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Large-scale reforestation and afforestation policy in Spain: A historical review of its underlying ecological, socioeconomic and political dynamics

Enric Vadell[a], Sergio de-Miguel[b,c], Jesús Pemán[c,*]

[a] Ministry of Agriculture, Livestock, Fisheries and Food, Government of Catalonia, Merce Rodoreda 16, La Seu d'Urgell, 25700 Lleida, Spain
[b] Faculty of Science and Forestry, University of Eastern Finland, P.O. Box 111, 80101 Joensuu, Finland
[c] Department of Crop and Forest Science, University of Lleida-Agrotecnio Center, Alcalde Rovira Roure 191, 25199 Lleida, Spain

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ABSTRACT

Spain had not more than six million hectares of woodlands in the mid-19th century. Nowadays woodlands cover more than sixteen million hectares. During the last one hundred and fifty years, much effort was devoted to improving forest cover and, as a result, five million hectares were artificially regenerated, which represents ten percent of the whole country area. All this work required large nursery infrastructures, thousands of workers and high public investments. The outcome of these reforestation and afforestation efforts is nowadays obvious throughout the Spanish landscapes, and sometimes has given rise to controversy between supporters and opponents. Nevertheless, the process that led to the vast reforestation of Spain has not been yet studied in depth from a historical perspective. This study aims at reconstructing that historical process, by describing it through several features that help to understand the historical development of the artificial forest regeneration policy in Spain, together with its social, political and economic context. The study period comprises since 1879 to present, with special focus on the recent history, that is, since the mid-20th century. The lessons learnt from this analysis may contribute to improving the design of large-scale reforestation policies as well as their potential impacts in other parts of the world and, in the end, shed light on the debate about the possible solutions to deforestation and forest degradation.

1. Introduction

In the mid-19th century, Spanish woodlands covered approximately six millions hectares (i.e., 12.5% of the national territory) (Armenteras, 1903). The causes of deforestation in Spain were similar to those of most developing countries at the time (Allen and Barnes, 1985; Kaplan et al., 2009): forest clearing in order to meet the demands of the growing population, extensive grazing, timber supply for the shipbuilding industry, mining or metallurgical activities, as well as successive wars and fires. Bauer (1980) mentioned two additional causes of deforestation specific to Spain: the seizures and the inappropriate distribution of the forest ownership.

Indeed, from 1766 to 1924, successive seizures that affected 19.9 million hectares (Rueda, 1997) provoked an increase in the deforestation and forest degradation rates. Such seizure processes consisted in the nationalization by the State of properties owned by certain institutions (i.e., Church and religious orders, nobility and municipalities) in order to sell them to private owners. Its primary purpose was tax collection, although it also aimed at promoting changes in the ownership structure of agricultural land (i.e., land reform).

The impact of such process on the drastic reduction of the national forest area varies according to different authors, ranging from four to seven million hectares, that is, from sixteen to twenty eight percent of the total forest area of Spain at that time (Aranda, 1999; GEHR, 1994). According to López-Estudillo (1992), ploughing, ground division, as well as sales and seizures affecting the Monarchy and municipalities, were important at the end of the 18th century and during the first half of the 19th century. In consequence, the existing public rural land experienced a sharp decrease after the beginning of the seizure process in 1855. A significant loss of forest cover was also due to forest fires and illegal logging in public forests which, in combination with the strong ploughing pressure, entailed a reduction in forest area from 29 million hectares in 1860 to 24.5 million hectares in 1926 (Sanz, 1986).

* Corresponding author.
E-mail addresses: enric.vadell@gmail.com (E. Vadell), sergio.demiguel@pvcf.udl.cat (S. de-Miguel), peman@pvcf.udl.cat (J. Pemán).

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As a consequence of the degradation of the vegetation cover, successive floods occurred in different parts of Spain, as for instance the cases of Júcar River (1864), where the estimated losses were seventeen million pesetas (60 million constant €$_{2006}$); Jiloca River in Daroca (1854, 1865 and 1877); Francolí River in Tarragona (1874), Murcia (1877, 1879 and 1884); Almería (1879) and Lérida (1907) (Cuesta, 1919; Villanueva, 1924). On the other hand, wood production in Spain was not enough to meet the demands of the national industry.

Deforestation was regarded as a major public concern at the time. In view of the gravity of forest deforestation and degradation, it was necessary to urgently undertake large-scale reforestations in order to mitigate the great impact of erosion and flooding processes on people livelihoods, as well as to meet the demand of the national market in terms of wood supply. According to Armenteras (1903), 10–16 million hectares of forest were required to improve this situation. The national reforestation plans of 1933 and 1938 estimated that 5–6 million hectares should be reforested in 100 years in order to achieve the objectives in terms of forest regeneration and timber production (Ximénez de Embún i Oseñalde and Ceballos, 1939). The national reforestation plan of 1938 constituted the main framework for the reforestations conducted between 1940 and 1984. Timber production-oriented and conservation-oriented reforestations represented, respectively, 36% and 64% of the overall reforestations. The reforestations for timber production aimed at responding to an increasing wood demand of 5 million cubic meters per year. Despite constituting the main planning framework, in reality the implementation of reforestations hardly followed the 1938 plan since the availability of funds was highly variable depending on the overall economic situation of a given year, and the availability of land for reforestation purposes (Casado, 1950; FAO Secretariado, 1958).

At the time, such a large-scale reforestation effort was rather unique in the world (Traugott, 1964), which was internationally acknowledged by appointing Spain as the host country of the 6th World Forestry Congress held in Madrid in 1966. Although almost 150 years of large-scale reforestation has contributed to some of the most relevant changes in the Spanish landscapes during the modern times, so far, its underlying ecological, socioeconomic and political dynamics have not been the object of a comprehensive analysis.

The aim of this study is to shed light on the large-scale reforestation and afforestation process undertaken in Spain from the end of the 19th century to present by filling the gaps in knowledge concerning the following features: (i) the reasons behind the need for reforestation in Spain; (ii) the evolution reforestation and afforestation since the mid-19th century; (iii) the legislation and administrative units set to carry out this activity; (iv) the investment in reforestation/afforestation projects at the national level; (v) the tree species used; (vi) the necessary technical infrastructures and technology utilized; and (vii) the impact of large-scale reforestation and afforestation on the structure of the forest ownership. In this study we use the term "reforestation" to refer to the artificial reestablishment of forest cover in a deforested land which was previously a forest, and the term "afforestation" to refer to the artificial establishment of forest cover in an area where the preceding vegetation or land use was not forest (Helms, 1998).

2. Materials and methods

In order to properly understand the reforestation pace in different periods, it is necessary to take into account the political context, the evolution of governmental administrative structures as well as the changes in the legislation along the entire historical period considered in this study (Arts and Buizer, 2009; Ayana et al., 2013). Previous research has divided the historical development of large-scale reforestations in Spain into different episodes (Gómez de Mendoza and Mata, 2002; Navarro-Garnica, 1977). In this study we have divided this historical process into the following three stages: (i) since the origin of forestry knowledge in Spain until the end of the Spanish Civil War (1877–1939), when the first reforestations were conducted; (ii) the period corresponding to Franco's dictatorship until the new democratic administrative organization (1940–1984), when large-scale reforestation was conducted by the public administration; (iii) the current democratic period (1984 to present), when reforestation conducted by the public administration was reduced after the decentralization of forestry competences to the Autonomous Communities, and when private afforestation of agricultural land partly boosted as a consequence of the EU policies.

Thirteen variables were analysed: (i) annual reforested area by the private property and by the Government between 1879 and 2006; (ii) replanted area by the Government due to seedling failure between 1946 and 2006; (iii) total reforested area by tree species from 1940 to 2006; (iv) the area to be reforested and afforested according to alternative policy instruments; (v) production of coniferous and broadleaf plants between 1940 and 2006; (vi) production of coniferous and broadleaf seedlings between 1940 and 2006; (vii) annual seed consumption from 1943 to 1987; (viii) budget of administration units between 1896 and 1984; (ix) investment in field implementation of reforestation projects between 1896 and 1984; (x) sowing and planting costs per hectare; (xi) plant production in the year 'n' in relation to the reforested area in the year 'n + 1′ in order to estimate the maximum planting density or plant consumption per reforested hectare; (xii) investment in reforestation works in relation to the total governmental budget; and (xiii) number of daily wages, calculated from the investment in reforestation works and the average agricultural salary of a temporary labourer. The data concerning the salaries were gathered from the historical series compiled by Carreras et al. (2005). When replanting after massive seedling failure was made the next year after reforestation, the replanting costs were estimated to be 65–75% of the reforestation ones. When replanting was delayed for more than one year, then the costs were assumed to be the same as the reforestation ones (Giménez, 1950). In addition, the following official publications were consulted in order to compile the datasets of the first eleven variables analysed: (i) sowing and plantation statistics, from 1877 up to the end of the forest year 1894–95; (ii) projects and reports of the Reforestation Commissions and Forest Divisions from 1889 to 1938; (iii) yearbooks of national public forests production statistics from 1922 to 1934; (iv) State Forest Heritage (*Patrimonio Forestal del Estado*, PFE) reports from 1940 to 1954; (v) yearbooks of the Spanish Forest Statistics from 1949 to 1965; (vi) reports of the Spanish Head Office of Forestry, Hunting and Fluvial Fishing (*Dirección General de Montes, Caza y Pesca Fluvial*, DGMCyPF) from 1955 to 1971; (vii) reports of the State Institute for Nature Conservation (*Instituto Nacional para la Conservación de la Naturaleza*, ICONA) from 1972 to 1987; (viii) yearbooks of the Ministry of Agriculture, Fishing and Food from 1983 to 2004; (ix) yearbooks of the Ministry of Environment of 2004 and 2005; (x) historical database of the Official State Gazzette (BOE), for analyzing the approved budgets and regulations. The total area reforested between 1896 and 1922 has been indirectly estimated in this study based on bibliographic references (Barrachina, 1926). The evolution of reforestation costs was analysed on the basis of bibliographic references and reforestation projects.

There are no official records concerning the investments related to reforestation activities before the year 1940. Thus, the only available information before that year comes from published papers. From 1940, the annual reports of the official institutions in charge of the reforestation activity, namely the PFE (1940–1954), DGMCyPF