodology used for this research was based on the participatory action research approach (Guzmán *et al.*, 2013; López García *et al.,* 2021) taken by L'Arada, which has also been applied in projects such as L'Actua (Baix Solsonès). This methodology is underpinned by networking and participatory work to generate an environment for social creativity with the aim of encouraging joint public and community territorial action. It is categorised as a participatory methodology for social intervention, specifically *sociopraxis* (Rodríguez Villasante, 2006). This practice advocates for learning through social movements, and the potential and popular creativity practised within the framework of critical science. Unlike other methodological approaches, it pursues collective social creativity and joint action.

The project "Betula: Comprehensive Local Promotion of the Towns of Cadí-Moixeró", run by the cooperative L'Arada-Creativitat Social, seeks to make joint progress towards the sustainability of the towns and small villages within the protected area through a territorial strategy focused on enhancement of the different dimensions of the landscape (as an economic asset, and as an element that unites and energises the territory). Since 2018, the project has highlighted the effects of socioeconomic and ecological changes on the landscape, seeing these changes a cumulative territorial expression of local and global socioeconomic history. For the municipalities involved in the project, which have been suffering from population decline for decades, promotion of the landscape's community values is an essential tool to enhance and enrich their collective identity, which in turn help strengthen social cohesion and promote local dynamism. The project is evaluated and monitored by the Steering Group, which is made up of public entities (Cadí-Moixeró Natural Park and several municipalities in the region), social and cultural entities (Reviure les Valls, Grup de Recerca de la Cerdanya, Institut d'Estudis Ceretans, Grup d'Amics de Montellà, Àmbit de Recerques del Berguedà, Valls del Pedraforca) and local people. The methodology used to obtain the information for this article is shared between the Betula project and the author of this article.

The participative approach of the project towards collective action has allowed the development of initiatives to enhance the landscape, through dissemination and territorial pedagogy. In relation to the community perspective, the project seeks to promote social organization to deal with the shortcomings of the territory, as is also developing similar community-based processes in other rural territories such as Baix Solsonès, through the Actua project and the Territori de Masies Coop rural cooperative. By way of example, during the last year Betula has accompanied a group of neighbours in the opening of a popular library in the small village of Saldes, managed collectively with a stable socio-cultural program. Betula is currently carrying out future workshops with the local population where they examine, among others, the challenges brought about by the rising cost of housing and the difficulties of access to buying food in regional capitals far away, to foreshadow alternative scenarios of economic, social and territorial change. The specific sources of information used to carry out this research are outlined below.

3.1. Oral testimonies about the territory: workshops, interviews and surveys

Throughout the Betula project (2018-23), 20 participatory workshops were carried out with a range of territorial stakeholders: social and cultural entities linked to the Steering Group and others such as the Traça Cultural, Associació de Veïns de la Molina and Sindicat d'Habitatge de la Cerdanya, public authorities (Parc Natural del Cadí-Moixeró, Reserva Nacional de Caça del Cadí and several municipalities in the region), private companies, farmers and the tourism sector. Three types of workshops were conducted: a) workshops on old photographs (meetings with local residents to collect old photographs of the villages and the surrounding areas to identify landscape and social changes and their causes); b) workshops on territorial diagnosis (meetings with local residents to agree on the socioecological history of the territorial changes, arrange them chronologically and classify them according to whether their implications are perceived positively or negatively); and c) workshops on proposed actions (that could be executed by local stakeholders to address or minimise negatively perceived changes and enhance positively perceived changes). Thirty-five life history and landscape memory interviews were carried out (56% with men and 44% with women) on the history and memory of the landscape. These were designed to shed light on life in the towns in Cadí-Moixeró throughout the 20th century and on key social, economic and ecological changes. The interviewees were between 50 and 100 years of age and had lived their whole lives, or most of their lives, in one of the towns or villages in Cadí-Moixeró.

3.2. Map analysis of land use and land cover changes throughout the 20th century

To verify the oral testimonies of the changes that had affected Cadí-Moixeró throughout these decades, land cover in different periods was analysed. The resulting maps, combined with the workshop content and discussions, were used to outline a history of the landscape and people's memory of its transformation. The methodology for creating the maps varied depending on the cartographic sources that were available. These differences may have caused minor comparative errors. However, we were interested in observing general patterns and trends, which are clearly shown on the maps presented.

Map 3 was created by digitising maps from the Spanish National Geographic Institute (IGN), from the handwritten paper documents stored in the institution's historical archive. Digitisation with GIS offered the possibility of comparing these with later sources. The fact that these maps were hand drawn meant that the margin of error was greater than with digital satellite maps, and the results were not as accurate as those of subsequent decades. The methodology we followed for 1956, 1987 and 2017 was different. For Map 4, digitisation was carried out by superimposing the 1927 layer with the orthophotomap obtained by photointerpreting the digitised aerial photos of the American flight of 1956 and digitising the changes. This re-digitisation was carried out for Alt Urgell and Cerdanya only, since the Berguedà *comarca* had already been digitised by Barcelona Provincial Council. Map 5 was obtained from the reclassification of the Ministry of Agriculture, Livestock, Fisheries and Food of Catalonia's Map of Crops and Uses. Lastly, Map 6 was obtained from the reclassification of the 2017 Map of Land Uses and Cover in Catalonia, prepared by the Remote Sensing and Geographic Information Science Research Group.

Given the problems associated with differentiating between specific types of land cover from the American flight of 1956, the direction of the land use and land cover changes between periods was analysed by homogenising the classification into broad land cover categories to make them comparable and calculate its absolute and relative extents with GIS: 1) forest (forest cover with varying degrees of density); 2) pastures and scrub (open spaces without forest or crops, including low-lying vegetation and grazing areas); 3) crops (herbaceous and woody crops); and 4) unproductive areas (developed land and other biologically unproductive land such as rocky areas and escarpments). The analyses of the changes in land covers and the resulting uses have been based on the comparison of the trends of the different types of land covers throughout the 20th and 21st centuries, which have made it possible to determine the evolution of the landscape in relation to change of uses linked to the economic transformation of this mountain territory. The software

used was ArcMap 10.3 and QGIS 3.10, the scale used was 1:10,000, and processing was carried out with the UTM ETRS_1989, TM31 projection.

3.3. Photographic research and diachronic analysis of landscape change

Comparing photographs of the same landscape taken at different times *(diachronic analysis)* makes it possible to identify changes in the vegetation that characterises the landscape –and the spatial distribution of the vegetation– (Métailié, 1986; Veblen & Lorenz, 1988; Hendrick & Copenheaver, 2009; Debussche, Lepart & Dervieux, 2004). The old photographs were obtained by organising residents' meetings, where the photos were scanned, coded and documented in a participatory action research, and also through the historical archive of the Hiking Club of Catalonia and the Digital Memory of Catalonia project. A total of 605 photographs were compiled: 27% were taken between 1900 and 1930; 16% between 1930 and 1960; 19% between 1960 and 1990; 8% between 1990 and 2020; for 30%, the date was unknown. Fifty-three of these data had photos for diachronic analysis, and five of which were selected based on the similarities between the replicated and original photos. The new photographs were taken during fieldwork by the L'Arada team.

Finally, to interpret the changes in land uses and land covers of these mountain landscapes, the information inferred from the digitized maps has been combined with that provided by the oral history about the management activities of these territories, and with the photographs of the population that has participated in the workshops, to finally made a diagnosis by joining all of them demographic and statistical data from available primary sources, and previous published studies on the study area.

4. FROM TRADITIONAL MOUNTAIN FARMING TO DEPOPULATION, LAND ABANDONMENT AND TOURISM

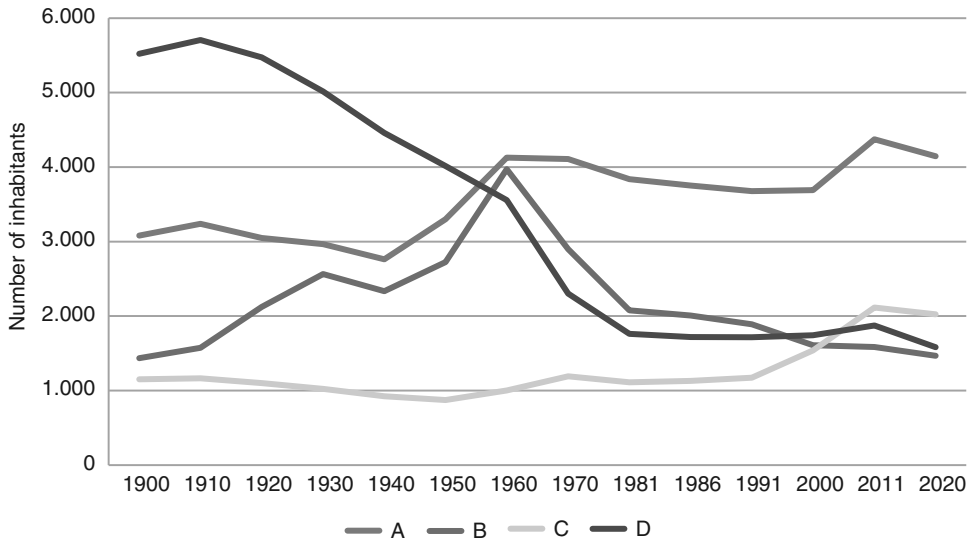
The results are presented from the analysis of the demographic situation and settlement pattern, the landscape configuration, the socioeconomic characteristics of the period, and the main vectors of change, which were identified based on life histories, maps, and statistical data. For each of the sections, a comparison is made for the four periods defined by the interviewees and attendees of the participatory workshops, who identified key historical moments linked to vectors of change: traditional agriculture, livestock and forestry model, still partially based on self-sufficiency (1900-1950); rural depopulation and loss of agricultural activity (1950-1980); economic tertiarisation and abandonment of envi-

ronmental management (1980-2000); current territorial model (2000-2020): economic dependence and gentrification.

4.1. Demographics: changes in the resident population, its distribution in the territory, and the habitat, 1900-2020

In the first half of the 20th century, the population of Cadí-Moixeró continued to decline, a pattern that had been seen throughout the Pyrenees since the 1860s (Cervera *et al.*, 2019), when the subsistence economy entered a crisis due to the imbalance between the population needs and the existing resources (Guirado, 2011), partly due to the non-availability of land for many (Aldomà *et al.*, 2004). Although depopulation was a widespread trend, demographic changes had historically varied according to the territorial development of each part of Cadí-Moixeró, which presented major differences. To observe this in detail, the villages in the study area were divided according to their location and type of farming (Fig. 1).

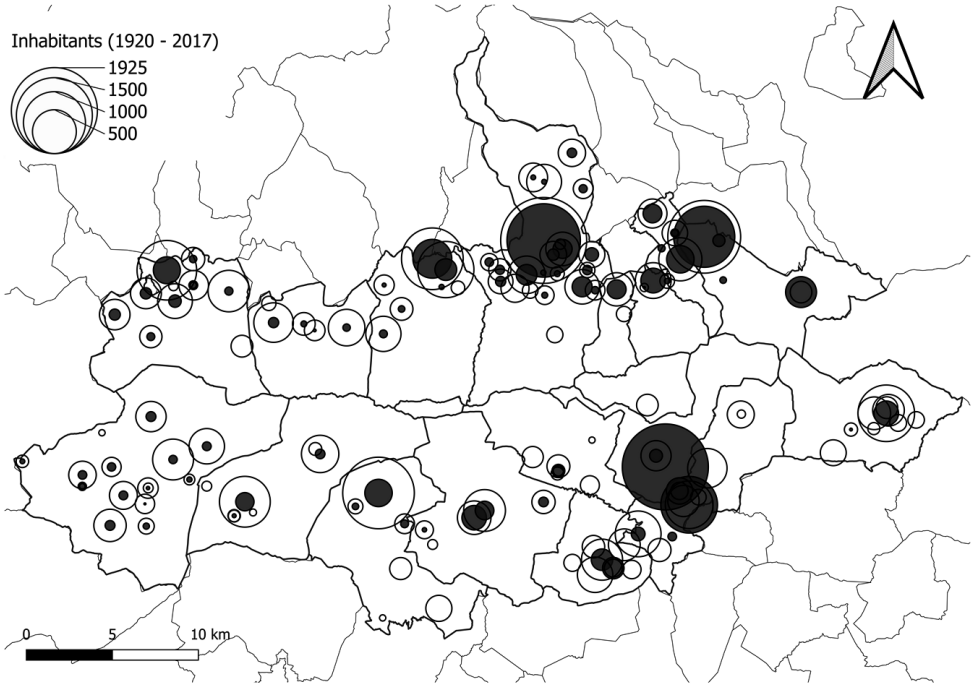
FIGURE 1
Demographic trends in Cadí-Moixeró according to habitat and economic types, 1900-2020



Source: prepared by the author based on data from the Databank for Catalonia at the Demographic Studies Centre (CED). A) Bellver de Cerdanya and Bagà (*subcomarca* capitals); B) Vallcebre, Saldes and Guardiola de Berguedà (villages linked to mining since the second half of the 19th century); C) Alp, Urús, Rio de Cerdanya and Das (villages soon linked to tourism due to the nearby ski slopes); D) Castellar de N'Hug, Josa i Tuixent, Gósol, La Vansa i Fórnols, Gisclareny, Cava, Montellà i Martinet, and Alàs i Cerc (villages linked to agriculture and livestock farming until a later stage).

Between 1900 and 1950, traditional agricultural and livestock farming villages suffered most from depopulation (Fig. 1). These were also the smallest and most sparsely populated settlements, with isolated farmhouses on high, steep terrain. This rural trend was replicated, albeit to a lesser extent, in the settlements that would go on to become tourist hotspots. By contrast, the population of the villages of Alt Berguedà increased due to mining. As we can see in Map 2, the most distinctive feature was a series of small, similar-sized settlements that lay at the intersection between high mountain meadows, forests and small crop areas. The location of these settlements made sense, since it provided the population with access to the natural resources they needed to live: herds, meadows, crops and forests.

MAP 2
Settlements and inhabitants according to its location in Cadí-Moixeró, 1920 (white) and 2017 (black)



Source: prepared by the author based on data from the Databank for Catalonia at the Demographic Studies Centre (CED) and Esteve (2003).

The spatial distribution of the population became increasingly unequal and unbalanced as the 20th century progressed and until present-day (Map 2). Although many people em-

igrated to the big cities, people also moved within the Cadí-Moixeró area. The population decline mostly affected small mountain settlements, whose inhabitants moved to villages in lower-lying areas increasingly dependent on jobs generated by tourism. Thus, the still-inhabited parts in the highest areas of the Cadí (traditionally linked to agricultural activity), where the climate conditions were harsher and the terrain hindered accessibility, were the first to suffer from depopulation. Thus, towns such as Bagà and Bellver de Cerdanya, which served as *subcomarca* capitals, absorbed many of the people who had left the scattered houses of the higher settlements. This population redistribution helped alleviate the population drain that affected the study area as a whole.

During that same period, tourism was consolidated in the municipalities of Cerdanya and provided the residents with other jobs, while in those years the tourist activity was consolidating in the municipalities of La Cerdanya. The lack of opportunities in agriculture and the closure of dairy cooperatives and coal mines were offset by new jobs in the only sector that was still active: services related to tourism, hotels, and second homes. The intensive construction of housing developments, with the successive real estate bubbles of the late 20th century (Naredo, 1996, 2021), gave rise to modest population growth in the La Cerdanya villages with links to the ski resorts of La Molina and La Masella, thus increasing the relative overdevelopment of the largest towns in relation to the smaller settlements. This trend, especially from the 1990s (Fig. 1), is also observed in other parts of the Pyrenees where economic tertiarization is more present: between 1991 and 2000 the population of Alt Pyrenees and Aran goes from just over 59,000 inhabitants to almost 65,000 (Guirado, 2011). The profile of these new arrivals, in the case of Cadí-Moixeró, were regular visitors and skiers from metropolitan area of Barcelona, who owned accommodation in Cerdanya, but who did not live there all year round.

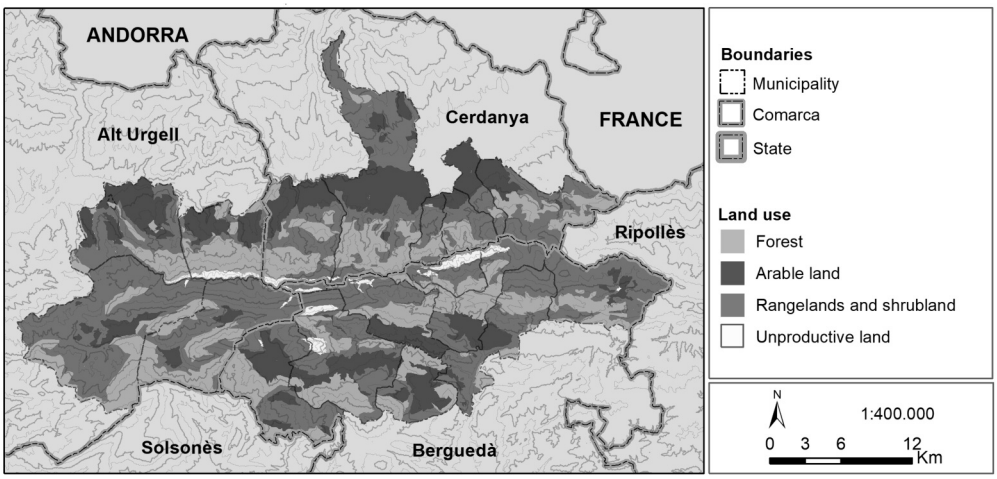
4.2. Changes recorded in land use and land cover maps, 1920-2020

In the early 20th century, the human impact on the landscape in mountain villages was significant and reflected an economy that was still strongly based on self-sufficiency. The crop areas, together with extensive forestry and livestock farming, gave rise to a highly diverse, humanised landscape. Map 3 reveals the basic structure of the landscape according to broad land uses and land covers calculated with GIS on the digitized maps available that have been described in the methodological section. Since these are not cadastral maps and therefore do not show the topographic elevation of each plot, the 1920 map served only to identify the location of large landscape units characterised by the dominant vegetation, while overlooking other, smaller mosaics that undoubtedly existed within these larger units. Despite this shortcoming, Map 3 reveals that each settlement was sur-

rounded by crops, which were used for food for the inhabitants and fodder for livestock in winter. These crops were surrounded by a forest matrix, both uphill and downhill, although the dominant species of each wooded area probably varied with altitude and had different uses. Natural meadows began to appear at a certain elevation, depending on whether the areas were in the sun or shade, where the livestock grazed in summer, and which were covered with snow in winter. In general, 50% of the land was covered with pastures and scrub and 20% with crops, which occupied the few flat areas near settlements. Forest cover accounted for no more than 30% and there was very little unproductive land.

MAP 3

Land uses and land covers in Cadí-Moixeró, 1920

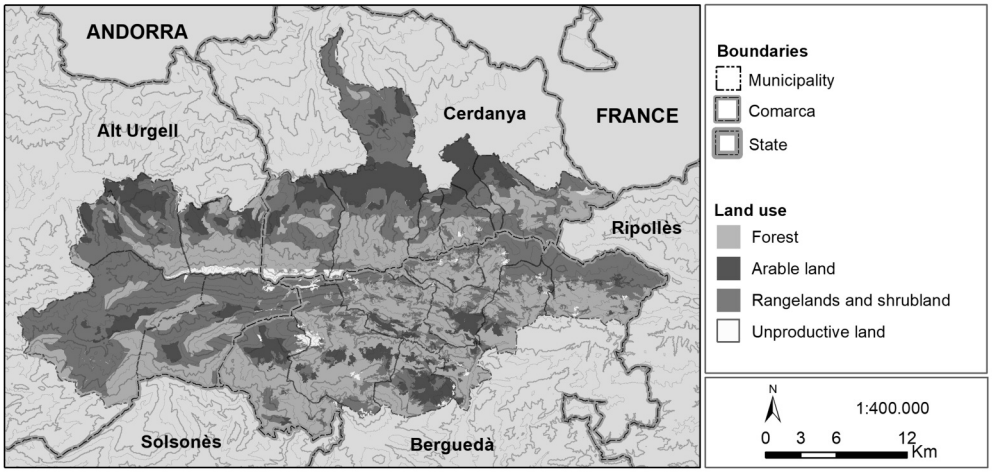


Source: prepared by L'Arada based on maps from the National Geographic Institute (IGN), https://www.ign.es/web/ign/portal

The contemporaneous transformation of the energy model in the era of cheap oil, with the arrival of electricity in the *comarca* and *subcomarca* capitals of the Pyrenees and the spread of butane cylinders in the 1960s, accelerated the settlement hierarchy and landscape homogenisation processes by reducing firewood harvesting and putting an end to charcoal production (Cervera, 2017; Cervera *et al.,* 2019; Maynou Felker, 2021). The growing use of cement in construction, including the cement produced at the Asland factory in Castellar de N'Hug until its closure in 1975, also exacerbated the declining forestry. This, coupled with the loss of crops and extensive pastures due to the end of transhumance (Vilà, 1958, 1991), expedited the abandonment of productive activities in the area (Map 4). This dynamic was compounded by the execution of various reforestation plans in some parts of Cadí-Moixeró between 1960 and 1970, promoted by the Forestry District and

later by the Spanish Nature Conservation Institute (ICONA) (Casals, 2005; Cervera, 2017; Cervera, Garrabou & Tello, 2015). The main reason was derived from the need at state level to have greater woodworking resources. According to the Cadí-Moixeró Natural Park, these replanting mainly affected land –especially public one– that was formerly arable or pastureland and which, with the abandonment of the rural world, became inactive. Generally, and according to the same source, these replanting was done with native species such as Scots pine *(Pinus silvestris)* and Black pine *(Pinus uncinata)*, although there is a small area with non-native species such as cedar. In some cases, during the replanting, some good pastures were damaged to plant pines, which, given the height, have never been able to develop properly.

MAP 4
Land uses and land covers in Cadí-Moixeró, 1956



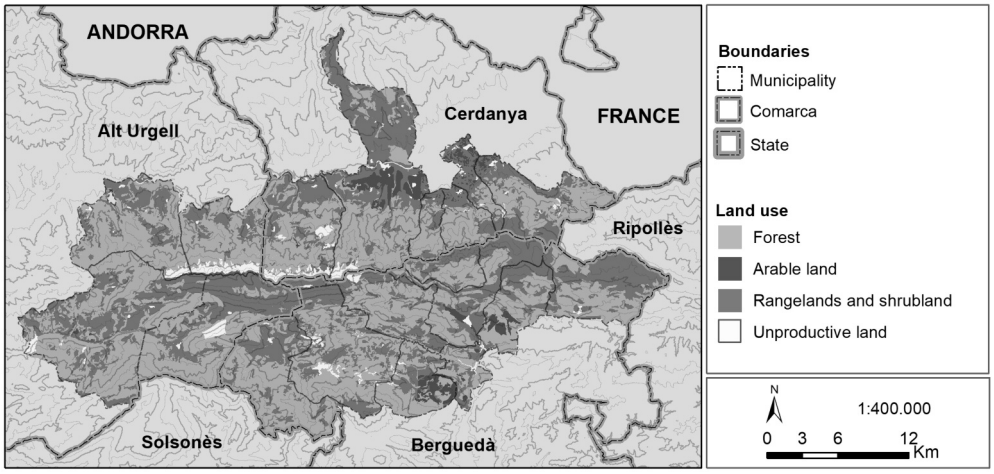
Source: prepared by L'Arada from the 1956 land cover map by the Technical Office for Land Planning and Analysis of Barcelona Provincial Council (DIBA) (https://www.diba.cat/es/web/directori/oficina-tecnica-de-cartografia-i-sig-local) and digitisation of the American flight of 1956.

To the end of working cattle and transhumance, which drastically reduced horse and sheep breeding due to the mechanization of the countryside and the Green Revolution, have been added the abandonment of many agro-livestock activities and the closure of farms, all generating a strong tendency towards uncontrolled reforestation (López-i-Gelats *et al.*, 2009b). Since the early 20th century, forest cover has increased by 9,670 hectares (38.42%). This translates to a 32% reduction in croplands and a 10% reduction in meadows and scrub. By 1956, 41% of Cadí-Moixeró was already covered by forest, at the expense of pastures and crops, which represented 43% and 13%, respectively. The croplands that were abandoned first were those that lay furthest from settlements, and only

those that were easy to mechanise remained. Forests began to colonise the abandoned areas and grew in both surface area and thickness. The natural reforestation was fast also taking into account the ease of Scots pine, the majority forest species in the natural park, to reproduce and colonize land.

The growing social demand to visit and stay in the mountains gave rise to the construction of large housing developments and second homes during that period. By 1981, this type of housing already accounted for 36% of all dwellings in the towns of Cadí-Moixeró, and this figure continued to rise. This had a considerable impact on the composition of the landscape, with an increase in unproductive land, and even distorted the architectural and cultural heritage of some mountain villages. Map 5 shows how the areas that were kept as pastures were steadily shrinking and were surrounded by woodlands that separated them from each other. The only exception was the alpine meadows, which were high enough to stop the advancing forest that continued, driven by the climate change process that was already under way. Forest cover had increased by 35% compared to 1956, with a 69% reduction in croplands in just 30 years. Pastures and scrub also decreased by 13%. Unproductive land had grown by 50% since the mid-20th century.

MAP 5
Land uses and land covers in Cadí-Moixeró, 1987

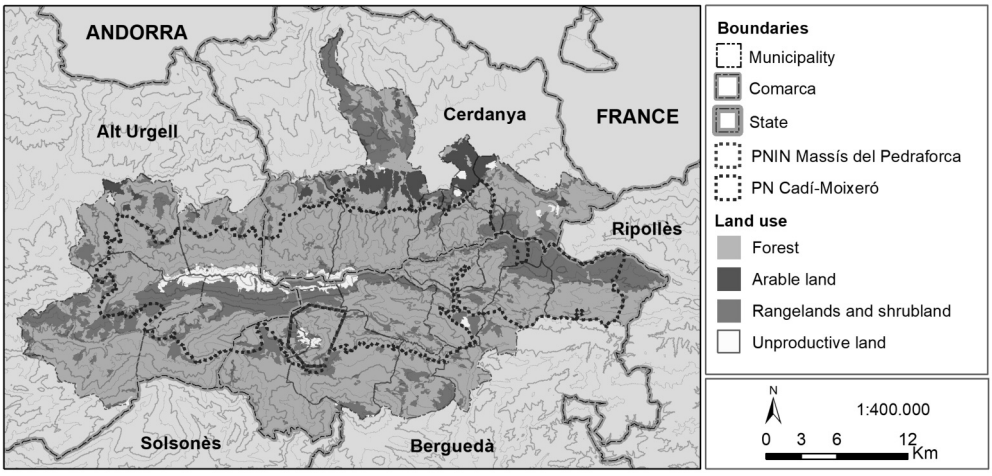


Source: prepared by L'Arada from the Ministry of Agriculture, Livestock, Fisheries and Food's Map of Crops and Uses (https://www.mapa.gob.es/en/cartografia-y-sig/publicaciones/agricultura/mac_1980_1990.aspx).

The post-industrial economy and society of the 21st century have continued to redefine the territories and landscapes of the study area. Cadí-Moixeró, which is recognised as a mountain tourism destination with a uniquely beautiful landscape, is becoming more and

more cherished by visitors, who use it to engage in recreational activities at weekends and during holidays. It is at this moment that the Cadí-Moixeró Natural Park is declared (1983). This declaration, according to the natural park itself, had little effect on the evolution of the uses inside, partly because the natural park has no jurisdiction over forestry or livestock management within the protected area. And partly because large repopulations had already been carried out at the time of the park's declaration. But since the 90s the park has contributed positively to the order of recreational uses with the creation of a network of grand and small trials (*senders de gran i petit recorregut*, GR and PR) of more than 400 kilometres in length, the limitation of access through barriers of forest tracks with no exit, the promotion of information centres (Bagà, Saldes, Tuixent, Martinet, Bellver, Castellar de N'Hug); and especially from 2019 onwards with the increase in the use of the territory for various recreational activities, with the hiring of new informants, private surveillance, arrangement of parking lots, dissemination of regulations for the use of the territory and others.

MAP 6
Land uses and land covers in Cadí-Moixeró, 2017



Source: prepared by L'Arada from the 2017 Map of Land Uses and Cover in Catalonia, prepared by the Remote Sensing and Geographic Information Science Research Group (Grumets, CREAF-UAB), https://www.creaf.cat/land-cover-map-catalonia

The high forest density and the extensive forest cover are the aspects that appeal most to these metropolitan visitors, who come in search of green spaces, silence and disconnection. The fact that no one works or takes care of these landscapes any longer means that the forest trend seen in recent decades has continued, i.e. increased surface area and density, and colonisation of alpine meadows and abandoned croplands. In fact, in just a hun-

dred years, forest cover has increased by 114% to cover 63% of the study area (53,920 hectares), while the cultivated area has decreased by 84% and pastures and scrub by 34%. The unproductive area has increased by 48% due to the construction of new tourist accommodation.

A comparison between Map 6 with maps 5 and 4 shows that forest ended up invading the croplands and meadows that existed as a mosaic around the settlements in 1956, until they virtually disappeared. Many mid-altitude meadows suffered the same fate, and the continuous line of alpine meadows around the ridges that join the highest peaks became thinner and even disappeared in some places. The predominance of conifers (mainly Scots pine and Black pine) is due not so much to the repopulation carried out, but to the forest management policy which, until the end of the 1980s, meant that the pine forest was prioritized over other species. The influence of the natural park and the new forest management policies have led to the respect of other forest species such as beech, oak, blades, birches, mosses, holly boxwood and others, increasing forest diversity, and the recovery of the area of beech forests, oak trees and other forest masses.

This loss of land cover diversity has been a common environmental change in high mountain areas (Casals, 2005; Cervera *et al.,* 2019; Verburg *et al.,* 2006), and has reduced habitat differentiation to the detriment of numerous plant and animal species that require open spaces and ecotones between landscape units (Macdonald *et al.,* 2000; López-i-Gelats, Milán & Bartolomé, 2011; Sitzia, Semenzato & Trentanovi, 2010; Lindborg & Eriksson, 2004). Therefore, this forest transition directly impacts ecosystem biodiversity, which is often reduced due to land cover homogenisation (Malavasi *et al.,* 2018; Cernusca *et al.,* 1998; Hunziker, 1995). Those responsible for Cadí-Moixeró Natural Park are conscious of this situation and have made efforts in recent years to open up spaces and break up the forest homogeneity in an attempt to enhance biodiversity and reduce the risk of fires. The controlled fires and selective clearing and cutting throughout the area have sought to diversify this landscape and return to an agroforestry mosaic, measures that have been taken in many other protected natural mountain areas (Fischer, Hartel & Kuemmerle, 2012).

4.3. Transformation of the landscape: diachronic analysis of photographs of the local population, 1915-2020

The changes described through cartographic digitization can be visualized through the historical photographs collected and discussed with the local population in the participatory workshops, which have been digitized and archived by the Betula project, com-

paring them with the current ones made by the author of this study from the same places and perspectives (Fig. 2). Some black-and-white photographs have limited resolution, and while they may be illustrative for visualizing major changes, they may be limited in clearly distinguishing other landscape details.

As can be seen in most of the photographs, the cultivated fields were located close to inhabited areas, taking into account the favourable topography of the land. Nevertheless, in many cases, an important part of that "flat land" had been built with levelled slopes in order to gain new arable spaces, as happened in most mountain areas. Photographs 2a and 2b reveal an increase in forest cover on the mountain slopes that extended as far as the highest alpine zones. Photograph 2a also shows more cultivated fields and greater crop diversity than photograph 2b, as a result of the loss of farming families. With respect to forest cover, photographs 2c and 2d reflect the same trend: areas that used to have pastures and crops are now covered with forest. This landscape change was replicated in much more isolated, higher-altitude settlements, as occurred in El Querforadat (photographs 2e and 2f), where forest has replaced pastures even at very high elevations. Photograph 2g from the 1970s shows that the landscape retained a certain degree of heterogeneity, with numerous cultivated fields over the entire mountainside and meadows in the most elevated zones. Photographs 2g and 2i reveal some dense areas of communal forest, which were reserved for forestry and were clearly demarcated from the other two uses. Photograph 2h shows how the increased forest cover, the abandonment of cultivated fields and the diminishing meadows blurred that clear structure, with spontaneous reforestation that tends to invade everything. The remaining open areas are alpine meadows, although these have also decreased. Photographs 2i and 2j show a much more pronounced change; in just 60 years, the entire mountainside has become covered in forest. There are still meadows on the inhabited side, but the more elevated, difficult-to-access croplands have been abandoned. This trend is clearly reflected in photographs 2k and 2l; the crops that were located on the edge of the settlements in the 1970s have been completely abandoned, along with the paths and trails, and have been replaced by trees.

4.4. Economy and work: a diagnosis of the main driving forces of landscape change, 1900-2020

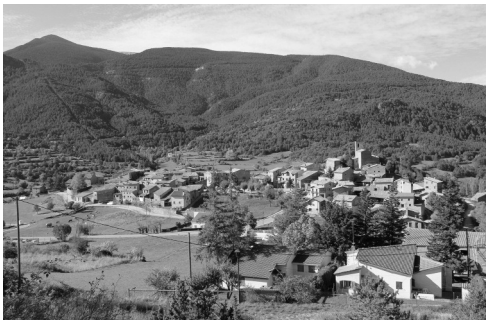
Despite being connected by commercial networks, livestock routes and seasonal work migrations with coastal territories and the plains quite far away, at the beginning of the 20th century the peasant and artisanal production of the study area was mostly articulated by small familiar exploitations, which intended to cover many of the basic needs of local communities to ensure their survival. Thus, agricultural work based on animal traction, fo-

FIGURES 2
Views of landscape changes in Cadí-Moixeró, 1915-2020

Figure 2A
View of Tuixent (Alt Urgell, 1940s)

Photograph provided by Dani Tarrés.

Figure 2B
View of Tuixent (Alt Urgell, 2020)



Photographer: Ferran Canudas.

Figure 2C
Views of Saldes and Pedraforca from Maçaners (Berguedà, 1915)

Photographer: Antoni Gallardo i Garriga.

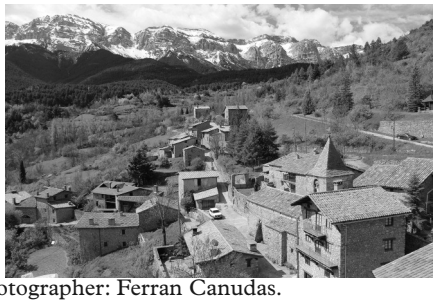
Figure 2D
Views of Saldes and Pedraforca from Maçaners (Berguedà, 2019)

Photographer: Josep Pujantell.

Figure 2E
Partial view of El Querforadat with the snow-capped Cadí in the background (Alt Urgell, 1926)

Photographer: Rossend Flaquer i Gil.

Figure 2F
Partial view of El Querforadat with the snow-capped Cadí in the background (Alt Urgell, 2021)



Photographer: Ferran Canudas.

FIGURES 2

Views of landscape changes in Cadí-Moixeró, 1915-2020

Figure 2G
Castellar de N'Hug, village and surroundings (Berguedà, 1970)

Photograph provided by Eduard de Cal Rossinyol.

Figure 2H
Castellar de N'Hug, village and surroundings (Berguedà, 1999)

Photograph provided by Eduard de Cal Rossinyol.

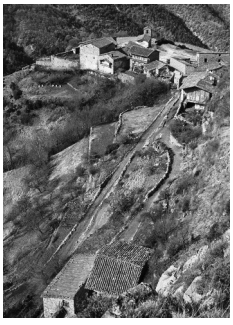
Figure 2I
General view of Urús (Cerdanya, 1962)

Photographer unknown.

Figure 2J
General view of Urús (Cerdanya, 2020)

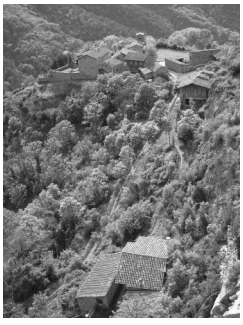
Photograph provided by Urús Town Council.

Figure 2K
Village in Cava (Alt Urgell, 1970)



Photograph provided by Joan Gispert.

Figure 2L
Village in Cava (Alt Urgell, 2008)



Photograph provided by Joan Gispert.

Sources: photos donated by residents who participated in Betula's workshops project and the author; Centre Excursionista de Catalunya (Hiking Club of Catalonia's archive), https://cec.cat/arxiufotografic/

cused primarily on minimising the need to buy provisioning daily goods from outside, but also on the sale of certain products such as potatoes, apples and pears. Livestock farming was small-scale and highly diversified with seasonal grazing between the plains and mountains through transhumance or transterminance involving sheep and goats. At the same time, there were regular trade in livestock (sheep, oxen, among others) through fairs and informal sales markets.

With the arrival of phylloxera and the decline in wine specialization in the area, work in the fields, meadows and forests was supplemented by mining, industry, smuggling and other activities, such as the collection and sale of herbs carried out by the *trementinaires* (turpentine peddlers) of La Vansa. Logging and the use of forest by-products were another year-long economic activity, through the various trades that derived from them (charcoal makers, merchants, basket makers, tanners, clog makers and glue makers, mushroom pickers, hunters). The same forest by-products –which in many cases came from communal lands of collective use– were used as part of the diet (from game meat, mainly), for folk medicine and as an energy source (to heat homes and cook food). Despite maintaining the character of a basically self-centred economy in the own territory, to ensure the survival of the local population, exchanges with other territories were essential. These exchanges could also be of labour force, as the seasonal migrations to the plains by reapers from some of the poorest families in high mountain communities.

In the second half of the 20th century, which was marked by the development of mining, the Green Revolution, the mechanisation of farming, the second phase of the industrialisation process in the big cities and the energy transition to fossil fuels, Cadí-Moixeró increased its dependence on outside provisioning sources. These driving forces exacerbated the rural exodus; many people moved to areas where new industrial and urban developments offered more stable job opportunities, higher incomes and a wider range of services. However, the opening of new ways of communication from the 1960s –both physical and of information and entertainment–, and the intensification of these mercantile exchanges, caused a disarticulation of those self-centred economies and forms of work (Guirado, 2011). In this way, the smaller and less machinable plots were gradually abandoned, as well as the fruit fields (apples and pears) due to a lack of profitability, and the sheep transhumant livestock. Instead, there was a concentration and intensification croplands, mostly intended for animal feed (oats, corn, alfalfa, sainfoin), with a growing dependence on outside imports to feed the resident population. Sheep and goat livestock were replaced by housing cattle in winter thanks to hay that was produced and harvested in the summer months. This new approach revolved around the Cadí Cooperative created in Seu d'Urgell in 1915 (Mármol & Gascón, 2014). In Alt Berguedà there was a rise of mining and arrival of immigrants (1950), followed by a gradual decline until the clo-

sure of the mines (1980). The traditional trades linked to multiple-use forestry, very present in the territory at the beginning of the last century, were diminishing or practically disappearing. In this period, the rise of the neo-rural movement and the first demands from environmentalists begins.

Spain's accession to the common market and the European Union in 1986 reduced the importance of milk as a strategic productive sector on the north face of the Cadí. Small livestock family farms became economically unviable, and many disappeared. In some cases, there was a transition from dairy cattle to beef cattle. Milk production continued, but it was concentrated in the hands of a few people and large farms (Viladomiu, 2015). Closure of mines in Alt Berguedà arrived when Cercs Power Station was found guilty of environmental crimes and replaced coal from Carbones de Berga, SA with imported coal. There was also an abandonment of cropland, except where it survived thanks to rural tourism and neo-rural experiences, which made the resident population almost totally reliant on food from outside sources.

The dramatic change in economic model, linked to the loss of "traditional" activities (not only agriculture, but also forestry, mining and industry), gave way to a new form of generating capital and jobs, focused exclusively on the service sector (Guirado, 2011). The inauguration of Cadí Tunnel in 1984 represented a key turning point in the territorial development of Cadí-Moixeró and paved the way for economic specialisation towards a tourism model based on skiing and hiking. This led to growth of the camping, resorts and adventure sports industry and a boom in the construction of housing developments and second homes. The high demand for construction material also involved the exploitation of quarries in Alt Urgell.

Economic tertiarisation in Cadí-Moixeró has given way to a true tourism monoculture in recent decades. According to Catalonia's Employment Observatory (2020), 69% of the active population is employed in the service sector, followed by the construction sector (18%), agriculture (7%) and industry (6%). La Cerdanya is the frontrunner, with ski slopes playing a central role in land consumption (despite the retreat of the snow and the high temperatures of recent winters). This situation is evident in the number of tourist dwellings and second homes. According to data from the National Institute of Statistics (INE) in 2021, 64% were non-main homes (the vast majority second and third residences), compared to only 34% main homes. According to the Regional Council of Cerdanya, in 2009 second residences were occupied on average 50.9 days/year, while the rest of the time the accommodation lies vacant. The income of the resident population throughout the year has become almost entirely dependent on spending from the sporadic influx of tourists and visitors to this abandoned territory and landscape. As a result,

TABLE 2
Vector of changes identified, 1900-2020

	1900-1950
1904	Arrival of the railway in Guardiola de Berguedà, on the Barcelona-Manresa-Berga-Cercs line.
1904	Opening of the Asland Cement Factory in Castellar de N'Hug.
1911	Creation of the company Carbones de Berga, SA.
1911	Opening of La Molina ski resort.
1915	Creation of the Cadí Cooperative in La Seu d'Urgell.
1922	Arrival of the railway in Puigcerdà, on the Barcelona-Vic-Ripoll line.
1934	Opening of first hotel in La Molina.
1935	Creation of the Sociedad Anónima Lechera Industrial (SALI) in Puigcerdà.
	Rise in the demand for wood to underpin the galleries in the mines of Alt Berguedà.
	1950-1980
1966	Declaration of Cadí National Hunting Reserve.
1967	Opening of La Masella ski resort.
1975	Closure of Asland Cement Factory in Castellar de N'Hug.
	Mechanisation of farming and the spread of the Green Revolution (industrial hybrid seeds, agrochemicals, intensive irrigation).
	Increase in transport links with the opening of roads for lorries, buses and a growing number of cars.
	Widespread distribution of new fossil fuels (petrol, diesel, butane and propane).
	1980-2000
1980	Opening of Tuixent-La Vansa ski resort.
1982	Declaration of Pedraforca Massif as a Natural Site of National Interest.
1982	Flooding of 1982.
1983	Declaration of Cadí-Moixeró as a Natural Park.
1985	Conviction of Cercs Power Station for environmental crimes due to sulphur emissions caused by burning coal from Carbones de Berga, SA.
1986	Spain's accession to the EU, introduction of milk quotas and strengthening of monoculture farming.
1991	Closure of the Seu d'Urgell dairy.
	2000-2020
2011	Definitive closure of Cercs Power Station.
2020	Covid-19 pandemic.
2022	Controversy in the area, and across Catalonia as a whole, concerning the proposal to present the Pyrenees as a candidate for the next Winter Olympics.

Source: prepared by the author based on oral testimonies collected by L'Arada's Betula SCCL project and supplemented with other sources cited in the text.

tourism itself has meant higher prices for basic consumer goods for the resident population and in housing prices, which has ended up leading to serious problems of residen-

tial gentrification in the mountain regions. The COVID-19 pandemic has helped to consolidate teleworking in mountain areas, so that this situation has become a claim, with an increase in demand for rural housing.

This context has ended up generating a process of territorial gentrification, especially in the region of Cerdanya due to its dependence on tourism. Gentrification is explained as the process of replacing the population of one territory by another with more purchasing power, which more easily accesses the market price of housing and indirectly increases it, making it inaccessible to the local population. This term was used for the first time by Ruth Glass (Glass, 2010 [1964]) with the aim of describing the process of expulsion of workers who lived in central London neighbourhoods due to the arrival of a population with greater purchasing power. Later, authors such as Gothham (2005), Gómez, Armesto & Cors (2019) and Hiernaux (2018) link this problem with tourism, becoming processes that feedback on each other. This situation allows us to consider that the territory suffers from serious housing, food, and territorial gentrification, which will be addressed in future research also carried out as part of the Betula project. Table 2 summarizes the main vectors of change identified in this research.

5. CONCLUSION

The socioeconomic system of the mountain villages in Cadí-Moixeró was transformed over the course of 20th century and the first two decades of the 21st century. Despite the fact that their economic focus began with a common denominator, *i.e.* an integrated approach to natural resource management by farmers, herders, lumberjacks and charcoal-makers, the transformation and abandonment of these villages have played a key role in the demographic and socioeconomic evolution of each area. Mining in Alt Berguedà, skiing in Cerdanya and the milk industry in Alt Urgell and Cerdanya have given rise to different evolutionary paths. However, they have always had common traits: the underlying structural changes that have increased the economic, social and cultural dependence of this Pyrenean territory on the purchasing power concentrated in the big cities and metropolitan areas. In reference to the demographic desertification of the mountain, the populations that live there refer to it by saying things like "there is no one working in the mountain anymore".

The mechanisation and capitalisation of agriculture marked a turning point for these mountain territories. The loss of viability for small agricultural holdings, livestock farms and forestry operators accelerated the depopulation process in the most isolated settlements, where the industrialisation of agrarian production was more challenging. This led to population loss, with many people moving to large towns and areas well served by trans-

port links. In the 1980s, Spain's entry into the common market compromised the economic viability of the small, family-run dairy farms that were still operating on the north face of the Cadí thanks to the Seu d'Urgell Cooperative. Since then, the farming community has lost many of its people, thus putting an end to their former role as maintainers of traditional agroforestry landscapes, thus giving way to a single economic focus that exploits the landscape without protecting it: tourism. With ski slopes, rural tourism, second homes, campsites and hiking, the resident population's economic dependence on this sector is growing, in a region with virtually no other options.

The "deagrarianization" of Cadí-Moixeró has also given rise to a major transformation of the land uses and landscapes. The forest has colonised the abandoned cropland, scythe meadows and pastures, homogenizing the landscape mosaic that characterised the territory in the early 20th century. The great urban expansion derived from economic outsourcing has had a great impact on the landscape, a resource on which –paradoxically– much of the area's development has been based. However, the new land consumption model has also brought about a more subtle, but more far-reaching, socioecological descent: the abandonment of an integrated approach to managing forests, pastures and croplands that is threatening the sustainability of the entire territory, thus placing Cadí-Moixeró in a very vulnerable situation. Despite the fact that until today there have still been no problems arising from fires due to forest repopulation (both human and natural), the disappearance of this landscape mosaic structure added to the effects of climate change, raising a very important concern in terms of fires. In this sense, Marc Castellnou, from the Fire Department of the Generalitat de Catalunya, has already stated in various media that we are at a time when the Pyrenees could easily burn from end to end, due to the continuity of the forest mass. This is why agroforestry landscapes are now increasingly valued from a landscape ecology perspective, due to their capacity to host biodiversity in the soil and vegetation and to maintain the ecosystem services stemming from species diversity: regulation of runoff, retention of moisture and prevention of soil erosion to keep it fertile; pollination and comprehensive pest and disease control; regulation of microclimate conditions and fire prevention; and the cultural and recreational services that make it possible to benefit from a territory in good ecological condition (Dean *et al.*, 2021). So, the landscape changes shown throughout the article have led to deterioration of ecosystem services, and tourism has not contributed to avoid them despite having set a certain population contingent that has remained resident in the area. Ironically, this dependence on an unsustainable tourism model is damaging the very ecosystem services that make the territory appealing to visitors.

At the same time, the lack of housing that derives from the gentrification process, added to rural abandonment and the loss of farming, are factors that have profoundly al-

tered local food production in the supply chains on which the population of Cadí-Moixeró depends. Studying territorial gentrification, the relationships and flows between the different links in the food supply chain with a view to identifying opportunities to enhance its circularity and local roots will constitute the Betula project's next line of participatory action research, based on an assessment of this study.

As seen in other high mountain areas across Europe (Mitchley, Price & Tzanopoulos, 2006), it is essential to revive agriculture to reverse the abandonment process of the territory (López Palomeque *et al.*, 1996), and improve the ecological status of Cadí-Moixeró Natural Park and the surrounding area (Prat, 2022). Mountain economies and societies must be involved in a new agroecological transition towards territorial sustainability (Gliessman, 2016), as proposed by international agroecological and farming movements (López Garcia & González de Molina, 2021; Anderson *et al.*, 2021; Wezel *et al.*, 2020), the UN Committee on World Food Security (HLPE, 2017, 2019), the FAO, and the European Union. The results of this research will reinforce the efforts of the Betula project to advance in this direction. The Betula project was structured around and by the territory, and involved a wide range of social territorial actors, from public authorities to sociocultural entities, farmers and the tourist industry. This diversity of actors, some with far-reaching capacity o impact social, economic and territorial aspects, will help ensure that our participatory action research will have a significant impact on the collaborative effort ahead of us.

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