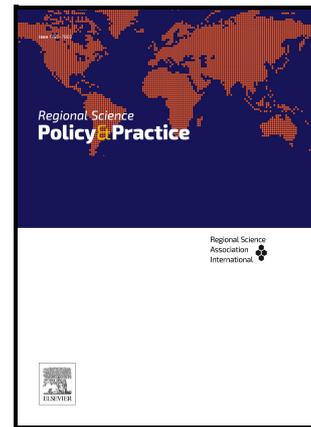


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RURAL DEPOPULATION IN THE 21st CENTURY: A SYSTEMATIC REVIEW OF POLICY ASSESSMENTS[☆]

Running title: Rural Depopulation in the 21st Century

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Abstract

Policies tackling rural depopulation are growing over the recent years and pose a significant challenge to policymakers and communities worldwide. This paper presents a systematic review of policy assessments aimed at mitigating rural depopulation. It encompasses 66 studies published since 2000. This is a highly atomized literature characterized by weak aggregate or comparative results and a lack of generalizability. Our analysis reveals that depopulation can be influenced by policies within four broad categories: social, fiscal, sectorial, and infrastructure. No single policy can independently halt depopulation in rural areas; rather, multiple policies addressing different aspects of the phenomenon are necessary for a successful outcome. Our findings have significant implications for policymakers seeking to address this complex socioeconomic and territorial challenge.

Keywords: depopulation policies, effectiveness, evaluation, rural development.

1. Introduction

‘Our rural areas are the fabric of our society and the heartbeat of our economy. [...] They are a core part of our identity and our economic potential.’ ‘We will cherish and preserve our rural areas and invest in their future.’ Ursula von der Leyen, President of the European Commission – July 2019 (Political guidelines for 2019-2024).¹

[☆] *The research did not receive any specific grant from funding agencies in the public, commercial or non-profit sectors.*

¹ European Commission. (2021). ‘A Long-Term Vision for the EU’s Rural Areas—Towards Stronger, Connected, Resilient and Prosperous Rural Areas by 2040’. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, and the Committee of the Regions. European Commission, COM(2021) 345 final, Brussels, 30.6.2021. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021DC0345>

Policies aiming at tackling rural depopulation have garnered recent interest among scholars and policymakers (Cuadrado-Roura, 2023). The number of publications devoted to this phenomenon has remarkably increased over the last years (Rodríguez-Soler et al., 2020). International organizations such as the OECD,² the United Nations (Lutz & Gailey, 2020) or the European Commission are paying more attention to this topic as a source of long-lasting territorial disparities (Proietti et al., 2022). These concerns are becoming more notorious, especially in advanced and mature economies where ageing populations are significantly impacting rural areas (Ceccorulli, 2015).

There is an increasingly precise diagnosis of the origins of rural depopulation (Johnson & Lichter, 2019) as well as its future consequences on sociodemographic structures (Newsham & Rowe, 2022). The COVID-19 pandemic has marked a tipping point in this literature, as new studies have sparked a vibrant policy debate on the potential of various policies—particularly digital connectivity and remote teleworking—to revitalize or even foster rural areas in the long run (González-Leonardo et al., 2022).

However, despite very specific efforts (Díaz-Lanchas et al., 2022), there is not a structured compilation of policy assessments categorizes research findings and enhance the discussion on rural depopulation policies. This paper aims to perform a systematic literature review on an extensive number of qualitative and quantitative academic works that analyse policies against depopulation in the XXI century. Given the progressive improvements in empirical tools for policy evaluation, our focus on works published in the 21st century provides a more rigorous and precise analysis of the assessment of policies against rural depopulation.

This literature review takes an interdisciplinary approach. It encompasses works from various social sciences disciplines, including economics, geography, politics, demographics, engineering, and environmental science. Nonetheless, it includes mainly empirical papers, as our goal is to identify those policies that have been practically implemented and evaluated, with higher or lower success.

²The OECD is carrying out extensive initiatives within the workstream on ‘Policies for depopulation and service delivery in rural regions’. Available at: <https://www.oecd.org/regional/rural-development/rural-service-delivery.htm>.

This paper does not address the broad array of policy assessments on population decline, as these policies can also impact urban and semi-urban areas (Santos & Fernandez, 2023). Instead, we focus specifically on those related to depopulation in rural areas as defined in the territorial typologies in Eurostat (2018). In this context, an absolute population loss in rural areas, even by a small rate, is considered as rural depopulation in throughout this paper.

This approach allows us to perform comparative analysis across various countries and policy frameworks, despite the broader field of rural depopulation being characterized by challenges in generalizability and comparability among different policies and outcomes (Castillo-Rivero et al., 2021). In particular, we focus on policies aimed at modifying trends of population decline defined in this case as a decrease in the total population. Thus, we pay attention to population growth as our primary variable of interest. Unlike alternative indicators such as net migration flows, population growth captures the demographic structure of rural areas, characterized by ageing populations and low fertility rates (Dorling & Gietel-Basten, 2017), as well as the influx and outflow of workers and residents. Accordingly, we deem a policy successful if it can arrest population decline and promote population stabilization or even trigger an increase in population growth. Conversely, we also examine policies with adverse effects on depopulation, namely those that accelerate the rate of population loss in low-density rural areas.

These distinctions are essential since policies designed to address overall population decline may differ from those targeting rural depopulation. For example, population decline due to deindustrialization in certain geographical areas requires a different analysis than depopulation in remote villages characterized by a lack of services and infrastructure or the loss of sociocultural networks and linkages (Rieniets, 2009).

It should also be acknowledged that elderly demographic structures, like those in most developed countries, create difficulties in reversing a process of population decline, especially in rural areas (Collantes & Pinilla, 2011). Moreover, agglomeration economies favour the development of large urban municipalities as opposed to small rural areas (Krugman, 1999).

All the studies considered are limited to the last decade given the lack of evidence prior to 2000. The various policies analysed are categorized into four broad groups based on their scope: social, fiscal, sectorial, and infrastructure programs. We provide a detailed summary of

the studies analysed including the most important factors for each paper, such as country, period, sample, method and main results.

Obtained findings show that several public policies have proven effective in mitigating, halting, or even reversing rural depopulation trends. In particular, tax exemptions and transport infrastructures policies could help to create employment and foster firms' development in rural areas. The provision of housing, connectivity and other basic services, would also help to curb depopulation patterns. Findings underscore the importance of adopting a holistic policy approach by which not only one specific policy, but a combination of them, should be considered to assess depopulation policies.

The contribution of this paper for the regional and rural literatures is twofold. First, it synthesizes the existing evidence on evaluated policies against rural depopulation. The comparison of policy areas is useful to enhance the discussion on the efficiency and the redistributive features of rural depopulation policies, as well as on the existing interlinkages between them.

Second, this paper provides a critical analysis of the literature and highlights its main weaknesses which can be summarized into excessive atomization, lack of generalizability, and partial and non-scalable results due to data scarcity and the local scale of policies. In almost all the reviewed cases, we detect policies which are successful in curbing depopulation processes, with just five exceptions (Duarte et al., 2022a; Duarte et al., 2022b; Morettini, 2023; Pérez-Sindin López et al., 2023; Fabra et al., 2023). It points out to a potential selection bias in the literature towards those studies showing positive policy impacts on rural depopulation patterns.

This paper is structured as follows. The next section revises the methods and data used for the systematic review of the literature. Section 3 presents the results for the four policy areas considered. In the discussion section, we critically analyse the main findings in the literature and stress their limitations. The last section concludes.

2. Methods and data

We conduct a systematic literature review utilizing two of the most prominent and widely used academic research databases: Web of Science (WoS) and Scopus (Zhu & Liu, 2020). Using these two databases result in 93 duplicate studies, which are subsequently removed.

Our review process involves, first, a key-inform search strategy to identify academic papers relevant to the assessment of rural depopulation policies. Specifically, we target papers published in English language between 2000 and 2024, using the following Boolean algorithm:

$$\begin{aligned}
 & [TS=(\text{evaluat}^*) \text{ OR } TS=(\text{assess}^*)] \\
 & \text{AND} \\
 & [(TS=(\text{policy}) \text{ OR } TS=(\text{policies}))] \\
 & \text{AND} \\
 & [(TS=(\text{rural}))] \\
 & \text{AND} \\
 & [TS=(\text{depopulat}^*) \text{ OR } ((TS=(\text{declin}^*) \text{ OR } TS=(\text{shrink}^*)) \text{ AND } TS=(\text{population}))]
 \end{aligned}$$

The search took place on June 3, 2024. As noted, the keywords applied for the compilation of papers relate to rural depopulation and cover key concepts such as ‘*evaluation*’, ‘*assessment*’, ‘*policies/policy*’, ‘*rural*’, ‘*depopulation/depopulated*’, ‘*decline/declining*’, ‘*shrinking*’ and, finally, ‘*population*’. The Boolean algorithm identifies 202 articles and book chapters on WoS and Scopus. We screen all the manuscripts to select those that evaluate the effect of a public policy on rural depopulation. The exclusion criteria are as follows:

- Studies not written in English as the standard language.
- Research published in the fields of medicine or ecological science, to focus the search on social sciences disciplines.
- Articles analysing static urban-rural differences in policy impacts, rather than dynamic effects.
- Papers that address depopulation broadly with a focus on long-term socioeconomic factors and drivers.

The implementation of these exclusion criteria gives rise to a total of 109 manuscripts. However, the screening process further filters out papers not directly related to the topic and to the assessment of depopulation policies. As a result, we refine the database to include 44 relevant studies. Additionally, we manually search the reference lists of 42 studies to identify further eligible works. This cross-citation and validation strategy yields 22 additional studies. In total, our final database includes 66 academic papers suitable for analysis.

Annex 1 includes a comprehensive table listing all these papers. We include the citation of each paper and categorize them based on *i*) the country where the policy was implemented; *ii*) the time period analysed; *iii*) the sample size of the study; *iv*) the methodology used; and *v*) their main findings.

It is important to note that the processes of screening, identification, and inclusion were rigorously conducted in accordance with PRISMA principles (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). This methodology ensures that systematic literature reviews are performed in a thorough and methodical manner, enhancing the reliability and transparency of the review process (Beller et al., 2013; Holden et al., 2014, Sarkis-Onofre et al., 2021). For further details, Annex 2 shows all the steps applied throughout the searching process and the PRISMA methodology.

3. Results

Figure 1 shows the number of studies in our final database published per year. Most of the 66 studies included have been published since 2019. Most of the 66 included studies have been published since 2019. Over the past four years, at least five papers per year have been published on this specific topic, whereas some years in the 2000s showed no detected publications. As previously mentioned, the assessment of depopulation policies is becoming an increasingly important topic among scholars and international organizations. This trend highlights the needs for a study collecting and summarizing the existing evidence on the subject.

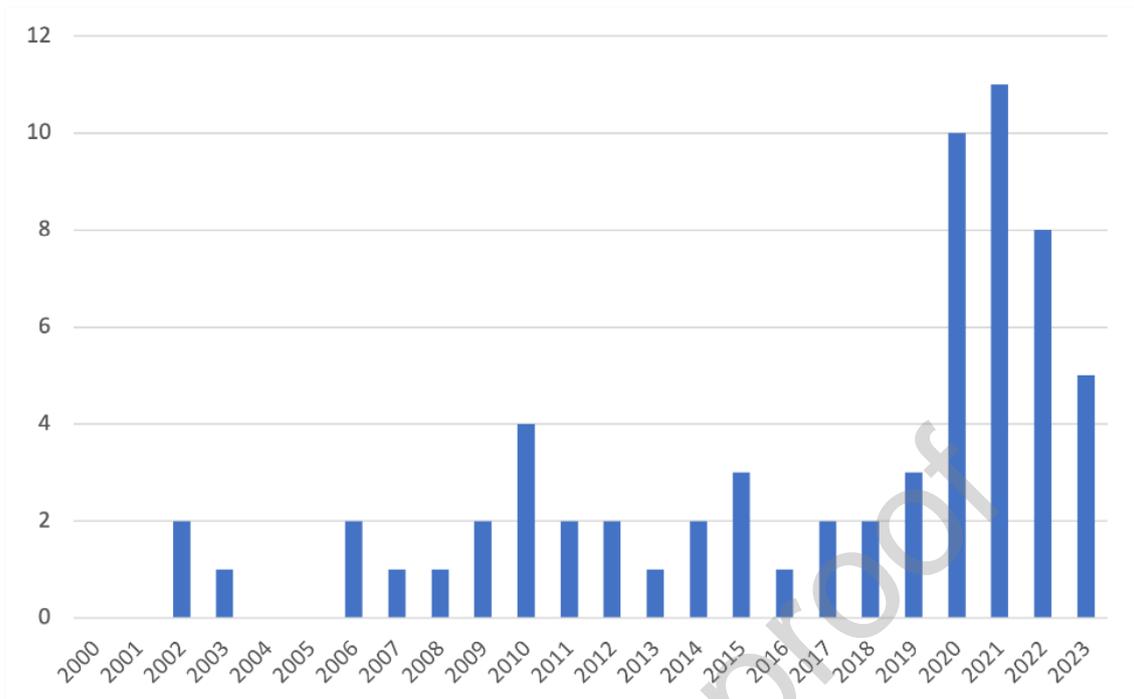


Figure 1. Studies in the review per year

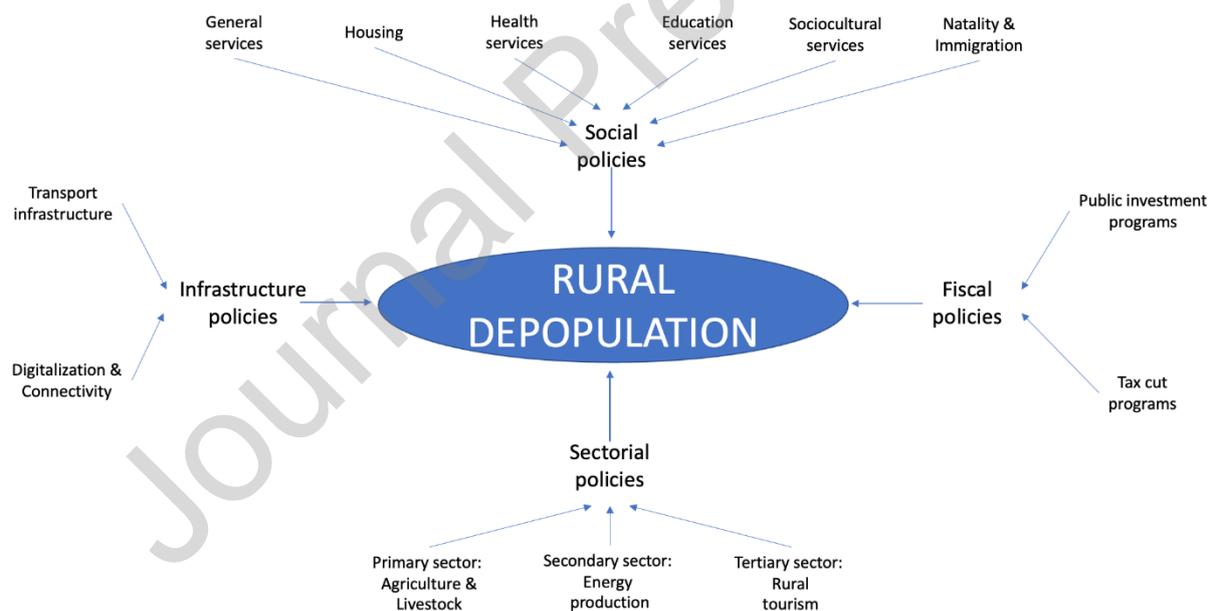


Figure 2. Categories of rural depopulation policies

The information contained therein allows us to exploit qualitative information on the type of policies implemented. We categorize them into four major types of interventions: sectorial, social, fiscal and infrastructure policies. Figure 2 synthesises this information and serves as the cornerstone of our analysis. ‘Social policies’ include general services, housing, health, education, and sociocultural services, as well as and natality and immigration-related interventions. ‘Fiscal policies’ consider both public investments and tax deductions programs.

‘Sectorial policies’ focus on agriculture and livestock, energy production, and rural tourism initiatives. Finally, ‘Infrastructure policies’ accounts for policies related to transport’s infrastructure and digital connectivity.

Table 1 shows the distribution of papers across each category, as well as the specific types of policies within each one. As seen, ‘Social policies’ are the most predominant, particularly those related to ‘General Services,’ ‘Housing,’ and ‘Health Services’. ‘Fiscal policies’ and ‘Sectorial policies’ are also significant. Fiscal policies analyse a similar amount of fiscal investments and tax cut programs. Sectorial policies primarily focus on agricultural interventions, while fiscal policies emphasize investment and tax programs. Lastly, ‘Infrastructure policies’ are less frequently addressed in our literature review, representing only 12% of the studies considered. They are evenly divided between transport and digital initiatives.

Table 1. Share (%) of studies by category

Category	Share (%)	Type of Policies	Share (%)
Social Policies	39%	General Services	9%
		Housing	8%
		Health Services	5%
		Educational Services	8%
		Sociocultural Services	3%
		Natality & Immigration	8%
Fiscal Policies	23%	General Investment Programs	12%
		Tax Cut Programs	11%
		Agriculture & Livestock	11%
Sectorial Policies	26%	Energy Production	8%
		Tourism	8%
		Transport Infrastructures	6%
Infrastructure Policies	12%	Digitalization and Connectivity	6%

Once we have analysed the composition and distribution of papers in our database, we proceed with a detailed description of the policies and findings for the four categories.

3.1. Social policies

‘Social policies’ groups interventions around the following areas: general services, housing, health, education and sociocultural services, as well as natality and immigration programs. First, general services involve the provision of services that cannot be included in any of the other categories without further specifications. Literature highlights that most of the analysed

rural municipalities are too small to efficiently provide all the minimum services needed. An effective policy to minimize this problem is to create clusters of Local Administrative Units (LAUs) close to each other so that each service can be provided in at least one of the LAUs (Alamá-Sabater et al., 2021). The critical point of this policy is to establish clusters that are sufficiently large in population to provide all essential services, yet small enough in geographical distance to ensure reasonable access to these services within a manageable time span (Goodwin-Hawkins et al., 2021).

Larger municipalities tend to retain at least part of the services under their jurisdiction, while smaller ones suffer from a progressive closure of the services (Christiaanse, 2020). Innovation and citizen involvement in designing new forms of service provisions can play an essential role in the future of general services policies (OECD, 2010). Technological advances, particularly related to the so-called "smart villages," can significantly enhance the provision of services and address other needs in depopulated areas (Paniagua, 2020).

General services also include all forms of private initiatives, such as supermarkets, pubs, and banks (Mount & Cabras, 2016). Innovative solutions, such as the integration of different services to reduce financing costs, generally work well in this regard. One example is the introduction of ATMs in rural pharmacies where financial or banking services do not exist (Náñez Alonso et al., 2022).

Second, housing policies are essential to curb rural depopulation. A housing market with limited sales is a barrier for individuals who plan to reside in rural areas temporarily. Therefore, one potential solution is to create construction programs that also provide rental options (Alexander, 2019). The effectiveness of housing policies increases significantly when they are combined with other public interventions, like those aimed at the promotion of local employment. When well-managed, they can greatly contribute to community resilience in depopulating areas (Hernández-Ramírez et al., 2022). Employment policies without adequate housing plans can result in workers residing in large non-rural municipalities and commuting daily to their jobs in rural areas (Cheng et al., 2019).

There has been a general lack of public initiatives on rural housing to prevent depopulation. Ireland's "Rural Renewal Scheme" (RRS) is an exception from which several lessons can be learned. For instance, publicly financing the construction of houses in rural areas helps to

prevent depopulation and to create temporary employment (Gkartzios & Norris, 2011). However, if the program is applied equally to primary and second residences³, it may lead to an excess of the latter. Consequently, the literature suggests that subsidies should be aimed at the construction of primary residences, ensuring that the beneficiaries will remain living there (Norris & Winston, 2009).

Third, evidence on the relationship between health provision and depopulation follows a two-way pattern. On the one hand, there is not much literature on the direct causal link between one variable and the other. On the other hand, there is plenty of literature on the problems derived from health service provisions in rural areas. What research is clear about is that the accessibility to health services is usually difficult in depopulating areas, which constitutes a barrier to those living in these areas (Henderson et al., 2003). The problem is not only constituted by the lack of hospitals or health centres, but also by the absence of human capital (Shipman et al., 2019). One of the standard policies that has been proposed to solve this problem is telemedicine, which is generally refused by patients (Sørensen, 2008). In the context of policy evaluations and assessment, there is still a lack of evidence on how the lack of access to health services affects rural depopulation patterns.

Fourth, education services are vital to understand living and migration decisions. Education is at the core of the migration decision from and to rural areas. Families that must send their children to schools in different municipalities may decide to migrate closer to them in order to maximize welfare and protect social networks (Cedering & Wihlborg, 2020). Evidence shows that depopulation rates increase significantly after the closure of primary and secondary schools in small municipalities (Lehtonen, 2021; Sørensen et al., 2021). Even in populated municipalities may suffer from this dynamism with the closure of tertiary and universities (Lovén et al., 2020). As a result, depopulation increases and the social capital in those areas falls (Kłoczko-Gajewska, 2020).

Fifth, the availability of sociocultural and leisure services is crucial to understand whether a family or an individual may decide to stay or to move from / to rural areas (Iversen et al., 2023). In addition to schools or cultural centres, pubs and bars are other common locations where

³ More broadly, many houses remain unused and off the market in rural depopulating areas for various reasons. For further details see Gallent et al. (2003).

individuals meet. The closing of these types of services significantly increase depopulation according to Mount & Cabras (2016).

Finally, fostering natality and immigration should contribute to the formation of a younger demographic pyramid. However, there are mixed evidence on the impact of this type of policy. On the immigration side, research shows mixed results as some authors find a positive effect on the moderation of depopulation trends (Collantes et al., 2014), while others find the opposite result (Bayona-i-Carrasco & Gil-Alonso, 2012).

As for natality, implemented policies have not led to the desired results, and they have not contributed to reverse rural depopulation and fertility decline (Brainerd, 2014; Cook et al., 2022). Higher masculinization rates in rural areas and higher women migration rates to urban areas, are among the reasons raised in the literature underlying these lower fertility rates in rural territories (Cobano-Delgado & Lorent-Bedmar, 2020).

As we have explained in this section, literature shows that different social policies contribute in various manners to depopulation tendencies. In general, an approach of clustering services by a network strategy has proven to be an effective way to organize services for villages that are too small to maintain services that require a minimum population (Christiaanse, 2020). Policy makers should apply service delivery in depopulated areas at administrative scales superior to the municipality, but inferior to the province (Alamá-Savater, 2021). Moreover, the provision of several services in one place saves resources and allows for an efficient retention of services in small villages. Technology can also help to reduce costs and maintain service delivery in depopulated areas (Paniagua, 2020).

3.2. Fiscal policies

Literature shows that fiscal policies have different effects depending on either the case for which they are designed and/or the kind of instrument implemented (Loras-Gimeno et al., 2024). We have divided fiscal policies into two main groups: public investments and tax cuts programs. The former consists of financing interventions to curb depopulation, while the latter includes tax reductions to businesses or households.

In the case of public investments, they have followed different strategies depending on their place of implementation, even when their common goal is to promote rural development. Some

programs have been directed to small enterprises so that they can increase their growth, generate economic activity and create jobs. Others have transferred funds to low-income citizens of rural areas so that they complement their wages. Lastly, some schemes have opted by an independent and local agency to allocate funds to the projects that can better promote economic development according to local specificities.

Some of the main examples of this type of policies can be found in the EU's LEADER program (*Liaison Entre Actions de Développement de l'Économie Rurale*) and the Spanish SIPTEA program (*Sistema Integrado de Protección de los Trabajadores Eventuales Agrarios*).

In the case of the LEADER program, subsidies are articulated through the Local Action Groups (LAGs), a bottom-up development strategy promoted and financed by the EU across all member countries since 1991. Reviewed studies analyse the LEADER program across European countries (France, Germany, Spain, England, and Ireland), and show good results in general, with different emphases on the program's weaknesses. LEADER has contributed to the shift from a rural development strategy based on agriculture and livestock to the incorporation of other sectors and economic activities. Some of these issues have been tackled thanks to the adaptation of the program over time (Scott, 2002).

However, the LEADER program presents some limitations, according to the literature. First, it has a propensity to focus more on non-depopulated rural areas where resources are more available than in depopulated rural areas with a substantial lack of resources. This would increase the gap between high-density and low-density rural areas (Navarro-Valverde et al., 2021). Most studies point to the necessity of its reform to be more effective in reducing depopulation by deploying a better system for evaluating projects therein (Bosworth et al., 2016). Another problem relates to the LAGs, especially in areas with low population, as the allocation of these subsidies is highly dependent on local elites that have sometimes used them as instruments of power (Esparcia et al., 2015). Last, the LEADER program lacks effective mechanisms for the promotion of endogenous growth and population attraction mechanisms are not working adequately (Bruckmeier, 2000).

The SIPTEA program is implemented in rural areas of Andalusia and Extremadura, two Spanish regions characterised by lower income levels. It is an income subsidy that complements unemployment benefits. It should act as an incentive to preserve populations in

rural areas. SIPTEA subsidy results in a higher probability of individuals to remain in or to move to rural areas. This program has been effective in moderating depopulation in its target areas (Jofre-Monseny, 2014; Serra et al., 2023).

Furthermore, subsidies orientated towards the financing of place-based policies have also worked in revitalising economic activity in rural areas and reduced depopulation. Particularly, the Italian Strategy for Inner Areas (SNAI) has subsidised the creation of businesses, as well as increased employment and population retention (Monturano et al., 2023).

Regarding tax reductions, literature focuses more on businesses than on households. Tax reductions typically take the form of payroll tax deductions and the creation of rural enterprise zones. Literature shows that tax reductions positively impact employment creation and, in very specific cases, wage growth in depopulated areas. In Sweden, a 10% reduction in the payroll tax of businesses in rural areas significantly increased employment creation and slightly increased wages (Benmarker et al., 2009). In Norway, the zoning of the country depends on the population density, with a difference of 14% in the payroll tax between densely populated and depopulated areas. This strategy has contributed to stimulating local employment and rising salaries in the latter (Ku et al., 2020; Rybalka et al., 2018). In Australia, the creation of a zone tax positively affected employment and population settlement. However, this effect vanished when the policy was lifted (Kettlewell & Yerokhin, 2019). In Colorado (US), the creation of enterprise zones with tax benefits for businesses increased employment in rural areas. The same policy did not have those positive effects in urban areas (Lynch & Zax, 2011).

Tax reductions in depopulated areas are generally applied to all companies, but they also have been directed to enterprises in specific sectors, such as construction. These programs also have positive effects on employment generation (Keane & Garvey, 2006). However, the main risk of tax programs lies in a non-generous implementation of tax exemptions and reductions. This can result in local enterprises benefiting from the tax breaks without creating jobs, increasing wages, or migrating their activities (Behaghel et al., 2015)..

3.3. Sectorial policies

We divide this category into the three main sectors affecting rural territories. In particular, the major sector is the primary one, with agriculture and livestock as the main economic activities.

The secondary sector is dominated by mining and renewable energies, and the tertiary by touristic services.

Agriculture and livestock activities are being affected by public interventions around their production process (Stojcheska et al., 2024). First, irrigation has been widely proposed by policymakers as an effective method to improve agricultural productivity by changing the type of cultivation from low to high value-added crops. This has increased agricultural productivity and income, which has curbed depopulation dynamics and attracted new inhabitants (Cazcarro et al., 2015). Consequently, it could be stated that the promotion of water infrastructures for irrigation expansion is a way to reduce depopulation (Silvestre & Clar, 2010; Tenza-Peral et al., 2022)⁴.

Land consolidation policies, that increase the size of fields and farms, show a positive effect for retaining population through increased economic productivity (Miranda et al., 2006). On the contrary livestock taxation fosters depopulation in farming-intensive areas (Morettini, 2023).

In the case of public subsidies, such as EU's Common Agricultural Policy (CAP), evidence shows that the impact is slightly positive for depopulation reduction, but cannot attract new inhabitants to those areas (Grodzicki & Jankiewicz, 2022; Lasanta & Laguna, 2007).

Industry has a weak presence in rural areas since factories generally need large amounts of workers and tend to be located in urban environments (Adam & Dadi, 2024). When a factory is established in a rural area, the new employment opportunities attract residents, leading to the development of the area into a small town (Liu, 2021).

According to our revision of the literature, energy generation is the only industry more commonly found in rural environments. During the second half of the XXth century, mining activities in rural areas contributed decisively to control depopulation, or even generate population attraction to those rural areas with mines during decades (Oei et al., 2020).

⁴ Notwithstanding, there are other studies that find this evidence elusive, with a weaker relationship between water infrastructures' promotion and slowing depopulation trends (Cazcarro et al., 2024).

However, the recent rise of renewable energies has progressively force the disappearance of coal mines, fostering the depopulation of rural areas at a fast pace (Pérez-Sindín López et al., 2023).

The literature shows that windmill and solar panels tend to increase depopulation as they do not generate employment after their construction. Indeed, they boost the migration of individuals who worked in sectors such as agriculture or rural tourism (Duarte et al., 2022b; Fabra et al., 2023). The only way identified in the literature in which this transition could be beneficial for rural depopulation areas is through the local ownership of the installations (Duarte et al., 2022a; Phimister & Roberts, 2012).

As for the tertiary sector, rural tourism has been an alternative for some rural economies in recent decades. Those areas that have developed these resources as tourism-oriented factors have succeeded in stopping depopulation (Hashimoto & Telfer, 2010). This strategy depends on each area's endowments (Vidal-Matzanke & Vidal-González, 2022). Literature highlights the importance of involving inhabitants in the experience offered through community-based tourism (Cáceres-Feria et al., 2021), developing museums or amusement parks adapted to the territorial reality (Alcalá, 2018), or using water reservoir management for leisure activities (Larraz & San-Martin, 2021).

3.4. Infrastructure policies

Infrastructure policies often appear in the public debate as a policy domain in which the gap between populated and depopulated areas is more significant (Whitacre & Mills, 2007). Infrastructure policies are expensive, so governments prioritize their construction in densely populated areas. Literature considers two categories of infrastructures: transport infrastructure and digital or connectivity infrastructure.

Evidence on transport infrastructures are mainly focused on evaluating the impact of roads and highways construction. The general conclusion is that the expansion of these networks effectively reduces rural depopulation and even transfer residents from suburbs of urban areas to rural ones. According to Levkovich et al., (2020), the gain in population for rural areas derived from their connection to highway networks is explained by the fact that individuals and firms prefer to move there than to a suburb in an urban area.

Road infrastructures that increase accessibility can break long-term population decline tendencies, especially in mountainous regions, and contribute to reduce the urban-rural income gap (Bjarnason, 2021). In the case of the EU, the road and highway expansion across Europe from 1990 to 2012 shows significant positive effects on rural areas, not only in terms of population attraction, but also from the employment and economic activity perspectives. This effect is stronger for long-distance connections (Adler et al., 2020).

To sum up, this policy also helps reducing the urban–rural income gap (Lu et al., 2022). For transport infrastructure, we find evidence on the impact of roads and highways on depopulation reduction.

Research on digital connectivity evaluates the implementation of policies to facilitate Internet access. Literature shows that rural depopulated areas would be the ones benefitting more from these interventions (Salemink et al., 2017). Results overwhelmingly show that the increase in digital connectivity effectively reduce depopulation. This policy cannot solve depopulation by itself (Lehtonen, 2020), as workers need to acquire the skills necessary to take advantage of those technologies (Esteban-Navarro et al., 2020). However, the evaluation of this kind of policy concludes that the urban–rural digital divide decreases and that the areas of implementation are less affected by depopulation (Briglauer et al., 2019).

4. Discussion

4.1. Implications from findings

Literature overwhelmingly shows that the policies described in the previous section can stop and reduce rural depopulation. There are only five exceptions warning about a potential negative relationship between depopulation and public policies intervention (Duarte et al., 2022a; Duarte et al., 2022b; Morettini, 2023; Pérez-Sindin López et al., 2023; Fabra et al., 2023). We present the implications from the obtained findings following the diagram in previous Figure 2.

First, sectorial policies are essential to guarantee employment possibilities in these areas. Without employment, it is difficult to retain or attract workers and their families, which can increase or maintain the population of a specific village or area. Investing in the most influential economic sectors in terms of employment creation could be one of the pillars for depopulation reduction.

Agriculture and livestock continue to be the main sectors in rural depopulated areas. Working to increase the productivity and innovation of the existing sectors is the approach taken by the EU CAP and other subsidies. The studies analysed show that this strategy is preferred to making investments in new sectors. Policies such as land consolidation or irrigation projects can also increase productivity.

The closing of mining activities rapidly fosters depopulation, and this is not remediated by the transition to clean energy production. On the contrary, renewable energies do not create stable employment in rural areas. They can even foster depopulation as they crowd out other economic activities such as agriculture or rural tourism. Rural tourism contributes to the shift from traditional rural activities to new ones, which often increases employment opportunities in depopulated areas.

Second, fiscal policies can also generate employment in depopulated areas. They are fundamental to complement specific investments in specific sectors, like those already mentioned. Public investments and tax reductions have been found to be effective in generating a more dynamic economy, with companies hiring more workers and paying higher wages. Public investments accelerate business creation and services' demand from local companies. However, employment creation is a necessary but not a sufficient condition to stop depopulation.

Programs like EU's LEADER or Spain's SIPTEA have worked as bottom-up rural development accelerators and as incentives to economic activity. Tax cut programs are found to have a stronger impact than interventions from the spending side. In general, policies such as the reduction of social security contributions or the creation of tax-free zones generate employment and raise salaries in areas at risk of depopulation.

Third, social public interventions play a crucial role in complementing the other three categories. It has been already said that employment creation is not enough to reduce depopulation by itself; housing policies are needed to incentivize the presence or the migration to rural areas. Results suggest that public interventions to achieve affordable housing are important in depopulated areas where private initiatives do not provide it.

The provision of education, health, and sociocultural services significantly influences individuals' decisions on where to live. In rural or depopulated areas, these services do not need to be offered in the same manner as in large cities, where economies of scale provide additional efficiencies in the provision of services. Tailoring different formats of service delivery can enhance the appeal of these rural areas. The literature examined points that some specific services, such as hospitals, universities, and shopping centres, require large populations and agglomerations to be economically viable.

Finally, infrastructure policies ease the access to those services that require large agglomerations through increased connectivity and accessibility. Research shows that adequate infrastructures are fundamental to turn a depopulation trend into a population gain one. On the one hand, thanks to Information and Communication Technologies (ICTs) new possibilities are flourishing for depopulated areas such as those related to e-commerce or remote teleworking. On the other hand, the development of transport infrastructure from unpopulated areas to more populated ones increase the accessibility of both areas. Infrastructure improvements would lead to easier access to cities where agglomeration services are available, which constitutes a way to access them from rural areas in a reasonable time span.

The simultaneous combination of policies that belong to the four categories in Figure 2 would improve the effectiveness of public interventions to curb rural depopulation. For instance, to address the problem of low employment in a rural depopulated area, policymakers would need to implement sectorial policies (housing) and fiscal policies (public investments or tax cuts) simultaneously. At the same time, socially-oriented interventions would provide the basic services that individuals need for their daily life, while infrastructure investments would connect rural areas with those that offer large-scale services. The notion that policy interventions need to follow a holistic approach, rather than an atomistic one, is present throughout the literature. However, this hypothesis is not specifically evaluated in any of the revised papers, but a large quantity of them point in this direction.

4.2. Critical analysis of the literature

Previous discussion based on policies comparison raised several questions related to the nature and characteristics of the revised literature. To better understand its key features we present a critical analysis of the literature revised around three vectors. First, we stress the limitations and specificities of the literature on policies to tackle rural depopulation. Second, we highlight

the consequences derived from them. Finally, we stress how these particularities and weaknesses should condition policymakers' decisions and researchers' strategies.

There are three big limitations that the analyzed literature undergoes. The first one is its atomization. Most of the analyzed papers respond to very narrow research questions, like the impact of irrigation projects on population (Silvestre and Clar, 2010), services provision in rural areas (Goodwin-Hawkins et. al, 2021) or the establishment of fiscal incentives for job creation in specific sectors (Keane and Garvey, 2006). Furthermore, almost 23% of the literature analyzes the research on a specific year and not in a broader time frame, which naturally limits its scope, as it can be seen in Figure 3:

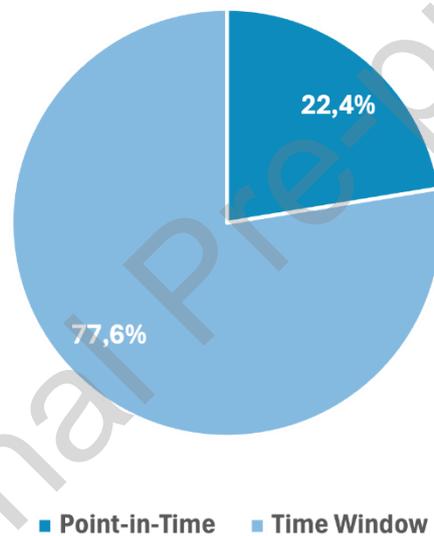


Figure 3. Distribution of Reviewed Articles per Time Frame Analysis

The second one is its regional and geographical approach. 80% of the analyzed articles focus on European countries or regions. Of the remaining studies, only four were conducted in America, three in Asia, and one in Oceania, with none addressing depopulation in Africa. This distribution can be attributed to the fact that depopulation predominantly affects advanced and mature economies characterized by demographic stagnation.

As for its regional-level analysis, 65% of the articles cover administrative units smaller than the country (regions, counties or municipalities). Only 22% of analyzed articles implement cross-country comparisons (13%), as can be seen in Figure 4.

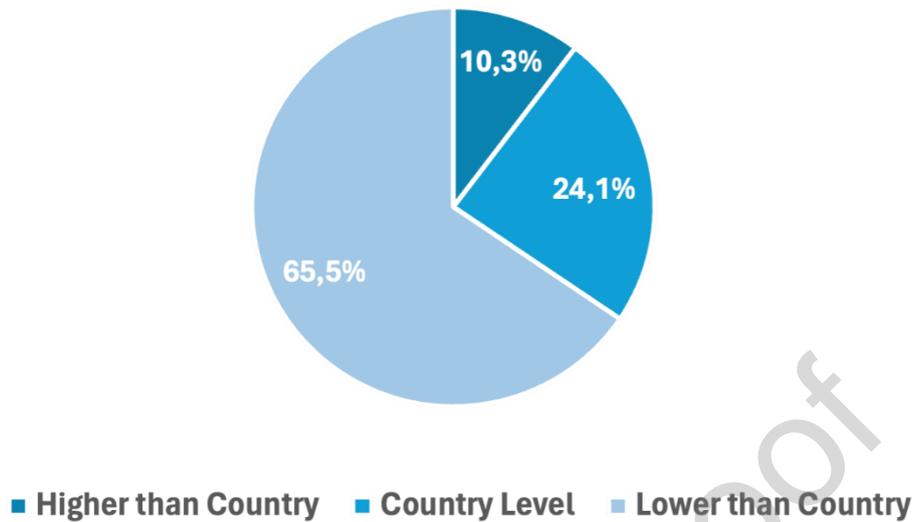


Figure 4. Distribution of Reviewed Articles per Administrative Level Covered

This result is not particularly surprising, as most anti-depopulation policy interventions tend to tackle specific areas rather than covering full countries. However, the lack of comparative analyses or articles that elevate circumstantial findings to permanent, reduces the aggregate robustness of this literature.

The third problem is connected with data availability and research methods. The lack of aggregate and homogeneous public data on depopulation policies leads researchers to rely on case studies, surveys or theoretical conjectures. More than 35% of the considered papers use these methods for data obtention, as shown in Figure 5. Decade by decade analysis shows that the percentage of qualitative articles has decreased from 50% in the 2000-2009 period, to 43% in the next 10 years, to 38% since 2020. Even if this trend suggests the existence of a richer-data environment, researchers seem to have adapted their strategies to this data-scarcity setting. Empirical strategies rely heavily on simulations, differences-in-differences and cross-section estimations.

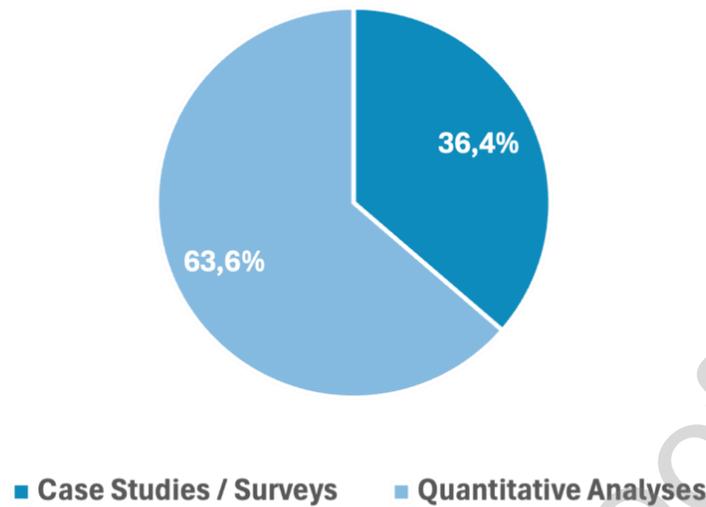


Figure 5. Distribution of Reviewed Articles per Research Strategy

From these limitations two consequences arise. The first one is the lack of comparability and scalability of the reviewed findings as, for instance, they often consider a very specific region or a set of municipalities during a single year. This makes the conclusions to be tentative and limited in many cases. The second one is that this literature cannot derive global and homogeneous findings.

For policymakers, this means that available research can only back pre-interventions analyses in a narrow and specific manner. Policies should then be adapted to the particularities of each issue and region. Furthermore, the lack of public data on depopulation and on the effects of policies to fight against it, demands a necessary effort from national and supranational authorities to produce quality, analogous and homogeneous data to foster comparable policy analysis and evaluation. Researchers, as it will be shown in the next subsection, have a large avenue to explore on the aggregation of all these atomized findings and on the analysis of all the new policies that are currently being implemented.

4.3. Limitations and future research agenda

The findings and limitations in this paper open a series of research avenues that could be complemented with substantial academic contributions. The reviewed articles combine an academic approach, as they are all published in peer-reviewed journals, with public policies assessments. Consequently, the revision does not cover non-peer-reviewed studies that are

often published by government agencies, NGOs, think tanks, or consultancy firms. These studies are also published in the national language of the country where the policy is implemented, which makes more complex the task of doing a generic worldwide comparison study. This is an area that should be covered in future literature reviews to obtain a more precise image of the anti-rural-depopulation policies efficiency.

Although this paper covers the academic evidence available worldwide, future research can also focus on developing region-specific studies adding non-academic evidence for the policies applied in one specific country. There is a trade-off between the size of the geographical scope covered and the possibility of including non-academic literature. Being less ambitious in the geographical scope to cover, allows to combine both academic and non-academic literature. Studies putting together both streams of literature would sacrifice academic rigour and geographical diversity, but at the same time they would incorporate the results from policy evaluations that would have been otherwise overlooked (i.e. evaluations from government agencies, think tanks, NGOs, etc.). This can potentially enrich the contributions of those articles that may have a deeper influence on policymakers due to the incorporation of non-academic references.

As explained before, the analysed results may suffer from a selection bias as none of the articles reports a null policy effect, which is something plausible in policy evaluations. Five articles present a negative effect on depopulation reduction, while the rest of them show a positive one. Literature has extensively documented this publishing bias when the effect found is null (Kepes et al., 2014). As a consequence, it would be useful in future research to document policies with null effects on depopulation.

With respect to results' comparability, it constitutes an almost inevitable limitation. The patterns in countries with intensely depopulated rural areas, like Spain or the Nordic countries, contrast with the reality of population losses in regions with vibrant rural areas like the Netherlands or Germany. On top of that, as has been already mentioned, the fact that almost all the literature covers only European regions limits findings' scalability.

All the policies evaluated in this review have as a main goal rural depopulation reduction as a quantitative variable. However, the discussion on the qualitative aspect of depopulation reduction is not presented in any study. The analyzed policies implicitly assume that having

more population is always better, without considering the qualitative characteristics of the population attracted or retained by rural depopulation policies. This opens the field to studies examining the types of individuals affected by these policies and how these individuals integrate into the daily lives of specific rural areas.

Finally, this paper opens a complementary line of study on the factors that are behind rural depopulation which cannot be influenced by public policies. It has been already commented that public policies may be unable to achieve certain goals associated with cultural and social perceptions of the so-called “rural world”. Future qualitative research is needed to explore the various motivations of individuals who leave rural, depopulated areas. Last, additional evidence is required to determine to what extent rural depopulation is driven by social and cultural perceptions rather than by the lack of material resources, which can potentially be addressed through public policies.

5. Conclusion

This paper presents a systematic review of the literature on policies’ assessments against rural depopulation. Our review covers 66 studies published since the year 2000 on prominent academic journals. Among all these studies, we differentiate four categories of thematic interventions: social, fiscal, sectorial and infrastructure policies.

Literature indicates that various public policies have been effective in mitigating, halting, or even reversing depopulation trends. Notably, policies involving tax exemptions and public subsidies can help to create employment and to foster business development in rural areas. Improved transport infrastructure also enhances accessibility. Additionally, providing housing, connectivity, and other basic services can further curb rural depopulation patterns.

These findings underscore the importance of adopting a holistic approach to effectively address the depopulation phenomena. Instead of focusing on a single policy, a combination of policies should be considered. More broadly, the results of this paper can help policymakers understand which policies are more effective than others in different contexts. Given the scarcity of public resources for policy interventions, this review contributes to the policymaking debate through a rigorous analysis of the efficiency of evaluated policies against rural depopulation.

This paper makes two significant contributions to the regional and rural literatures. Firstly, it synthesizes existing evidence on evaluated policies aimed at addressing rural depopulation. By comparing different policy areas, it enhances the discussion on the efficiency and redistributive features of rural depopulation policies, as well as the interconnections between them. Secondly, this paper offers a critical analysis of the literature, identifying its main weaknesses: excessive atomization, lack of generalizability, and the production of partial and non-scalable results due to data scarcity and the local focus of policies.

This paper has several limitations as mentioned above. First, our methodology is limited to articles that contain policy assessments. Consequently, some effective policies may be excluded from our analysis if they have not yet been formally evaluated in academic journals. This exclusion may leave out of our analysis some policy interventions due to our methodological focus, which aims to ensure comparability of results across different countries, regions, and policy interventions.

Second, it does not encompass all the motivations behind individuals' migration decisions, which may be influenced by cultural or social factors (Figueiredo et al., 2020). Public policies primarily aim to achieve social ends (e.g., reducing depopulation) through material means (e.g., infrastructure construction, subsidies, service provision). However, migration's decisions between rural and urban places might be influenced by other interests and objectives beyond material means, as the literature on this topic suggests (Alonso-Carrillo et al., 2023).

Third, our analysis focuses on population decline as a wide, tangible and measurable indicator which might guide policy interventions. Nevertheless, we acknowledge that some circumstances of rural areas (ageing, brain drain, floating population, or negative net migration, among others) recommend a more complex analysis beyond population decline to evaluate the success of a specific policy through more systematic analysis (Chaplitskaya et al., 2024). These systematic approaches could consider, *inter alia*, research criteria attending to the territorial scope of each of the initiatives (region-based versus local-based initiatives) or even the governance and applicability of these policies (top-down or bottom-up approaches). Considering these categories could offer valuable perspectives. Future research could benefit from analysing the presented policies from those perspectives, as well.

Fourth, the article does not differentiate between preventive or adaptive policies. This is a crucial distinction to analyse rural depopulation policies which was not commonly found in the reviewed literature. Consequently, we grouped all studies under the single category of “depopulation policies”. We believe that future research should consider this policy perspective to increase our understanding of the impact of public interventions on this phenomenon.

Fifth, the articles included in the study are not evenly distributed across continents and countries. This imbalance is partly due to the fact that depopulation is a phenomenon predominantly observed in developed countries (Westlund & Borsekova, 2023). As a result, with the exception of two studies on China and one on Mexico, the evidence presented in this paper is largely drawn from developed nations. Specifically, the dataset includes three studies on the United States and one on Japan, while the remaining evidence focuses on European countries. Some of these studies provide supranational insights, covering regions such as the OECD or the European Union as a whole. Within the substantial European focus, Spain stands out, accounting for 23 of the 66 studies. This overrepresentation can be attributed to Spain's unique demographic characteristics: the country exhibits the lowest density of settlements in Europe, making its uneven and sparse spatial population distribution an anomaly in the European context (Gutiérrez et al., 2023). This distinct pattern has garnered significant academic attention, with researchers seeking to understand its underlying causes and consequences.

Lastly, a key limitation of this paper lies in its methodological inability to delve into the sociocultural perceptions influencing the depopulation process. While the paper rigorously evaluates public policies, it does not explore how rural areas' perceptions and values shape individuals' decisions. Depopulation cannot be solely attributed to housing or employment shortages. On the contrary, individuals' perceptions on rural living standards may play a significant role on their decision to reside in rural areas. Empirical assessments focusing on the sociocultural dimensions of rural depopulation are notably lacking. Therefore, further research efforts should be made to shed light on these under-looked aspects.

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Annex 1. Summary table of the papers included in the systematic literature review

SECTORIAL POLICIES					
Author & year	Country	Period	Sample	Method	Results
AGRICULTURE & LIVESTOCK					
Cazcarro et al., 2024	Spain	1910-2011	8122 municipalities	Difference-in-differences	Irrigation projects increase population during an initial period, but the positive effect vanishes after some time. The effect is diverse depending on the construction time.

Tenza-Peral et al., 2022	Mexico	2010-2050	Region of Oasis of Comonú	Dynamic simulation model and a sensitivity analysis	Improving agriculture and livestock yields leads to a reduction or even reversal of depopulation.
Miranda et al., 2006	Spain (Galicia)	1960-2000	2490 parishes and 180 municipalities	Statistical analysis of the EU evaluation guidelines	Land consolidation helps to slow rural depopulation.
Lasanta & Laguna, 2007	Spain (Central Pyrenees)	1986-2001	All municipalities in the Aragonese Pyrenees	Bivariate analysis of correlations	Agricultural subsidies like the CAP help reduce depopulation, although they do not reduce ageing. They also complement income from tourist activities.
Grodzicki & Jankiewicz, 2022	Baltic states	2000-2020	Estonia, Latvia, Lithuania	Time series analysis in the frequency domain.	The CAP positively affects GDP growth, poverty reduction, broadband network access, bed places and employment. These effects of the CAP reduce depopulation.
Morettini, 2023	Italy	1911-1971	1285 municipalities	Ordinary Least Squares regression model	Implementing taxes to livestock activities to achieve environmental goals fosters out-migration, inequality, food insecurity and power conflicts.
Silvestre & Clar, 2010	Spain (Ebro basin)	1900-2001	90 villages	Comparisons of percent changes in compound annual growth.	Irrigation projects have diverse effects. In some cases, they can help to increase population. In others, population is stabilized, or they can cause a slight decline.
ENERGY PRODUCTION					
Duarte et al., 2022b	Spain (Aragon)	1996-2018	Campo de Belchite county (9 wind farms)	Synthetic Control Method	Renewable energy implementation fosters depopulation by avoiding other local activities like agriculture or tourism and do not generate stable employment.
Duarte et al., 2022a	Spain (Aragon)	2020	97 surveys of 34 questions each	Survey Analysis	Citizens affected by renewable energies do not perceive that their installation helps reduce depopulation or generates sustained employment.
Pérez-Sindín López et al., 2023	Spain	1991-2001	Municipalities in Asturias, León, Palencia and Teruel	Nearest Neighbor Matching technique	The closing of coal mines significantly fosters depopulation in rural areas.
Phimister & Roberts, 2012	United Kingdom	2005	North East Scotland region	Regional Computable General Equilibrium Model	Local ownership and local reinvestment of the benefits from renewable energies increase

Fabra et al., 2023	Spain	2006-2020	3.200 municipalities	Treatment and control regressions to estimate projections	household income and retain population. Solar plants generate some employment, although it is not local. Wind plants do not generate any significant change in employment.
TOURISM					
Hashimoto & Telfer, 2010	Japan	2003-2008	Oita prefecture	Case study	The development of the rural tourism sector is effective to reduce depopulation in traditionally agricultural societies.
Vidal-Matzanke & Vidal-Gonzalez, 2022	Spain (inland Castellon province)	2020	16 individuals	Semistrucured interviews	Sports tourism contributes to slow depopulation and develop local business in that sector that generate employment in rural areas.
Cáceres-Feria et al., 2021	Spain (South–West)	2000-2020	Linares de la Sierra village	Case study	Community-based tourism offers a complement to traditional rural tourism that allows the village to maintain the population figures stable.
Alcalá, 2018	Spain	2001-2018	Teruel province	Case study	Decentralized institutions that combine museums and science and take profit from endogenous resources can be effective in reducing depopulation in sparsely populated areas.
Larraz & San-Martin, 2021	Spain (Cuenca, Guadalajara and Madrid)	1900-2011	Rural municipalities near the reservoirs	Comparative analysis of the population in the municipalities	Infrastructures like water reservoirs, if their use is combined with touristic uses, have the potential to develop rural tourism to stop depopulation.

SOCIAL POLICIES

Author & year	Country	Period	Sample	Method	Results
GENERAL SERVICES					
Christiaanse, 2020	Netherlands	2000-2012	Fryslân province	GIS networks analysis	Decline in facilities in rural areas is not in line with demographic changes but with the size of the municipality. Where basic facilities cannot be provided in every municipality, it is important to have a network approach that ensures a reasonable distance. Clustering

OECD, 2010	OECD countries	1991-2007	All OECD countries, with a special focus in United Kingdom	Case study comparison	services in a big municipality is not efficient in retaining the populations of small municipalities. Some important factors for service delivery in rural areas at risk of depopulation are monitoring performance and providing incentives, promoting decentralization and adequate funding, and strengthening local democracy.
Alamá-Sabater, 2021	Spain	2010-2019	542 municipalities of the Valencian region	Spatial population growth model	Instead of trying to have the highest possible number of services in each small municipality, creating clusters of municipalities for service provision is crucial to prevent depopulation.
Paniagua, 2020	Spain	2017-2020	9 initiatives developed in Spain	Theoretical analysis	The smart village concept and technology has the potential to develop solutions against depopulation improving the existing economic sectors.
Náñez Alonso et al., 2022	Spain (Castille and Leon)	2021	Provinces of Palencia, Ávila, Zamora, Segovia, and Soria	Calculation of indexes of accessibility	The multiprovision of services helps reduce depopulation by providing various services with the same infrastructure. The possibility of accessing cash in rural pharmacies implies a significant increase in the accessibility to that service.
Goodwin-Hawkins et al., 2021	Austria, Finland and Wales	2013-2021	Initiatives in Ceredigion (UK), Allerleierei (Austria) and Finland.	Conceptual framework proposition derived from case study analysis	A neo-endogenous approach to the provision of services in rural areas is crucial to reduce depopulation. Local capacities should be mixed with exogenous resources, diverse networks and digital platforms
HOUSING					
Cheng et al., 2019	China	2015	Municipalities in the Fuping County	Construction of a symbiotic index	The parallel development of housing and industry/employment is the basis for gaining population and revitalizing rural areas.
Gkartzios & Norris, 2011	Ireland	1998-2006	267 electoral divisions	Mixed methods: GIS analysis and	Fiscal incentives for the renovation and construction of houses in rural areas stops population decline,

				semistructured interviews	generates temporary employment and increases housing output.
Norris & Winston, 2009	Ireland	1991-2006	9 regions and 3 counties	Statistical data analysis and case studies	Subsidies for housing produce an excess of housing vacancies in rural areas if the subsidy is not directed to first residences instead to any type of residence. To reduce depopulation, subsidies should be focused on permanent habitants.
Hernández-Ramirez et al., 2021	Spain	2018	Huertas village, Sierra de Arracena Mountains	Ethnographic case study	The use and management of redundant housing is a fundamental factor to revitalize villages and reduce depopulation.
Gallent et al., 2002	Europe	1990-2000 (approx.)	10 European countries	Case studies and statistical analysis	Diverse and varied results in the many chapters of the book. Across Europe, the housing market in rural areas is quite different from the housing market in urban areas, with different problems and solutions. A good housing policy is key to stop depopulation.
HEALTH SERVICES					
Henderson & Taylor, 2003	United States (Texas)	1996	484 hospitals in 251 counties	Generalized and zero-inflated Poisson linear models	Since population is the main determinant of having a hospital in a specific area, rural areas tend to be underserved by hospitals and health centres. The presence of a hospital plays an important role in the population growth of a region.
Sørensen, 2008	Denmark	2005	1000 individuals	Fully structured interviews	Most patients in rural areas reject the idea of tele-medicine as a way to deliver services in depopulated areas.
Shipman et al., 2019	United States	2017	618.856 applications	Statistical analysis	There is a lack of professionals who want to provide health services in rural areas. This problem is predicted by the fact that rural individuals are an underrepresented minority in medicine and other related studies.
EDUCATIONAL SERVICES					
Lehtonen, 2021	Finland	2010-2018	2297 schools in 336 municipalities	Difference-in-differences	Maintaining schools in small villages helps retain population and reduce depopulation.

Sørensen et al., 2021	Denmark	2011-2021	8 rural schools	Difference-in-differences and qualitative surveys	Closing schools accelerate the speed of depopulation in rural areas both in the short and long run.
Lovén et al., 2021	Sweden	1990-2013	63.000 individuals in 21 municipalities	Difference-in-differences	Maintaining universities in small regions helps reduce depopulation, keeping individuals who otherwise would have migrated to pursue higher education.
Cedering & Wihlborg, 2020	Sweden (Ydre municipality)	2002-2010	24 individuals affected and 12 policy-makers	Semistructured interviews	Schools in rural areas are more than a place for teaching and learning, they are important community hubs that strengthen the life in the village. Closures that do not consider this dimension contribute to declining rural areas.
Kłoczko-Gajewska, 2020	Poland	2004-2016	29 individuals	Semistructured interviews	School closures in small villages contribute to the decline of structural and cognitive social capital, that is among the factors that explain depopulation of some rural areas.
SOCIOCULTURAL SERVICES					
Mount & Cabras, 2016	United Kingdom	Not specified	715 municipalities	Structural Equations Model	Village bars/pubs are complementary to the provision of other services and the serve as community meeting points. Maintaining village pubs is effective in reducing depopulation.
Iversen et al., 2021	Denmark	2020	27 individuals	Semistructured qualitative interviews	Facilities and meeting places in rural areas play an important role in the increase of the self-assessed quality of life. The closing of those facilities and places contribute to depopulation.
NATALITY & IMMIGRATION					
Collantes et al., 2014	Spain	1991-2008	22 provinces	Estimations and contrafactual techniques	International migration helps reduce depopulation or even increase population in rural areas in the short run.
Bayona-i-Carrasco & Gil-Alonso, 2012	Spain	1996-2009	480 municipalities	Typology constructions	International migration does not reduce depopulation in rural areas. This happens only in municipalities whose main economic sector is rural tourism or those that are near to urban areas.

Brainerd, 2014	Central and Eastern Europe	1970-2010	7 countries	Statistical analysis	Policies to encourage fertility are only modestly effective in increasing the number of children per marriage.
Cook et al., 2022	Russia, Poland & Hungary	2000-2019	3 countries	Statistical analysis	Pro-natalist policies have limited impact on fertility.
Cobano-Delgado & Llorent-Bedmar, 2020	Spain (Celtiberian Range)	Not specified	280 individuals	Mixed methods (Qualitative and quantitative data collection)	Women have higher migration rates from rural to urban environments since they have more job opportunities, basic services and leisure opportunities. The migration of women and masculinization of rural areas is one of the key factors explaining depopulation.

FISCAL POLICIES

Author & year	Country	Period	Sample	Method	Results
GENERAL PUBLIC INVESTMENT PROGRAMS					
Esparcia et al., 2015	Spain	2011	13 individuals (team managers and chairpersons)	Focus groups	LAGs play an important role in fostering economic development in rural depopulated areas in Spain. However, they face the risk of becoming an instrument of power and clientelism.
Bosworth et al., 2015	England	2012-2013	549 individuals from 64 LAGs	Interviews and questionnaires	The LEADER program generates a diversity of projects and a diversity of outcomes. The model works in promoting networking, supporting innovation and taking a bottom-up economic development approach in remote areas.
Bruckmeier, 2002	Germany	1994-1999	LAGs in the West part of the country	Case study	The LEADER program is contributing to sustainable rural development, but it can improve its ability to keep population in rural areas by improving innovation and governance systems.
Scott, 2010	United Kingdom	Not specified	15 LAGs in Northern Ireland	Semistructured interviews	Adaptation to the LEADER methodology was at first difficult, but further adjustments of the program are viewed by practitioners as a

Serra et al., 2023	Spain	2002-2012	Municipalities in Extremadura and Andalusia	Logistic probabilities estimation	potential for rural development. The PER subsidy for rural unemployment helps to reduce depopulation in those municipalities where the citizens receive the funds.
Monturano et al., 2023	Italy	2014-2020	269 municipalities	Staggered difference-in-differences	Financial aid from the SNAI program significantly increases the number of businesses created in depopulated areas, contributing with positive spillovers too.
Navarro-Valeverde et al., 2021	Spain	2015-2020	70 depopulated municipalities in Andalusia region	Diagnosis of the Local Development Strategies and SWOT analysis.	A risk of LAGs is that they focus on the more dynamic and populated municipalities, leaving aside those depopulated municipalities that precisely are more in need of the LEADER aid.
Jofre-Monseny, 2014	Spain	1981-1991	Municipalities in Extremadura and Andalusia	Regressions with border identification strategy.	Subsidy transfer programs to rural partially employed individuals reduce depopulation. In absence of the subsidy, there was a population loss of 15% for that period, while with the subsidy, there was a population gain of 3%.
TAX CUTS PROGRAMS					
Keane & Garvey, 2006	Ireland	1997-2003	48 local employment offices	Panel data with fixed effects regression	Fiscal incentives for construction activities generate employment creation in sparsely populated areas.
Benmarker et al., 2009	Sweden	2001-2004	More than 50.000 workers	Difference-in-differences	The reduction of social security contributions in depopulated areas do not increase employment in existing businesses, but they increase the creation and attraction of businesses. Salaries also rise.
Ku et al., 2020	Norway	2000-2006	880.812 workers	Difference-in-differences	The reduction of social security contributions in depopulated areas increase both employment and salaries in those regions.

Kettlewell & Yerokhin, 2017	Australia	1921-1961	More than 250 municipalities	Difference-in-differences and discontinuous regression models	The creation of tax-free zones in depopulated areas produce an increase of the population living in those regions.
Lynch & Zax, 2011	United States (Colorado)	1990-2000	55.334 establishments	Heckit regressions	The creation of tax-free zones creates employment in depopulated regions, in contrast with urban environments, where this policy does not create employment.
Rybalka et al., 2018	Norway	1997-2014	All the workers affected by the tax reductions	Difference-in-differences, regression kink design, GMM estimators, Fixed effects and Between effects.	The reductions of the social security contributions increase employment and wages in depopulated areas, helping those territories to gain population. Existing firms create more employment, but also new firms are created.
Behaghel et al., 2015	France	1996-2009	Firms and employments in 789 low-density cantons	Regression Discontinuity Design	Tax exemptions that are not generous enough for firms do not create employment or wage increases in rural depopulated areas.

INFRASTRUCTURE POLICIES

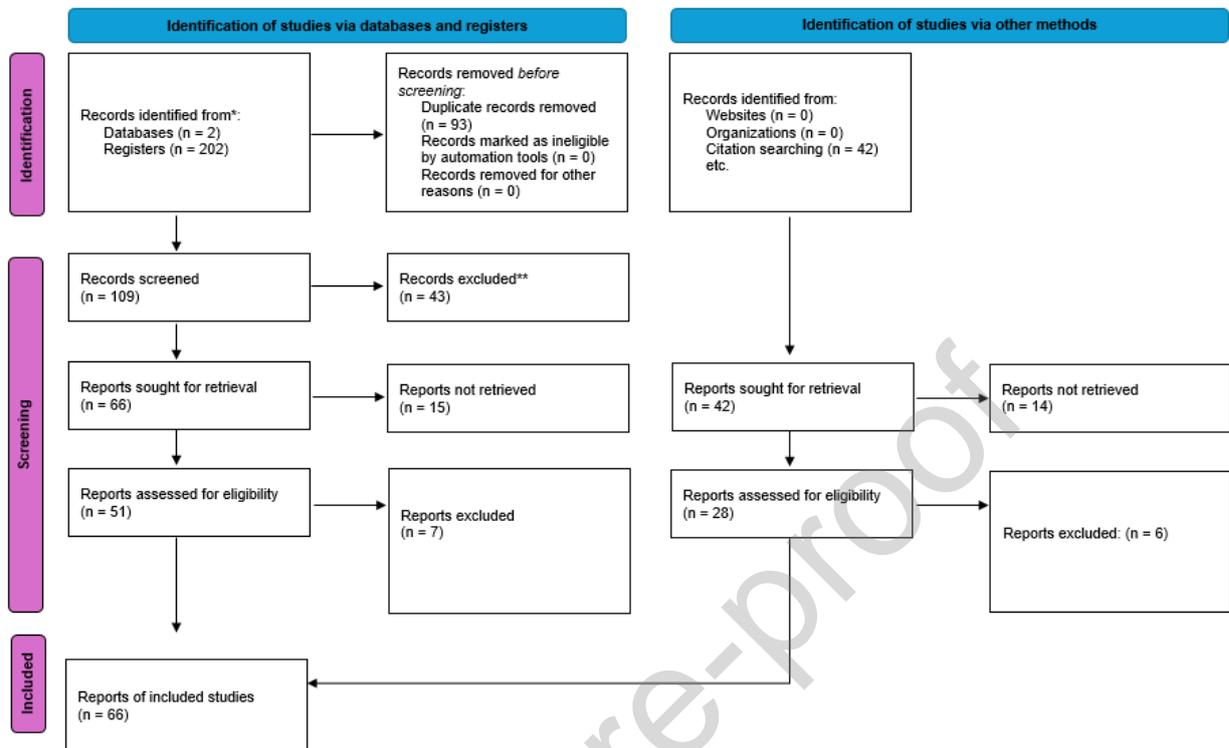
Author & year	Country	Period	Sample	Method	Results
TRANSPORT INFRASTRUCTURES					
Levkovich et al., 2020	Netherlands	1970-2018	78 municipalities	Ordinary Least Squares regressions	The construction of highways improves accessibility and produces the migration of individuals from urban to rural areas.
Adler et al., 2020	Europe	1990-2012	26 EU countries (All except UK and Ireland)	Instrumental variables regressions	Transport infrastructure increases market access. "An increase in market access by 1% increases regional population by 0.6%, GDP by 0.2%, and employment by 0.7% on average." Benefits are higher when connecting those regions with less market access.
Lu et al., 2022	China	2016	227 prefectural cities	Geographically weighted regressions considering instrumental variables	National, provincial and municipal roads narrow the urban-rural income gap by facilitating rural labour mobility and increasing rural incomes. This makes

Bjarnason, 2021	Iceland	2000- 2020	Total population of Fjallabyggð municipality	Statistical analysis	rural areas more attractive for living. “Improved road infrastructure coincides with a break in long-term population decline through parity in net migration and positive changes in the composition of the population of sparsely populated areas.”
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DIGITALIZATION AND CONNECTIVITY

Esteban- Navarro et al., 2020	-	2016- 2020	28 studies	Scoping literature review	Connectivity enhancement is effective in promoting economic development of rural remote areas. This digital inclusion is a potential tool for retaining population in these areas.
Lehtonen, 2020	Finland	2010- 2018	Population grid cells of 1 km in all the country	Difference-in- Differences	The availability of broadband connection reduces the depopulation of remote and sparsely populated rural areas. However, broadband infrastructure cannot alone solve the structural problems of rural areas.
Briglauer et al., 2019	Germany	2010- 2014	All municipalities in the Bavaria region	Difference-in- Differences	Increasing broadband coverage with state aid decreases the depopulation of sparsely populated areas.
Salemink et al., 2017	-	2013	157 studies	Systematic literature review	Digital connectivity can compensate for the lack of physical connectedness in some depopulated areas. However, less physically connected areas usually also have less digital connectivity.

Annex 2. PRISMA 2020 flow diagram for new systematic reviews



From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: <http://www.prisma-statement.org/>

Conflict of Interest

The authors have no conflict of interest to declare.

Declaration of interests

- The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.
- The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: