Journal of Rural and Community Development

Circular Economy and the Rural Environment in the Post-COVID Era: New Models Against Longstanding Challenges

Authors: Miguel-Ángel García-Madurga & Ana-Julia Grillo-Mendez

Citation:
García-Madurga, M.-A., & Grillo-Mendez, A. J. (2023). Circular economy and the rural environment in the post-COVID era: new models against longstanding challenges. *The Journal of Rural and Community Development*, *18*(4), 125–154.

Publisher:
Rural Development Institute, Brandon University.

Editor:
Dr. Doug Ramsey

ISSN: 1712-8277 © Authors
www.jrcd.ca

Circular Economy and the Rural Environment In the Post Covid Era: New Models Against Longstanding Challenges

Miguel-Ángel García-Madurga
University of Zaragoza
Zaragoza, Spain
madurga@unizar.es

Ana-Julia Grillo-Mendez
University of Zaragoza
Zaragoza, Spain
agrillo@unizar.es

Abstract

The depopulation of rural areas is a major problem with relevant environmental and socio-economic implications. This article identifies and analyses the proposals made by the academic literature to contribute, with the help of the circular economy, to gradually reverse this situation while recovering from the impact of the COVID-19 pandemic. For this purpose, a systematic review has been carried out, whose flow of inclusion decisions, based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses [PRISMA] methodology, has allowed the selection of thirty-nine articles from the main scientific databases, Scopus and Web of Science. Its qualitative analysis concludes that the research focuses on the strategies to be adopted to implement the principles of the circular economy in rural areas and on case studies on the use of fruit and vegetable waste and energy generation. Future studies should establish the procedures for scaling up these experiences.

Keywords: systematic review, circular economy, rural environment, COVID-19 pandemic recovery.

Économie circulaire et environnement rural à l'ère post-Covid : de nouveaux modèles contre des défis de longue date

Résumé

Le dépeuplement des zones rurales constitue un problème majeur ayant des implications environnementales et socio-économiques importantes. Cet article identifie et analyse les propositions faites par la littérature académique pour contribuer, avec l'aide de l'économie circulaire, à inverser progressivement cette situation tout en se remettant de l'impact de la pandémie de COVID-19. À cet effet, une revue systématique a été réalisée, dont le flux de décisions d'inclusion, basé sur la méthodologie PRISMA, a permis la sélection de trente-neuf articles issus des principales bases de données scientifiques, Scopus et Web of Science. Son analyse qualitative conclut que la recherche se concentre sur les stratégies à adopter pour mettre en œuvre les principes de l'économie circulaire dans les zones rurales et sur des études de cas sur l'utilisation des déchets de fruits et

légumes et la production d'énergie. Les études futures devraient établir les procédures permettant d'étendre ces expériences.

Mots-clés : revue systématique, économie circulaire, environnement rural, reprise après la pandémie de COVID-19.

1.0 Introduction

For the first time in history, more people live in urban areas than in rural areas (United Nations, 2020). This trend is unstoppable, to the point that world population growth over the next three decades is expected to occur almost exclusively in cities: 68% of the population will live in urban areas by 2050 (United Nations, 2018), largely due to migration from the rural world.

Depopulation has already become commonplace in many rural regions and communities and will be difficult to reverse. The abandonment of agricultural land is a major problem, with environmental, socio-economic, and landscape implications that affect not only the abandoned area and its local population but also society as a whole (Lasanta et al., 2017). In this difficult context, movements of middle-class people from urban areas in search of a rural lifestyle (Milbourne, 2007) and new immigrants have provided some areas with a demographic lifeline (Johnson & Lichter, 2019) and, together with commercial networks and information technology, have transformed spaces that were often considered isolated and stagnant areas into dynamic places connected to the rest of the world (Pires de Almeida, 2017).

From an economic perspective, the rural world is perceived as strictly agricultural and dedicated to primary production, and, unlike urban spaces, is endowed with industrial activities and services (Crovetto, 2019). For decades, agricultural and, therefore, rural development has been based on specialization, intensification, and scaling up. This has ended up weakening the economic resilience of farms and forcing farmers to experiment with alternative avenues of development based on diversification and a resurgence of interest in local products. This decision has required the learning of the skills to market high-value-added agricultural products, the establishment of short food chains, the rebuilding of supportive social and economic networks (DeRoest et al., 2018), the increase in the ability of farmers to interact with other actors in the supply chain over time and space and the support of institutions and agencies charged with supporting economic and social regeneration in rural areas in power struggles operating in the development of new food supply (Marsden et al., 2000).

Gradually, to have a basic agrarian role, providing food, raw materials, and human resources to cities, rural areas have shifted towards a multifunctional profile (Rubio, 2010). The multifunctionality of agriculture and rural landscapes has garnered increasing academic and policy attention in recent years (Renting et al., 2009; Song et al., 2020). These studies underscore the potential of agricultural activity to provide functions beyond food production, such as natural resource management, environmental conservation, and socio-economic contributions. While there are various approaches to analyzing and measuring agricultural multifunctionality at the landscape scale, a key challenge is to integrate them to support decision-making and policy design for the advancement of sustainable rural communities.

However, in a rapidly changing global digital economy, rural-based microenterprises are at risk of being left behind: many rural communities cannot exploit the full potential of the Internet and remain at a comparative disadvantage

compared to most of their urban counterparts (Philip & Williams, 2019). Actions to close the digital divide must be oriented towards diverse aspects, depending on the differences derived from the resources available to access ICT or the geographical, demographic, educational, socio-economic, and cultural disparities that condition the capacity and skills for the use of these technologies (Esteban-Navarro et al., 2020).

For a long time, priority has been given to urban development at the expense of agriculture and the rural economy, widening the gap between urban and rural areas (Long & Woods, 2011). But rural areas should not be perceived only as places with development problems and subordinate to urban areas, as they present important opportunities and increasing resilience (Tonts et al., 2014). An intelligent and carefully adapted management system that allows for sustainable development and the focus on social innovation aspects are essential to harness such potential (Matthews et al., 2016). In the current context in which resource scarcity is beginning to be felt in both policies and markets, reintegrating agriculture with rural and urban in new and innovative ways has become essential. The question is how to put it into practice. One possible answer is the development of an integrative eco economy (Kitchen & Marsden, 2009), with agroecology, which raises the need for the conservation of all forms of life integrated into ecosystems, agroecosystems or "ethnoagroeco" systems (Sevilla, 2006), the social economy (Anderson & Bell, 2000), which promotes local development processes that generate income and employment in rural areas and contributes to the fixation of human capital to the territory (Juste et al., 2011) and the circular economy as main banners.

Crises cause turbulence in the market due to changes in routines and structures (Williams et al., 2017), although their impact is very uneven depending on the sector. This article argues that the actions undertaken by actors in rural areas under the umbrella of the circular economy would be desirable if they were accelerated due to a post-COVID-19 environment. This is due to the fact that an environment in which changes are traditionally slow, such as the rural environment, will be forced to change quickly, like the rest of the sectors. The circular economy is a way to promote sustainable development, reduce environmental damage and face the challenge of resource scarcity (Homrich et al., 2018). In contrast to the linear economy, which ignores the environmental impacts linked to resource consumption and waste disposal, the circular economy is concerned with the impact of economic activity on the environment, promoting efficiency in the use of resources (Sauvé et al., 2016). In fact, the concept of waste disappears in a circular economy, because products and materials are, in principle, reused indefinitely (Den Hollander et al., 2017). The circular economy has a great potential for job creation and serves as an extraordinary starting point for new and innovative business models, which integrate their principles into their value propositions (Urbinati et al., 2017; Geissdoerfer et al., 2018; Manninen et al., 2018).

Scientific production on circular economy has grown exponentially in recent years, as society has become more aware of the enormous environmental problem we face. And there have also been numerous systematic reviews carried out on the circular economy (Ghisellini et al., 2016; Kalmykova et al., 2018; Govindan & Hasanagic, 2018), but none focuses on success stories of applying circular economy paradigms in rural areas. It seems the right time to synthesize such experiences and highlight the opportunities that the circular economy offers to overcome the challenges facing the rural world: help to identify the best experiences and good practices of circular economy in rural areas, based on scientific studies, is a research problem of obvious scientific and social relevance.

The aim of this article is, therefore, to provide society and its actors with a general and sufficiently concise knowledge of the real applications of the circular economy in rural areas so that the relevant specialized research is brought together in a single document which, as an executive summary, provides the basis for its applicability. To this end, and based on the documents selected with the help of the methodology that will be described later, the following research question will be elucidated: How can the circular economy contribute to solving the challenges facing the rural world according to the studies based on the application of social research methods and techniques carried out so far?

The manuscript is structured as follows: identification of a relevant research problem from a literature review focused on the circular economy and its importance in addressing the challenges of the rural environment; a detailed explanation of the methodology used; presentation and discussion of results; and, finally, reflection based on the results of the study and its limitations and implications for future studies.

2.0 Materials and Methods

Systematic reviews provide a synthesis of the state of knowledge in a field, from which future research priorities can be identified; they address questions that otherwise could not be answered by individual studies; they allow research problems to be identified for future studies; and they can generate or evaluate theories about how or why phenomena occur (Page et al., 2021). Carrying out reviews is undoubtedly one of the main methods of knowledge synthesis (Grant & Booth, 2009).

The review was conducted following the PRISMA statement (Liberati et al., 2009). PRISMA consists of a checklist of 27 items and a flowchart outlining the steps authors should take when composing a systematic review and meta-analysis. It was developed by an international group that included methodologists, guideline developers, journal editors, researchers, and users of reviews (Moher et al., 2009).

PRISMA emphasizes the importance of thorough preparation to minimize bias, conducting a comprehensive literature search, having explicit criteria for the critical assessment of studies, as well as carrying out appropriate data analysis and presentation. The 27 items cover the title, abstract, introduction, methods, results, discussion, and funding. The flowchart illustrates the study selection process. PRISMA has been widely adopted, enhancing the informative quality of systematic reviews and meta-analyses. It provides a standardized framework to increase transparency, reproducibility, and comprehensiveness in such research (Moher et al., 2009). Therefore, PRISMA was followed to ensure a rigorous methodological process in this review.

The PRISMA guidelines were followed to ensure a robust methodology. PRISMA provides an evidence-based set of items to guide the reporting of systematic reviews and meta-analyses (Page et al., 2021). It builds on QUOROM and MOOSE guidelines, consisting of a 27-item checklist and a four-phase flow diagram depicting the process of study selection (Moher et al., 2009). For this review, the four main processes were carried out: identification of studies via databases and registers, screening of studies and application of eligibility criteria, full-text review of retained studies, and final inclusion of studies in the qualitative synthesis. Further specifics on the review protocol can be found in the PRISMA 2020 Statement (Page et al., 2021). Following PRISMA ensures the transparent and complete reporting of the systematic review methodology and results.

First, the inclusion and exclusion criteria were specified and documented as shown in Table 1. The exclusion is because the dissemination in the scientific community and the impact factor of the books and chapters is lower.

The inclusion criteria were limited to peer-reviewed research articles published in academic journals and conference proceedings in order to focus on studies that have undergone rigorous scholarly critique and evaluation. Books and book chapters were excluded for several reasons. Books and book chapters tend to have less visibility and impact within the scientific community compared to journal articles. Furthermore, journal articles allow for more current and up-to-date research to be captured, whereas books may present findings that are several years old by the time they are published. By focusing on peer-reviewed journal articles, this review aimed to provide a synthesis of the most current and rigorously evaluated research on the application of circular economy principles in rural areas. The inclusion of English-language articles allowed for feasibility while still capturing the majority of relevant literature. Future reviews could consider expanding the inclusion criteria to provide a more comprehensive view of the topic.

Table 1. *Inclusion and Exclusion Criteria*

Inclusion criteria	**Exclusion criteria**
Research studies published in scientific journals	Books and book chapters.
Conferences and minutes	
English language	

The database search in Scopus and Web of Science was conducted between March and May 2021. Keyword combinations and phrases pertinent to circular economy and rural settings were employed to construct the optimal search equation.

The keywords utilized for this search included: "circular economy" and "rural economy." The focus of the search was narrowed to thematic areas encompassing environmental sciences, social sciences, economics, business, management, and accounting.

The year range was restricted to publications from 2011 to 2021 to capture the most current literature on the application of circular economy in rural areas, given that the concept has gained significant traction within the last decade.

Constraints established in the search equation included articles in English published in peer-reviewed academic journals and conference proceedings. Books and book chapters were excluded for reasons delineated in the Materials and Methods section.

The final search equation employed was: TITLE-ABS-KEY ("circular economy" AND rural) AND (EXCLUDE (DOCTYPE,"ch") OR EXCLUDE (DOCTYPE,"bk")). This facilitated the retrieval of the most relevant articles on circular economy in rural settings indexed in Scopus and Web of Science.

Subsequently, a selection was carried out based on the title and the examination of the summary, opting for those transversals and/or generalizable contributions to business models in a broad sense. An evaluation of the degree of interest of the selected documents was then carried out based on two criteria: first, their

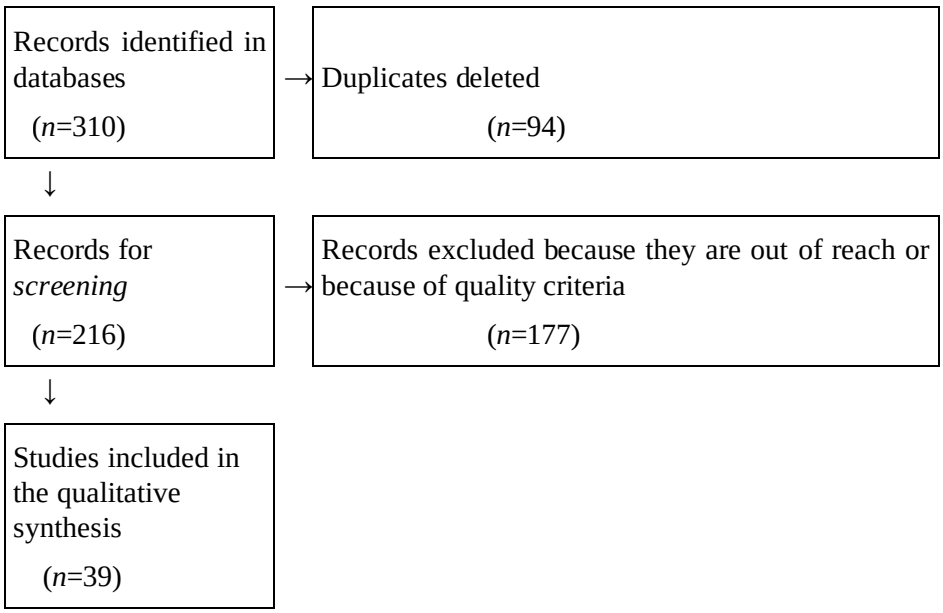
suitability for the objective of the study from the perspective of their scope; and second, the quality, understood as the originality of their contributions (Daudt et al., 2013) and the affirmative response to the five criteria proposed by Dixon-Woods et al. (2006).

The selection of studies was carried out in two phases. First, studies were screened based on title and abstract review, excluding those that were deemed out of scope or relevance to the research objective. Second, the retained studies underwent full-text review and were further evaluated for quality and originality based on the five criteria proposed by Dixon-Woods et al. (2006):

- Are the aims and objectives of the research clearly stated?
- Is the research design clearly specified and appropriate for the aims and objectives?
- Do the researchers provide a clear account of the process by which their findings were reproduced?
- Do the researchers display enough data to support their interpretations and conclusions?
- Is the method of analysis appropriate and adequately explicated?

Studies were excluded if they did not meet at least four of these five criteria. In total, 177 studies were excluded based on being out of scope or not meeting quality appraisal criteria. While a structured quality assessment tool was not utilized, the Dixon-Woods framework allowed for critical evaluation of study quality and rigour within feasibility constraints. Therefore, 39 documents were included in the qualitative synthesis. Figure 1 shows the flowchart of inclusion decisions with the process steps.

Figure 1. Flowchart of inclusion decisions.



3.0 Results

The studies included in the synthesis were aggregated into a table (see Table 2) with all relevant data to inform the research objective and question. The fields of extraction agreed by the team of researchers were the following: title, first author, journal or congress, year, keywords, and main contribution.

Table 2. *Studies Included in the Synthesis*

Title	Author	Magazine/ Congress	Year	Keywords	Main contribution
Building resilience: A self-sustainable community approach to the triple bottom line	Aguiñaga	Journal of Cleaner Production	2018	Circular economy, stakeholder management, zero waste, Mexico, regional sustainable development	Need for active participation by business and civil society where there is insufficient environmental leadership from governments for the implementation of circular economy principles
A biomass small-scale externally fired combined cycle plant for heat and power generation in rural communities	Amirante	Renewable Energy Focus	2019	Rural electrification, biomass, combined heat and power, rankine cycle isolated power systems	Innovative small-scale power plant capable of generating electrical and thermal energy from solid and gaseous biomass, to be used in rural electrification projects within the framework of the circular economy paradigm
Turning agri-food cooperative vegetable residues into functional powdered ingredients for the food industry	Bas-Bellver et al.	Sustainability	2020	Vegetable's waste, agri-food by-products, bio-waste valorization, bio-waste processing, food system sustainability, functional food ingredients	Example of collaboration between primary producers, the university, and the regional government for the transformation of vegetable waste into functional ingredients through a series of processes involving pretreatments and drying stages, aimed at maximizing bioactive compounds and their antioxidant activity
The "eco-effectiveness" of agritourism dynamics in Italy and Spain: A tool for evaluating regional sustainability	Belliggiano	Sustainability	2020	Agritourism, eco-effectiveness, rural development,	Development of a Synthetic Sustainability Index (ISS) to assess the eco-effectiveness of

				circular economy, index decomposition analysis (IDA)	the evolving dynamics of agrotourism
Circular biogas-based economy in a rural agricultural setting	Blades et al.	Energy Procedia	2017	Circular economy, anaerobic digestion, biogas, biomethane, renewable energy, dairy farming	Electricity production from an aerobic digestion (DA) plant that generates energy from a waste product, so that the plant provides renewable energy for agriculture and agriculture feeds the DA plant.
Circular economies for rural renewal: Revitalizing towns and their bioregions	Brown	WIT Transactions on Ecology and the Environment	2019	Circular economy, rural revitalization, resiliency, decarbonization, interdisciplinary collaboration	Need for an integrated approach and multidisciplinary teams for the resolution of complex problems related to the implementation of the principles of the circular economy
Sustainable energy storage for solar home systems in rural Sub-Saharan Africa–a comparative examination of lifecycle aspects of battery technologies for circular economy, with emphasis on the South African context	Charles et al.	Energy	2019	Solar energy, batteries, circular economy, critical materials, Africa, end-of-life	Description of optimal solutions for the selection of the battery for small-scale sustainable domestic photovoltaic energy using the circular economy model, to obtain social, environmental, and economic benefits in sub-Saharan Africa
Policy and legislative barriers to close water-related loops in innovative small water and wastewater systems in Europe: A critical analysis	Cipolleta et al.	Journal of Cleaner Production	2021	Environmental policy, innovation, non-conventional water resource, rural area, sustainability, reclaimed water reuse	Identification of barriers to achieving water reuse circuits, highlighting the lack of an enabling environment for small-scale decentralized technologies at community level
Hand in glove? Processes of formalization and the circular economy post-COVID-19	Dewick et al.	IEEE Engineering Management Review	2020	Circular economy, sustainability, informal economy, agri-food	The adoption of circular principles by smallholder farmers as a tool for them to become part of formal agri-food systems that reduce their social and economic vulnerability and improve

					environmental outcomes
An ecosystemic approach for energy transition in the mediterranean region	Echave et al.	1st International Conference on Energy Transition in the Mediterranean Area (SyNERGY MED)	2019	Eco systemic transition units, energy transition policies, energy local communities, climate change, island areas, land use planning, Mediterranean Region, prosumers, renewable energy, rural areas	Design of a comprehensive strategy through the Ecosystem Transition Units (ETU), as a planning and management tool to promote and ensure the energy transition at regional and local level through policies in the fields of climate change, energy transition, land use planning and the circular economy
Household biogas development in rural China: On policy support and other macro sustainable conditions.	Feng et al.	Renewable and Sustainable Energy Reviews	2012	Household biogas, Policy support, sustainable development	Description of the development of domestic biogas in rural areas of China and the need for public policies for its dissemination
Identifying agri-food research priorities for Spain. 2017 results	Garcia et al.	Spanish Journal of Agricultural Research	2018	Foresight, sustainability, efficiency, competitiveness, climate change	Development of models in the agri-food sector that allow the balance between food quality and production costs, the conservation of the ecosystem and the mitigation of environmental impacts by maintaining the population in rural areas, making more efficient use of own resources and by-products within the framework of a circular economy
Local contribution to circular economy. A case study of a Polish rural municipality	Golebiewski et al.	Agro-Alimentaire economy	2019	Circular economy, waste management, sustainable development, technological innovation, waste-to-energy.	Positive circular impact on local development in rural municipalities
Multi-criteria evaluation of bran use to promote circularity in the cereal production chain	Grippo et al.	Natural Resources Research	2019	Circular economy, multi-criteria analysis, rural	Multi-criteria valuation model, which combines the environment, the social environment, and economic

				development, bran uses	criteria, for the evaluation of political strategies in order to promote circularity
Study on circular economy education in rural areas in China	Guo	LEMCS	2014	Education, circular economy, farmer, rural area, model	Recommendations for the implementation of educational models that facilitate the active participation of farmers in the implementation of the circular economy in their environment
Agriculture, rural tourism and circular paradigm	Immacolata	Calitatea	2018	Tourism system, circular economy, sustainable tourism, sustainability indicators, sustainability paradigm, circular paradigm	Tool for reflection on possible sustainability indicators for the tourist destination in rural environments
Research on the development of leisure agriculture tourism in Yi County based on circular economy	Jia et al.	Management & Engineering	2014	Tourism, leisure agriculture, circular economy, sustainable development	Model of development of leisure agriculture in a county of China: inns in cottages and agricultural sightseeing and collection gardens
Modeling circular economy dimensions in agri-tourism clusters: Sustainable performance and future research directions	Joshi et al.	International Journal of Mathematical, Engineering and Management Sciences	2020	Agri-tourism clusters, sustainable transition, circular economy, circular economy dimensions (CE-D), MDCM techniques.	Conceptualization and analysis in 9 districts of 11-dimensional plan to measure the development and implementation of "agrotourism" clusters in Uttarakhand (India)
Development strategy research of modern eco-agriculture on the basis of constructing the rural circular economy-for the example of Shandong	Junjie et al..	Energy Procedia	2011	Modern eco-agriculture, circular agriculture, restrictive factors, development strategy	Importance of technology, biology, information, and remote sensing in promoting the development of modern organic farming and circular farming
Enabling sustainable agro-food futures: Exploring fault lines and synergies between the integrated territorial paradigm, rural	Kristensen et al.	Journal of Agricultural and Environmental Ethics	2016	Agro-food futures, circular economy, the eco-economy, the integrated	Proposal of three approaches to conceptualize the future of agri-food: the eco economy, the

eco-economy and circular economy				territorial agri-food paradigm, sustainable futures	integrated territorial agri-food paradigm, and the circular economy. The circular economy stands out as an unexplored, open approach that favors collaboration between agents
Spanish strategy on bioeconomy: Towards a knowledge based sustainable innovation	Lainez et al.	New Biotechnology	2018	Spanish strategy on bioeconomy. circular economy, sustainability	Description of the bioeconomy strategy in Spain as part of rural and coastal development in sectors such as food, agriculture, and forestry
Benefit analysis on rural human resource development	Liu	International Conference on Education, Management and Computing Technology	2015	Rural human resource, development benefit, current problems, effective measures	Proposal of strategies to address the current problems of human resources development in rural areas
Analysis on the coupling development path of economy and ecological environment under the rural revitalization strategy	Liu & Li	Fresenius Environmental Bulletin	2020	Ecological environment, rural revitalization strategy, economic development, coupling system, factor analysis method	Proposed development route for rural revitalization
Application of circular economy in shrinking regions	Livina & Veliverronena	Environment Technology Resources Proceedings of the International Scientific and Practical Conference	2019	Circular economy, shrinking rural region, planning, balanced development	Analysis of the challenges faced by shrinking rural regions (mobility, vacating of buildings, waste collection and recycling, service location, bio-agriculture), with proposals on how to apply the principles of the circular economy in these areas
Rural areas receptivity to innovative and sustainable agrifood processes. A case study in a viticultural territory of Central Spain	Losada et al.	Regional Science Policy & Practice	2019	Focus group, aarticipatory processes, rural territories, sustainable development, wine sector innovation	Need to generate strategies to mitigate the impact of agriculture on climate change, in particular by optimizing the nutrient cycle

Planning the flows of residual biomass produced by wineries for the preservation of the rural landscape	Manniello et al.	Sustainability	2020	Rural landscape, agricultural biomass, winery pomace, Geographic Information System, soil organic matter, circular bioeconomy	Strategies for the management and valorization of waste from the processes involved in the value chain of wine production, in order to restore the soil and contribute to the sustainable preservation of the rural landscape
Conceptualizing waste as a resource: Urban biosolids processing in the rural landscape	Mason-Renton & Luginaah	The Canadian Geographer	2018	Sustainability, circular economy, relational geography, rural environmental justice, sewage	Differences in perspective when communities process waste from other communities, based on social and political aspects, emotional assessments, and notions of equity
Agroforestry in Europe: A land management policy tool to combat climate change	Mosquera-Losada et al.	Land Use Policy	2018	Silvopasture, Silvoarable, homegardens, Riparian buffer strips, forest farming	Reflection on the potential options for mitigating climate change through the use of silvopasture on forest land, the promotion of forest agriculture and home gardens, as ways to increase the use of short supply chains and increase the connection of urban, peri-urban, and rural areas within a framework of bioeconomy and circular economy
Circular economy and bioeconomy interaction development as future for rural regions. Case study of Aizkraukle Region in Latvia	Muizniece et al.	Environmental & Climate Technologies	2019	Bioeconomy indicators, bioresources, economic growth, regional economy	Methodology for the assessment of small rural areas in the context of the circular economy and the bioeconomy, in order to effectively guide the development of these regions through the full use of existing biological resources
Social farming in the virtuous system of the circular economy. An exploratory research	Nicolosi et al.	Sustainability	2021	Resilience, circular economy, social model innovation, social network analysis,	Results of a research that highlights dynamic and innovative experiences of social agriculture in the

				multiple correspondence analysis	context of the circular economy
Towards standards-based of circular economy: Knowledge available and sufficient for transition?	Peralta et al.	International Journal of Sustainable Development & World Ecology	2020	Circular economy, closed-loop material flows, circularity, economy transition, sustainability, project management	Analysis of the effectiveness of the frameworks, methods, tools, and evaluation indicators available for the approach, planning, and implementation of circular economy projects
The socio-economic force field of the creation of short food supply chains in Europe	Popp et al.	Journal of Food and Nutrition Research	2018	Circular economy, food production, institutional economics, MACTOR method, strategic analysis	Explanation of the contradiction between the proliferation of statements on the importance of the circular economy and short supply chains in sustainable rural development, and that these systems hardly exist in the new member states of the European Union (EU)
The circular economy: A broader perspective for rural areas	Quaranta et al.	Rivista di studi sulla sostenibilità	2018	Circular economy, rural development, sustainability, open-source technology, social platform, social innovation	Refocus on the application of circularity concepts as a key to restructuring, rethinking and operationalizing rural areas
Circular economy contributions to the tourism sector: A critical literature review	Rodriguez et al.	Sustainability	2020	Circular economy, CE principles, circular practices, rural tourism, cultural tourism, maritime sector, renewable energy, resource's consumption, sustainable development, waste generation	Identification of current research trends and gaps in the literature on circular economy and tourism
Mixed biomass pelleting potential for Portugal, step forward to circular use of biomass residues	Sirous et al.	Energy Reports	2020	Biomass residues, circular economy, mixed biomass pelleting, Portugal,	Technoeconomic valuation of mixed biomass pelletization for Portugal that provides information on different aspects of granulation,

				potential assessment	mainly related to the properties and quality standards that researchers and professionals of this technique can find
Is knowledge of circular economy, pro-environmental behavior, satisfaction with life, and beliefs a predictor of connectedness to nature in rural children and adolescents? A pilot study	Solano-Pinto et al.	Sustainability	2020	Pro-environmental behavior, connectedness to nature, knowledge, life satisfaction, circular economy, rural students, elementary education	Identification of the appropriate variables to establish an awareness-raising program and implement strategies related to the circular economy in the educational and family sphere, aimed mainly at children and adolescents and their educational and family environment
The impact of green economy measures on rural employment: Green jobs in farms	Unay-Gailhard & Boinec	Journal of Cleaner Production	2019	Green economy, circular economy, agri-environmental measures, green jobs, farms, farm accountancy data network, Slovenia	Identification of the potential of green economy measures for job creation in rural areas
Challenges of the introduction of circular business models within rural SMEs of EU	Uvarova et al.	International Journal of Economic Sciences	2020	Circular economy, circular business models, rural SMEs	Identification of opportunities for the introduction of new circular business models among rural SMEs and identification of support necessary to promote further development of circularity between them
Accelerate the rural ecological environment in Dalian actively promote the development of circular economy	Wang et al.	Advanced Materials Research	2011		Description of Dalian's successful experience in integrated environmental management and recycling economics for circular economy development in rural China

The researchers independently extracted data from the first 10 studies and came together to confirm that their approach to data extraction was consistent with the question and purpose of the research. The disagreements between the reviewers were mediated by internal discussion.

The qualitative analysis of said table enabled the researchers to categorize the extracted studies in accordance with the research objectives for synthesis. Table 3 presents the grouped articles along with the corresponding count and references, as elaborated upon and expounded upon in the discussion section.

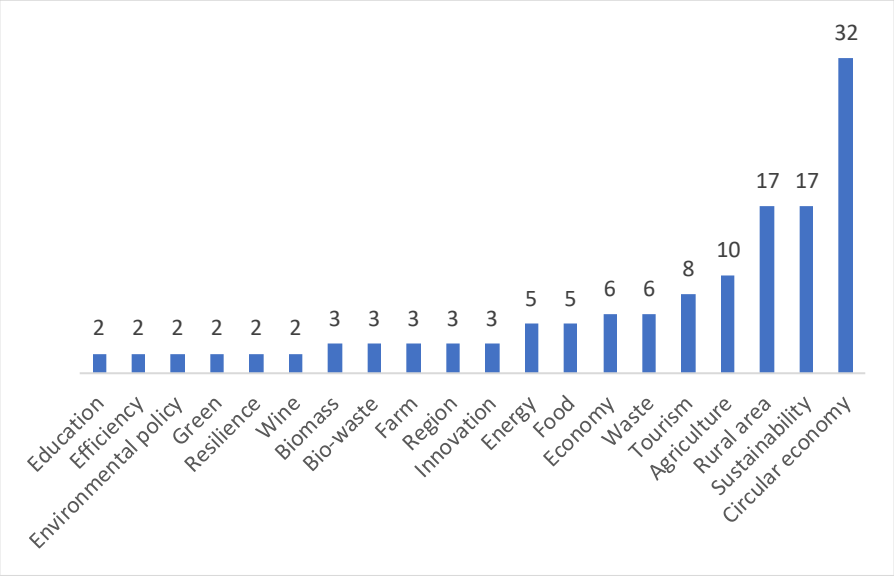
Table 3. *Documents Included in Qualitative Summary*

Types	**Number of articles**	**References**
Strategies for implementing the circular economy in rural areas	24	Aguiñaga et al. (2018); Belliggiano et al. (2020); Brown (2019); Dewick et al. (2020); Echave et al. (2019); García et al. (2018); Grippo et al. (2019); Guo & Zhang (2014); Immacolata (2018); Joshi et al. (2020); Junjie et al. (2011); Kristensen et al. (2016); Liu & Li (2020); Liu (2015); Livina & Veliverronena (2019); Losada et al. (2019); Mosquera-Losada et al. (2018); Peralta et al. (2020); Popp et al. (2018); Quaranta et al. (2018); Rodríguez et al. (2020); Solano-Pinto et al. (2020); Unay-Gailhard & Bojnec (2019); Uvarova et al. (2020)
Success stories of the circular economy in rural areas	15	Amirante et al. (2019); Bas-Bellver et al. (2020); Blades et al. (2017); Charles et al. (2019); Cipolleta et al. (2021); Feng et al. (2012); Golebiewski et al. (2019); Jia et al. (2014); Lainez et al. (2018); Manniello et al. (2020); Mason-Renton & Luginaah (2018); Muizniece et al. (2019); Nicolosi et al. (2021); Sirous et al. (2020); Wang et al. (2011)

The publication platforms of the selected articles are journals dedicated to environmental sciences, energy, social sciences, management, accounting and business, biology and engineering, and agricultural sciences. *Sustainability* (6), *Journal of Cleaner Production* (3), and *Energy Procedia* (2) are the journals with more than one article included in the qualitative synthesis.

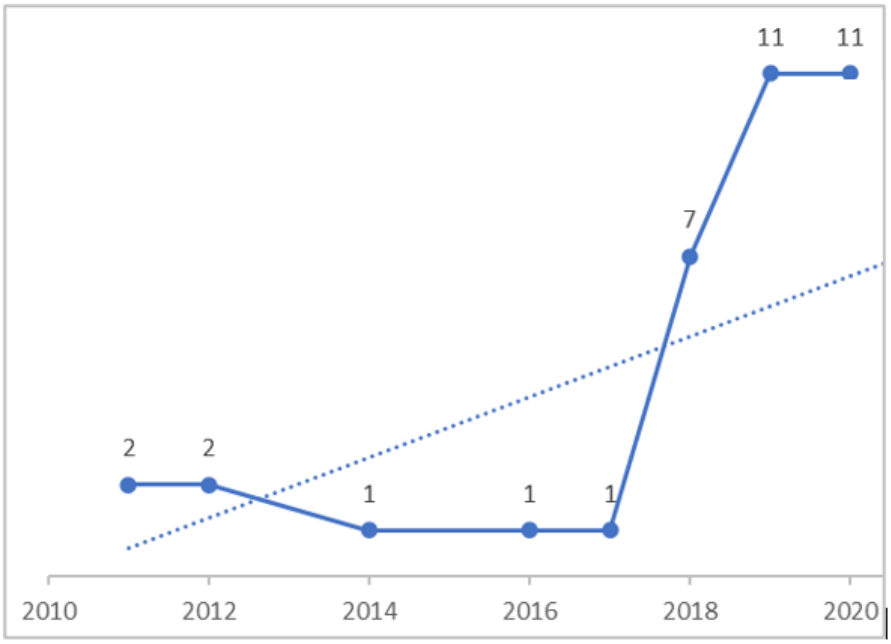
The keywords in the selected articles are generic for the entire corpus or specific to one or more topics. These keywords are presented in Figure 2 and grouped by those topics that encompass more than one keyword. Apart from the most obvious ones linked to the search equation, the themes of sustainability (17), agriculture (10), tourism (8), waste (6), and economy (6) stand out.

Figure 2. Keyword grouping topics by number of occurrences.



The selected research has received funding from a wide range of sources, including the European Regional Development Fund (5) and the European Commission (4). Articles published in the last two years, 2019 and 2020 (11 each of the years) prevail, as Figure 3 clearly shows.

Figure 3. Year of publication of the selected articles.



As for the geographical distribution of this literature, Italy and Spain stand out, with ten appearances, followed by China (4), Canada, Greece, and the UK (3 in total). It should be recalled that, according to the inclusion and exclusion criteria, literature published in languages other than English was not considered, and, therefore, the analysis may not represent an overall sample. In addition, the analysis was only performed in scientific publications, thus excluding other types of publications such as public documents and other grey literature.

4.0 Discussion

It will prevail in the analysis of these documents, which is presented below, the interpretive synthesis, having opted in the dichotomy "add versus integrate" proposed by Bloomberg and Volpe (2012) for the latter.

The analysis of the selected articles shows two major topics of study. The first is a description of success stories in various sectors and geographical areas, and the second is proposals for strategies for the implementation of the circular economy in rural areas.

The term "strategies" in the context of this research refers to the systematic plans, approaches, or sets of actions designed to achieve specific objectives within the field of circular economy, especially in rural settings. These could range from policy recommendations and organizational restructuring to technological interventions and public awareness campaigns. Strategies are generally higher-level constructs that lay the groundwork for implementation and may include the following sub-categories:

- *Policy Strategies*: Governmental or institutional frameworks that encourage or mandate the circular economy.
- *Technological Strategies*: Adoption or development of technologies that facilitate circularity such as waste recycling systems or renewable energy infrastructure.
- *Business Models*: Economic models that prioritize sustainability and resource optimization, such as "Product-as-a-Service" or "Sharing Economy" models.
- *Community Engagement Strategies*: Grassroots initiatives or awareness campaigns aimed at fostering a culture of sustainability and resourcefulness in rural areas.
- *Supply Chain Optimization*: Approaches that minimize waste and maximize efficiency across the production and distribution networks.

On the other hand, "success stories " pertain to specific, real-world instances where these strategies have been put into practice. They serve as empirical evidence to validate or critique the feasibility and effectiveness of various strategies under study. Application cases can be viewed as micro-level implementations that fall under the macro-level framework of strategies. They can be categorized based on sectors, such as:

- *Agriculture*: Use of circular economy principles in farming practices, such as regenerative agriculture or zero-waste farming.
- *Rural Development*: Projects that have uplifted communities by implementing circular economy practices, like local recycling programs or community-led renewable energy projects.
- *Business*: Corporations or SMEs in rural settings that have successfully incorporated circular economy models into their operations.
- *Education and Awareness*: Case studies on programs or campaigns that have successfully educated rural populations about the benefits and modalities of a circular economy.
- *Policy Impact*: Examples of areas where policy strategies have been successfully implemented and have led to measurable changes in sustainability metrics.

By distinguishing between "strategies" as overarching frameworks and " success stories" as specific instances of implementation, the research aims to provide a multi-layered understanding of how circular economy principles can be effectively operationalized in rural contexts.

A good number of them (Aguiñaga et al., 2018; Popp et al., 2018; Feng et al., 2012) agree on the importance of public policy involvement in addressing projects and on the need for greater commitment and support from governments to circular economy initiatives in rural areas: a bottom-up governance approach requires a deep understanding of the social, political, environmental, and economic characteristics of the community, as well as civic collaboration. Also, Gołębiewski et al. (2019) and Muizniece et al. (2019) highlight existing circular economy solutions in local environments, identifying possible ways for their development; waste management, technical infrastructure, and level of education and cooperation between all agents are the highlights, recommending a greater degree of involvement of public bodies, being an environment strongly influenced by public regulations. Popp et al. (2018) analyze the paradox between the relevance of achieving sustainable rural development by shortening supply chains under circular economy schemes and their lack of implementation in the EU. Their suggestions to policymakers relate to coordinated support for small and medium-sized local producers, intervening through policies that limit competition, financial support, collaboration in the promotion of local cooperatives and in the renewal of elements that improve food security and education and, finally, promotion of local producers in the application of ICT.

4.1. Strategies for the Implementation of the Circular Economy in Rural Areas

Most of the proposals analyzed are committed to integrating circular economy approaches, which include dimensions beyond the sectoral or industry-specific dimensions in which the activities analyzed are framed. Evaluating strategies to achieve circularity is a complex management problem due to the need to consider all environmental, social, and financial aspects (Grippo et al., 2019) and to formalize circular processes as a means of reducing vulnerability in crises such as COVID-19 (Dewick et al., 2020). The adoption of circular principles could make smallholder farmers part of formal agri-food systems that reduce their social and economic vulnerability and improve the environment. Addressing projects with an integrated approach in rural areas in the process of depopulation requires facing challenges such as cooperation, the philosophy of consumption and values, and the willingness and availability to pay for services (Livina & Veliverronena, 2019). Salvia et al. (2018) and Quaranta et al. (2018) propose to refocus the concept of circularity in rural areas, the role of technology, and the need to transform production and consumption patterns.

The agri-food sector is, together with tourism, the most addressed from the sectoral point of view in the proposals for the implementation of circular economy strategies (Rodríguez et al., 2020). The development of new, more modern, and efficient business models, based on technology, biology, information, and remote sensing and the eco-economy and collaboration between agents highlights the need to modernize the agri-food sector (García et al., 2018; Junjie et al., 2011; Kristensen et al. 2016). The relationship of agriculture with climate change and the reduction of its impact through the circular economy is another topic addressed by authors such as Losada et al. (2019) and Mosquera-Losada et al. (2018) with contributions on the optimization of the nutrient cycle and the promotion of forest-agriculture and home gardens to achieve shorter cycles.

More holistic and synergistic approaches can contribute to the revitalization of the rural environment. Brown (2019) proposes to model a circular economy through a conceptual plan developed for a small town that highlights intersectoral synergistic opportunities. For his part, Liu and Li (2020) propose a revitalization strategy that integrates improvements in infrastructure, education, the development of ecological industries, and the transformation of public policies. This systematic approach is similarly manifested in the study conducted by Echave et al. (2019) concerning the development of ecosystem transition units [ETU] as instruments for regional and local planning and management.

All these strategic principles go through the training of human resources and the development of new business models. Liu (2015) provides strategies to overcome the current problems of human resources development in rural areas, the enhancement of the concept of social economy, expanding investment in rural education, and the continuous improvement of the quality of human resources in rural areas and improving their level of protection. Education is the key pillar in Guo and Zhang's research (2014), referring to the need for new educational models for farmers, while Solano-Pinto et al. (2020) focus on on-demand education in a family environment and with children and adolescents as the main recipients. Regarding the generation of new jobs, Unay-Gailhard and Bojnec (2019) raise the need to take into account the dimensions of gender and age, and Uvarova et al. (2019) emphasize that public policies should play an important role in promoting circular business models in rural SMEs.

The complex and interdisciplinary nature of the implementation of the circular economy in rural areas reveals several intersectoral measurement proposals (Peralta et al., 2020), most of which focus on tourism in rural areas (Belliggiano et al., 2020; Immacolata, 2020; Joshi et al., 2020).

4.2. Circular Economy Success Stories in Rural Areas

Waste transformation and energy procurement are the main themes around which successful experiences related to the application of the circular economy in rural areas revolve. The industrialization of fruits and vegetables generates a large amount of organic waste with a negative environmental impact, which must be managed properly. In fact, they are the products most used by the circular economy among horticultural crops, although they are still generally underutilized, have a very short shelf life, and are considered low-value materials. Bas-Bellver et al. (2020) describe a collaborative project in Spain between producers, the university, and the regional government to transform plant waste into functional ingredients through a series of processes involving pretreatments and drying stages aimed at maximizing bioactive compounds and their antioxidant activity. In the same vein, the reuse of waste generated by activities derived from wine production is an excellent strategy from the perspective of a circular bioeconomy (Manniello et al.,2020). Mason-Renton and Luginaah (2018) highlight, at the other extreme, the injustices related to the processing of urban biosolids in the rural landscape. The authors propose to redirect the discussion on biosolid processing beyond the stigma of danger or waste to a more open conversation about the properties of valuable resources and global sustainable waste management on a broader scale, considering feelings of injustice at waste deposit sites.

This virtuous system, based on collaboration between productive agricultural activities, agri-food industries, and entrepreneurs and the analysis of economic and environmental viability, brings numerous benefits, essentially related to the costs of transport and waste management, improves soil properties, and achieves greater sustainability of the rural landscape associated with the natural

restoration of soil fertility. In this regard, Sirous et al. (2020) introduce a pathway for detailed potential assessments of raw materials and their corresponding energy content, showing the considerable potential of pruning residues from vineyards, fruit trees, and olives; cereal straw; almond residues; and olive husks.

Among the studies included in our qualitative analysis are several small circular economy projects that are easily scalable to other rural areas. Cipolleta et al. (2021) describe a technological solution for water reuse based on the circular economy. Blades et al. (2017) describe how electricity production on dairy farms in a rural agricultural environment in Northern Ireland from an anaerobic digestion plant allows energy to be generated from a waste product and for the farmer to work around a more flexible schedule without the additional cost of use at rush hour, generating improved biogás (biomethane) which has enormous potential as a vehicle fuel and is suitable for injecting into the natural gas grid. Amirante et al. (2019) analyze a new power plant based on mature and cheap technology derived from the automotive sector, capable of generating electricity and thermal energy from solid and gaseous biomass, with the potential to be used in rural electrification projects. Charles et al. (2019) propose the development of a project for the selection of batteries and the management of the end of their useful life-supporting sustainable photovoltaic systems outside the grid using the circular economy model, obtaining social, environmental, and economic benefits in sub-Saharan Africa.

A concept that arises associated with the circular economy is that of the bioeconomy. The bioeconomy provides the means to ensure that the challenges facing society are addressed following the guiding principles of sustainability, taking advantage of the economic opportunities provided by the efficient use of biological resources to develop new bio-based products that reach the market in the coming years (Lainez et al., 2018). The most important aspect that separates the concepts of bioeconomy and circular economy is the former's focus on the use of bio-resources, while the circular economy cycle includes the complete flow of all resources, providing processes for their reuse and recycling (Muizniece et al., 2019).

Other ways of developing circular economy strategies in rural areas are leisure agriculture (Jia et al., 2014) and social farms (Nicolosi et al., 2021). Both combine traditional activities with others, such as tourism in the form of inns or cottages, agricultural sightseeing, collection gardens, educational and social inclusion activities, agri-food innovation, and community networking.

A final success story is that described by Wang et al. (2011), which focuses on integrated environmental management and the development model of the recycling economy for the development of the circular economy in rural areas of China. This project integrates aspects such as the implementation of rural sewerage, garbage, fertilizers, pesticides, manure and straw, and a series of projects to ensure ecological and food security, as well as the use of livestock and straw manure, and other solid waste for the development of methane and biomass energy.

5. Conclusions

The sudden appearance of the COVID-19 virus has caused profound changes in society as a whole and the business environment in particular, in a VUCA (volatile, uncertain, complex and ambiguous) context. It will be necessary to reconsider routines to survive. It is obviously too early to determine whether the pandemic will bring about permanent economic, social, and political changes, but the "new normality" must be based on a conciliatory approach that ensures

affordable access to products and services for the population, properly manages society's consumption of natural resources, and strives for technological excellence (Herstatt & Tiwari, 2020).

This systematic review aimed to elucidate how the circular economy can contribute to solving the challenges facing rural areas based on the academic literature. The analysis of strategies and success stories found several key ways circularity principles can aid rural communities:

1. Taking a systemic approach that integrates environmental, economic and social dimensions can help revitalize and create synergies across rural systems.
2. Transforming waste into resources, particularly energy, can support sustainability and self-sufficiency. \
3. Collaboration across stakeholders and shortening value chains is vital for implementation.
4. Innovation and technology, alongside training and education, enable new circular business models.

However, scaling up and transferring circular solutions remains a barrier. While further research is needed, this review has mapped pathways through which the circular economy can regenerate and add resilience to rural areas facing complex, interlinked challenges.

The analysis of the data obtained through a systematic review has made it possible to synthesize strategies and successful cases of application of the circular economy in rural areas that can contribute to reversing this situation. Reviews are intended to provide a preliminary map of the evidence for a topic and provide more extensive than comprehensive information on a particular topic (Tricco et al., 2016) and, therefore, cannot be considered as a final outcome (Grant & Booth, 2009). The above limitations are offset by providing a quick overview of the state of a discipline when it is incipient, such as the circular economy and its application in rural areas, and by identifying knowledge gaps that will encourage new research.

From the prism of the strategies to be adopted, it seems clear that there is a need for a systemic, transversal, and integrative approach favouring collaborative models supported by new technologies. Cross-sectoral examples which have been described, such as tourism, can make a significant contribution in this context. In any case, it is a question of proposing business models that raise awareness of demand with training campaigns supported by the public authorities.

Academic literature describes success stories involving the repurposing of waste for power generation. These accounts detail the processes with substantial technical precision. Notably, the emphasis on energy generation is especially pertinent, considering the complexity of the current energy landscape.

The findings of this review highlight important implications for public policy to support the implementation of the circular economy in rural areas First, governments should adopt a collaborative governance approach that deeply engages local communities, considering their unique social, political, economic, and environmental characteristics. Public policies and investments are needed to build local capacity and infrastructure, educate rural citizens, and incentivize sustainable innovations aligned with circular principles. Policymakers should also coordinate targeted support for small local enterprises, cooperatives, and value chains to strengthen sustainable rural development. Additionally, a policy mix addressing competition, financial incentives, promotion, education, food

security and ICT adoption could accelerate the proliferation of short supply chains. Finally, cross-sectoral strategies integrating circular economy into regional planning represent a systems-thinking approach to revitalizing rural communities. Policymakers have a vital role to play in enabling the transition to sustainability across rural territories.

While this systematic review provides an overview of strategies and success stories regarding the application of the circular economy in rural areas, the methodology has some limitations. First, the analysis only included articles published in English, which excludes relevant literature in other languages. Second, only peer-reviewed journal articles were included, omitting grey literature and other publication types which may offer additional insights. Third, qualitative studies capturing perspectives of rural inhabitants were notably absent from the literature reviewed. Finally, the academic literature alone cannot provide a comprehensive understanding of scaling and implementation procedures for transferring these experiences to the real world. Future studies should address these gaps through the inclusion of diverse literature and direct engagement with rural communities to develop a more complete understanding of the possibilities for a circular economy in the rural environment.

Unfortunately, there is no research on the transfer of these experiences to industrial reality or on the procedures to be followed for scaling up and generalizing them. Nor have qualitative studies been identified that collect the possibilities of the circular economy in the rural environment from the point of view of its inhabitants, nor the design and implementation of training programs in the specific skills that would require the people living in the countryside to know exhaustively the principles of the circular economy and enable innovative business initiatives. In our view, future investigations should address these gaps.

As a society, we live in turbulent moments due to the pandemic that has devastated the planet. It is a serious problem to add to the many that rural areas have been suffering for a long time. The diversification of activities in rural areas from the prism of the circular economy will contribute, in the terms described, to the optimization of available resources, curbing demographic bleeding, and, finally, to confronting old problems with new models.

References

Aguiñaga, E., Henriques, I., Scheel, C., & Scheel, A. (2018). Building resilience: A self-sustainable community approach to the triple bottom line. *Journal of Cleaner Production, 173*, 186–196. https://doi.org/10.1016/j.jclepro.2017.01.094

Amirante, R., Bruno, S., Distaso, E., La Scala, M., & Tamburrano, P. (2019). A biomass small-scale externally fired combined cycle plant for heat and power generation in rural communities. *Renewable Energy Focus, 28*, 36–46. https://doi.org/10.1016/j.ref.2018.10.002

Anderson, C. D., & Bell, M. M. (2000). The social economy of rural life: An introduction. *Journal of Rural Studies*, *16*(3), 269–272.

Bas-Bellver, C., Barrera, C., Betoret, N., & Seguí, L. (2020). Turning agri-food cooperative vegetable residues into functional powdered ingredients for the food industry. *Sustainability*, *12*(4), 1284. https://doi.org/10.3390/su12041284

Belliggiano, A., Garcia, E. C., Labianca, M., Valverde, F. N., & De Rubertis, S. (2020). The "eco-effectiveness" of agritourism dynamics in Italy and Spain: A tool for evaluating regional sustainability. *Sustainability*, *12*(17), 7080. https://doi.org/10.3390/su12177080

Blades, L., Morgan, K., Douglas, R., Glover, S., De Rosa, M., Cromie, T., & Smyth, B. (2017). Circular biogas-based economy in a rural agricultural setting. *Energy Procedia*, *123*, 89–96. https://doi.org/10.1016/j.egypro.2017.07.255

Bloomberg, L. D., & Volpe, M. (2012). *Completing your qualitative dissertation: A road map from beginning to end* (2nd ed.). Sage.

Brown, H. (2019). Circular economies for rural renewal: Revitalizing towns and their bioregions. *WIT Transactions on Ecology and the Environment*, *238*, 291–300. https://doi.org/10.2495/SC190261

Charles, R. G., Davies, M. L., Douglas, P., Hallin, I. L., & Mabbett, I. (2019). Sustainable energy storage for solar home systems in rural Sub-Saharan Africa – A comparative examination of lifecycle aspects of battery technologies for circular economy, with emphasis on the South African context. *Energy*, 166, 1207–1215. https://doi.org/10.1016/j.energy.2018.10.053

Cipolletta, G., Ozbayram, E. G., Eusebi, A. L., Akyol, Ç., Malamis, S., Mino, E., & Fatone, F. (2021). Policy and legislative barriers to close water-related loops in innovative small water and wastewater systems in Europe: A critical analysis. *Journal of Cleaner Production*, *288*, 125604. https://doi.org/10.1016/j.jclepro.2020.125604

Crovetto, M. M. (2019). Espacios rurales y espacios urbanos en la teoría social clásica. [Rural spaces and urban spaces in social theory]. *Quid 16: Revista del Área de Estudios Urbanos*, *11*, 15–31.

Daudt, H. M. L., Van Mossel, C., & Scott, S.J. (2013). Enhancing the scoping study methodology: A large, inter-professional team's experience with Arksey and O'Malley's framework. *BMC Medical Research Methodology 13*, 48. https://doi.org/10.1186/1471-2288-13-48

De Roest, K., Ferrari, P., & Knickel, K. (2018). Specialisation and economies of scale or diversification and economies of scope? Assessing different agricultural development pathways. *Journal of Rural Studies*, *59*, 222–231. https://doi.org/10.1016/j.jrurstud.2017.04.013

Den Hollander, M. C., Bakker, C. A., & Hultink, E. J. (2017). Product design in a circular economy: Development of a typology of key concepts and terms. *Journal of Industrial Ecology*, *21*(3), 517–525. https://doi.org/10.1111/jiec.12610

Dewick, P., Pineda, J., & Ramlogan, R. (2020). Hand in glove? Processes of formalization and the circular economy post-COVID-19. *IEEE Engineering Management Review*, *48*(3), 176–183. https://doi.org/10.1109/EMR.2020.3014014

Dixon-Woods, M., Cavers, D., Agarwal, S., Annandale, E., Arthur, A., Harvey, J., Hsu, R., Katbamna, S., Olsen, R., Smith, L., Riley R., & Sutton, A. J. (2006). Conducting a critical interpretive synthesis of the literature on access to healthcare by vulnerable groups. *BMC medical research methodology*, 6, 1–13. https://doi.org/10.1186/1471-2288-6-35

Echave, C., Ceh, D., Boulanger, A., & Shaw-Taberlet, J. (2019, May 28–30). An ecosystemic approach for energy transition in the Mediterranean region. *1st International Conference on Energy Transition in the Mediterranean Area (SyNERGY MED)*, Cagliari, Italy, 2019, pp. 1–5. https://doi.org/10.1109/SyNERGY-MED.2019.8764107

Esteban-Navarro M.-Á., García-Madurga M.-Á., Morte-Nadal T., & Nogales-Bocio A.-I. (2020). The rural digital divide in the face of the COVID-19 pandemic in Europe—Recommendations from a scoping review. *Informátics*, *7*(4),54. https://doi.org/10.3390/informatics7040054

Feng, Y., Guo, Y., Yang, G., Qin, X., & Song, Z. (2012). Household biogas development in rural China: On policy support and other macro sustainable conditions. *Renewable and Sustainable Energy Reviews*, *16*(8), 5617–5624. https://doi.org/10.1016/j.rser.2012.06.019

García, M., Tello, M. L., de la Poza, M., Villalobos, N., Lansac, R., Nárdiz, P. M., & Andrés, M. L. (2018). Identifying agri-food research priorities for Spain – 2017 results. *Spanish Journal of Agricultural Research*, *16*(3), e0001. https://doi.org/10.5424/sjar/2018163-13587

Geissdoerfer, M.; Morioka, S. N., de Carvalho, M. M., & Evans, S. (2018). Business models and supply chains for the circular economy. *Journal of Cleaner Production, 190*, 712–721. https://doi.org/10.1016/j.jclepro.2018.04.159

Ghisellini, P., Cialani, C., & Ulgiati, S. (2016). A review on circular economy: The expected transition to a balanced interplay of environmental and economic systems. *Journal of Cleaner Production*, *114*, 11–32. https://doi.org/10.1016/j.jclepro.2015.09.007

Golebiewski, J., Takala, J., Juszczyk, O., & Drejerska, N. (2019). Local contribution to circular economy. A case study of a Polish rural municipality. *Economia agro-alimentare, 21*(3), 771–791. https://doi.org/10.3280/ECAG2019-003011

Govindan, K., & Hasanagic, M. (2018). A systematic review on drivers, barriers, and practices towards circular economy: A supply chain perspective. *International Journal of Production Research*, *56*(1–2), 278–311. https://doi.org/10.1080/00207543.2017.1402141

Grant, M. J., & Booth, A. (2009). A typology of reviews: An analysis of 14 review types and associated methodologies. *Health Information Libraries Journal*, *26*, 91–108. https://doi.org/10.1111/j.1471-1842.2009.00848.x

Grippo, V., Romano, S., & Vastola, A. (2019). Multi-criteria evaluation of bran use to promote circularity in the cereal production chain. *Natural Resources Research, 28*(1), 125–137. https://doi.org/10.1007/s11053-019-09457-w

Guo, P., & Zhang, X. (2014). Study on circular economy education in rural areas in China. In *International Conference on Logistics Engineering, Management and Computer Science (LEMCS 2014)* (pp. 945-948). Atlantis Press.

Herstatt, C., & Tiwari, R. (2020). Opportunities of frugality in the post-Corona era. *International Journal of Technology Management*, *83*(1–3), 15–33. http://hdl.handle.net/10419/220088

Homrich, A. S., Galvao, G., Abadia, L. G., & Carvalho, M. M. (2018). The circular economy umbrella: Trends and gaps on integrating pathways. *Journal of Cleaner Production, 175*, 525–543. https://doi.org/10.1016/j.jclepro.2017.11.064

Immacolata, V. (2018). Agriculture, rural tourism and circular paradigm. *Calitatea*, *19*(S1), 556–562.

Jia, Z., Qin, A., & Jia, H. (2014). Research on the development of leisure agriculture tourism in Yi County based on circular economy. *Management and Engineering*, *15*, 72–76.

Johnson, K. M., & Lichter, D. T. (2019). Rural depopulation: Growth and decline processes over the past century. *Rural Sociology*, *84*(1), 3–27. https://doi.org/10.1111/ruso.12266

Joshi, S., Sharma, M., & Kler, R. (2020). Modeling circular economy dimensions in agri-tourism clusters: Sustainable performance and future research directions. *International Journal of Mathematical, Engineering and Management Sciences*, *5*(6), 1046–1061. https://doi.org/10.33889/IJMEMS.2020.5.6.080

Junjie, C. A. O., Ming, L. I., & Shuguo, L. I. (2011). Development strategy research of modern eco-agriculture on the basis of constructing the rural circular economy-for the example of Shandong province. *Energy Procedia*, *5*, 2504–2508. https://doi.org/10.1016/j.egypro.2011.03.430

Juste, J. J., Gómez, J. M., & Fernández, J. E. (2011). Economía social y desarrollo local/rural. Un análisis de sus sinergias. [Social economy and local/rual Development. An análisis of their synergies]. *Estudios de economía aplicada*, *29*(1), 189–222.

Kalmykova, Y., Sadagopan, M., & Rosado, L. (2018). Circular economy – From review of theories and practices to development of implementation tools. *Resources, conservation and recycling*, *135*, 190–201. https://doi.org/10.1016/j.resconrec.2017.10.034

Kitchen, L., & Marsden, T. (2009). Creating sustainable rural development through stimulating the eco-economy: Beyond the eco-economic paradox? *Sociologia ruralis*, *49*(3), 273–294. https://doi.org/10.1111/j.1467-9523.2009.00489.x

Kristensen, D. K., Kjeldsen, C., & Thorsøe, M. H. (2016). Enabling sustainable agro-food futures: Exploring fault lines and synergies between the integrated territorial paradigm, rural eco-economy and circular economy. *Journal of Agricultural and Environmental Ethics*, *29*(5), 749–765. https://doi.org/10.1007/s10806-016-9632-9

Lainez, M., González, J. M., Aguilar, A., & Vela, C. (2018). Spanish strategy on bioeconomy: Towards a knowledge based sustainable innovation. *New biotechnology*, *40*, 87–95. https://doi.org/10.1016/j.nbt.2017.05.006

Lasanta, T., Arnáez, J., Pascual, N., Ruiz-Flaño, P., Errea, M. P., & Lana-Renault, N. (2017). Space–time process and drivers of land abandonment in Europe. *Catena*, *149*, 810–823. https://doi.org/10.1016/j.catena.2016.02.024

Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P. A., Clarke, M., Devereaux, P. J., Kleijnen, J., & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. *PLoS medicine*, *6*(7), e1000100. https://doi.org/10.1371/journal.pmed.1000100

Liu, J. (2015, June). Benefit analysis on rural human resource development. *International Conference on Education, Management and Computing Technology (ICEMCT-15).* Atlantis Press. https://doi.org/10.2991/icemct-15.2015.81

Liu, Y., & Li, N. (2020). Analysis on the coupling development path of economy and ecological environment under the rural revitalization strategy. *Fresenius Environmental Bulletin*, *29*(12A), 11702–11709.

Livina, A., & Veliverronena, L. (2019). Application of circular economy in shrinking regions. In *Environment, Technologies, Resources. Rezekne, Latvia. Proceedings of the International Scientific and Practical Conference* 1, 147–153.

Long, H., & Woods, M. (2011). Rural restructuring under globalization in eastern coastal China: What can be learned from Wales? *Journal of Rural and Community Development*, *6*(1), 70–94.

Losada, R., Gómez-Ramos, A., & Rico, M. (2019). Rural areas receptivity to innovative and sustainable agrifood processes. A case study in a viticultural territory of Central Spain. *Regional Science Policy and Practice*, *11*(2), 307–327. https://doi.org/10.1111/rsp3.12187

Manniello, C., Statuto, D., Di Pasquale, A., Giuratrabocchetti, G., & Picuno, P. (2020). Planning the flows of residual biomass produced by wineries for the preservation of the rural landscape. *Sustainability*, *12*(3), 847. https://doi.org/10.3390/su12030847

Manninen, K., Koskela, S., Antikainen, R., Bocken, N., Dahlbo, H., & Aminoff, A. (2018). Do circular economy business models capture intended environmental value propositions. *Journal of Cleaner Production*, *171*, 413–422. https://doi.org/10.1016/j.jclepro.2017.10.003

Marsden, T., Banks, J., & Bristow, G. (2000). Food supply chain approaches: Exploring their role in rural development. *Sociologia Ruralis*, *40*(4), 424–438. https://doi.org/10.1111/1467-9523.00158

Mason-Renton, S. A., & Luginaah, I. (2018). Conceptualizing waste as a resource: Urban biosolids processing in the rural landscape. *The Canadian Geographies/Géographies canadiennes*, *62*(2), 266–281. https://doi.org/10.1111/cag.12454

Matthews, A., Mahé, L. P., Bureau, J. C., Dax, T., & Copus, A. (2016). Research for AGRI committee – CAP reform post-2020-challenges in agriculture. In *Workshop documentation. Directorate-General for Internal Policies, Policy Department B: Structural and Cohesion Policies*. Retrieved October 20, 2023, from: https://www.europarl.europa.eu/RegData/etudes/STUD/2016/585898/IPOL_STU(2016)585898_EN.pdf

Milbourne, P. (2007). Re-populating rural studies: Migrations, movements and mobilities. *Journal of Rural Studies*, 23(3), 381-386. https://doi.org 10.1016/j.jrurstud.2007.04.002

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS medicine*, *6*(7), e1000097. https://doi.org/10.1371/journal.pmed.1000097

Mosquera-Losada, M. R., Santiago-Freijanes, J. J., Rois-Díaz, M., Moreno, G., Den Herder, M., Aldrey-Vázquez, J. A., & Rigueiro-Rodríguez, A. (2018). Agroforestry in Europe: A land management policy tool to combat climate change. *Land Use Policy*, *78*, 603–613. https://doi.org/10.1016/j.landusepol.2018.06.052

Muizniece, I., Zihare, L., Pubule, J., & Blumberga, D. (2019). Circular economy and bioeconomy interaction development as future for rural regions. Case study of Aizkraukle Region in Latvia. *Environmental and Climate Technologies*, *23*(3), 129–146. https://doi.org/10.2478/rtuect-2019-0084

Nicolosi, A., Laganà, V. R., Di Gregorio, D., & Privitera, D. (2021). Social farming in the virtuous system of the circular economy. An exploratory research. *Sustainability*, *13*(2), 989. https://doi.org/10.3390/su13020989

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., ... & Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, *372*, n71. https://doi.org/10.1136/bmj.n71

Peralta, M. E., Luna, P., & Soltero, V. M. (2020). Towards standards-based of circular economy: Knowledge available and sufficient for transition? *International Journal of Sustainable Development and World Ecology*, *27*(4), 369–386. https://doi.org/10.1080/13504509.2019.1701581

Philip, L., & Williams, F. (2019). Remote rural home-based businesses and digital inequalities: Understanding needs and expectations in a digitally underserved community. *Journal of Rural Studies*, *68*, 306–318. https://doi.org/10.1016/j.jrurstud.2018.09.011

Pires de Almeida, M. A. (2017). Territorial inequalities: Depopulation and local development policies in the Portuguese rural world. *Ager*. Revista de Estudios sobre Despoblación y Desarrollo Rural, (22), 61–87. https://doi.org/10.4422/ager.2016.08

Popp, J., Oláh, J., Kiss, A., Temesi, Á., Fogarassy, C., & Lakner, Z. (2018). The socio-economic force field of the creation of short food supply chains in Europe. *Journal of Food and Nutrition Research*, *58*(1), 31–41. http://www.vup.sk/en/index.php?mainID=2&navID=34&version=2&volume=58&article=2127

Quaranta, G., Andreopoulou, Z. S., & Salvia, R. (2018). The circular economy: A broader perspective for rural areas. *Rivista di studi sulla sostenibilitá, VIII*, 87–105.

Renting, H., Rossing, W. A., Groot, J. C., Van der Ploeg, J. D., Laurent, C., Perraud, D., Stobbelaar, D. J., & Van Ittersum, M. K. (2009). Exploring multifunctional agriculture. A review of conceptual approaches and prospects for an integrative transitional framework. *Journal of Environmental Management*, *90*(Suppl 2), S112–S123. https://doi.org/10.1016/j.jenvman.2008.11.014

Rodríguez, C., Florido, C., & Jacob, M. (2020). Circular economy contributions to the tourism sector: A critical literature review. *Sustainability*, *12*(11), 4338. https://doi.org/10.3390/su12114338

Rubio, P. (2010). Modelización de los cambios y evolución reciente del sistema rural español. [Modeling of changes and recent evolution of the Spanish rural system. *Boletín de la Asociación de Geógrafos Españoles*, *54*, 203–235. https://bage.age-geografia.es/ojs/index.php/bage/article/view/1286

Salvia, R., Andreopoulou, Z. S., & Quaranta, G. (2018). The circular economy: A broader perspective for rural areas. Rivista di studi sulla sostenibilità: VIII, 1, 87-105. https://doi.org/10.3280/RISS2018-001008

Sauvé, S.; Bernard, S., & Sloan, P. (2016). Environmental sciences, sustainable development, and circular economy: Alternative concepts for trans-disciplinary research. *Environmental Development*, *17*, 48–56. https://doi.org/10.1016/j.envdev.2015.09.002

Sevilla, E. (2006). *De la sociología rural a la agroecología* [From rural sociology to agroecology]. Icaria

Sirous, R., da Silva, F. J. N., da Cruz Tarelho, L. A., & Martins, N. A. D. (2020). Mixed biomass pelleting potential for Portugal, step forward to circular use of biomass residues. *Energy Reports*, *6*, 940–945. https://doi.org/10.1016/j.egyr.2020.01.002

Solano-Pinto, N., Garrido, D., Gértrudix-Barrio, F., & Fernández-Cézar, R. (2020). Is knowledge of circular economy, pro-environmental behavior, satisfaction with life, and beliefs a predictor of connectedness to nature in rural children and adolescents? A pilot study. *Sustainability*, *12*(23), 9951. https://doi.org/10.3390/su12239951

Song, B., Robinson, G. M., & Bardsley, D. K. (2020). Measuring multifunctional agricultural landscapes. *Land*, *9*(8), 260. https://doi.org/10.3390/land9080260

Tonts, M., Plummer, P., & Argent, N. (2014). Path dependence, resilience and the evolution of new rural economies: Perspectives from rural Western Australia. *Journal of Rural Studies*, *36*, 362–375. https://doi.org/10.1016/j.jrurstud.2014.04.001

Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K., Colquhoun, H., Kastner, M., Levac, D., Ng, C., Pearson Sharpe, J, Wilson, K., Kenny, M., Warren, R., Wilson, C. Stelfox, H., & Straus, S. (2016). A scoping review on the conduct and reporting of scoping reviews. *BMC medical research methodology*, *16*(1), 1–10. https://doi.org/10.1186/s12874-016-0116-4

Unay-Gailhard, İ., & Bojnec, Š. (2019). The impact of green economy measures on rural employment: Green jobs in farms. *Journal of Cleaner Production*, *208*, 541–551. https://doi.org/10.1016/j.jclepro.2018.10.160

United Nations. (2018). *World Urbanization Prospects: The 2018 Review*. Retrieved October 20, 2023, from https://population.un.org/wup/

United Nations. (2020). *World Social Report 2020. Inequality in a rapidly changing world.* Retrieved October 20, 2023, from https://www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2020/02/World-Social-Report2020-FullReport.pdf

Urbinati, A., Chiaroni, D., & Chiesa, V. (2017). Towards a new taxonomy of circular economy business models. *Journal of Cleaner Production*, *168*, 487–498. https://doi.org/10.1016/j.jclepro.2017.09.047

Uvarova, I., Atstaja, D., & Korpa, V. (2020). Challenges of the introduction of circular business models within rural SMEs of EU. *International Journal of Economic Sciences*, *9*(2), 128–149. https://doi.org/10.20472/ES.2020.9.2.008

Wang, H. S., Zhu, J. C., Yan, L. Z., Lin, C. X., Yan, Z. Y., & Jiao, X. C. (2011). Accelerate the rural ecological environment in Dalian actively promote the development of circular economy. *Advanced Materials Research*, 361–363, 1539–1546. https://doi.org/10.4028/www.scientific.net/amr.361-363.1539

Williams, T. A., Gruber, D. A., Sutcliffe, K. M., Shepherd, D. A., & Zhao, E. Y. (2017). Organizational response to adversity: Fusing crisis management and resilience research streams. *Academy of Management Annals*, *11*(2), 733–769. https://psycnet.apa.org/doi/10.5465/annals.2015.0134