International Journal of Economics, Commerce and Management
United Kingdom ISSN 2348 0386 Vol. 13, Issue 7, July 2025

https://ijecm.co.uk/

SUSTAINABLE DEVELOPMENT IN AGRICULTURE AND CIRCULAR ECONOMY: A LITERATURE REVIEW

Ana GORENCA, PhD
Lecturer, Department of Management-Marketing
Faculty of Economic Sciences
Mediterranean University of Albania
ana.gorenca@umsh.edu.al

Abstract

Agriculture plays a critical role in global sustainability, both as a contributor to environmental degradation and as a potential driver of sustainable development. In response to growing resource constraints, environmental challenges, and the adoption of the 2030 Agenda for Sustainable Development, circular economy principles have emerged as a practical framework for transforming agricultural systems. This literature review examines the intersection of sustainable development, circular economy principles, and agricultural systems, with a focus on implementation challenges in developing contexts. Drawing from academic literature, policy documents, and empirical studies, the review synthesizes current understanding of how circular economy models can support sustainable development goals (SDGs) in agriculture. It identifies key theoretical frameworks, explores implementation barriers, and highlights opportunities for integrating circular practices into agricultural systems. Special attention is given to the Western Balkans and Albania, where EU accession processes intersect with sustainability transitions. The review reveals significant implementation challenges and underscores the need for integrated approaches that address financial, technological, regulatory, and social barriers to circular economy adoption in agriculture.

Keywords: Sustainable Development, Circular Economy, Agriculture, Sustainable Development Goals, Albania

INTRODUCTION

Sustainable development has evolved from an environmental concern in the 1970s to a central organizing principle for global development policy. The Brundtland Report of 1987 defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (see World Commission on Environment and Development, 1987), establishing intergenerational equity principles while recognizing the interplay between economic development, social progress, and environmental protection. The 2030 Agenda for Sustainable Development, adopted by 193 UN member states in 2015, established 17 Sustainable Development Goals (SDGs) with 169 targets (see UN, 2024). SDG 12 on "*Responsible Consumption and Production*" is particularly relevant to economic transformation and resource management discussions. Parallel to sustainable development discourse, circular economy has gained prominence as a practical framework of sustainability principles. The circular economy represents a departure from the linear "*take-make-dispose*" model toward a regenerative system that eliminates waste, circulates materials at their highest value, and regenerates natural systems (see Ellen MacArthur Foundation, 2024). The Ellen MacArthur Foundation (2024) describes three core principles: eliminating waste and pollution through design, circulating products and materials, and regenerating nature. Agriculture occupies a unique position in sustainable development and circular economy discussions due to its role in food security, rural livelihoods, and environmental stewardship. Agriculture simultaneously contributes to environmental challenges—greenhouse gas emissions, water pollution, soil degradation, biodiversity loss—and offers significant potential for implementing circular economy principles (Fusco et al., 2023). Agricultural transformation toward sustainability and circularity is critical for achieving multiple SDGs, including hunger (SDG 2), clean water (SDG 6), climate action (SDG 13), and life on land (SDG 15).This literature review addresses gaps in understanding how circular economy principles can be effectively implemented in diverse agricultural contexts, what barriers impede implementation, and how policy frameworks can support transition toward sustainable agricultural systems. These gaps are particularly pronounced in developing countries where resource constraints, institutional weaknesses, and competing development priorities create additional challenges. The review examines theoretical foundations, empirical evidence, implementation challenges, and opportunities for integrating circular economy principles into agricultural systems. Special attention is given to the Western Balkans and Albania, where EU accession processes create both opportunities and challenges for sustainability transitions.

THEORETICAL FOUNDATIONS

Sustainable Development and Circular Economy Integration

The theoretical foundations of sustainable development and circular economy provide complementary frameworks emphasizing systems thinking, integration of multiple dimensions, and long-term perspective. The three-pillar approach to sustainable development—environmental, social, and economic dimensions—has become the dominant framework for understanding sustainability (Mensah, 2019). Environmental sustainability requires resource utilization within ecosystem regeneration parameters, social sustainability emphasizes enhanced living conditions and inclusive practices, and economic sustainability focuses on sustainable income generation and resource efficiency (Tennankon et al., 2024; Kuzniarska et al., 2023; Vallance et al., 2011). The 2030 Agenda represented significant evolution in sustainable development theory, providing a comprehensive framework recognizing interconnected development challenges and integrated solutions (see UN, 2024). Unlike earlier Millennium Development Goals, the SDGs adopt a universal approach applying to all countries while explicitly recognizing environmental dimensions. Circular economy theory draws from industrial ecology, cradle-to-cradle design, and systems thinking (Korhonen et al., 2017) . The Ellen MacArthur Foundation's three principles—eliminate waste and pollution, circulate products and materials, regenerate nature—provide practical implementation guidance (see Ellen MacArthur Foundation, 2024). The ReSOLVE framework (Regenerate, Share, Optimize, Loop, Virtualize, Exchange) offers action areas for implementation across sectors and scales. Kirchherr et al. (2023) analyzed 221 circular economy definitions, identifying core characteristics: emphasis on reducing, reusing, and recycling materials; closing material loops; multiple implementation levels; and integration of environmental and economic objectives. However, variations exist in social dimension incorporation and circular economy-sustainable development relationships. The relationship between circular economy and sustainable development has been extensively analyzed. Korhonen et al. (2018) argue circular economy should be understood as means to achieve sustainable development rather than an end itself, emphasizing that circularity alone does not guarantee sustainability if social and ethical dimensions are neglected.

Agricultural Applications

Application of these theoretical frameworks in agricultural contexts requires consideration of sector-specific characteristics, including biological production nature, soil health and biodiversity importance, and complex social and economic relationships characterizing rural communities. The emphasis on systems thinking, integration of multiple dimensions, and long-

term perspective in sustainable development theory aligns with holistic approaches required for agricultural sustainability. Similarly, circular economy's focus on closing loops, eliminating waste, and regenerating natural systems offers practical principles for transforming agricultural systems toward greater sustainability.

CIRCULAR ECONOMY AND SUSTAINABLE DEVELOPMENT GOALS

The relationship between circular economy principles and SDGs represents critical convergence between theoretical frameworks and practical implementation strategies. The 2030 Agenda provides comprehensive framework for addressing global challenges, while circular economy offers specific mechanisms for achieving these objectives (see UN, 2024).

SDG 12 and Resource Efficiency

SDG 12, ensuring "sustainable consumption and production patterns," represents the most direct connection between SDGs and circular economy principles (see UN, 2023) . The goal employs 11 targets addressing resource efficiency, waste reduction, and sustainable business practices. Target 12.2 calls for "sustainable management and efficient use of natural resources" by 2030, while Target 12.5 aims to "*substantially reduce waste generation through prevention, reduction, recycling and reuse*." Circular economy provides concrete mechanisms for achieving SDG 12 targets through waste elimination, material circulation, and natural system regeneration. The Ellen MacArthur Foundation's analysis suggests circular economy approaches could reduce chemical fertilizer use by 80% in European food systems (see Ellen MacArthur Foundation, 2024). Progress on SDG 12 reveals both achievements and challenges. From 2019 to 2023, 63 countries reported 516 policy measures related to sustainable consumption and production, yet global material consumption continues increasing (See UN, 2024; Cai & Wolff, 2023). Food waste represents a critical challenge for SDG 12 implementation. In 2022, 19% of global food was wasted, totaling 1.05 billion tons, generating significant greenhouse gas emissions and costing over $1 trillion annually while 783 million people suffered from hunger(See UN, 2018). Circular economy's emphasis on designing out waste offers strategies for addressing food waste through improved supply chain design, packaging innovation, and consumer behavior change.

Cross-Connections with Other SDGs

Circular economy's impact extends beyond SDG 12, with significant implications for multiple goals. The UN analysis identifies particular promise for achieving SDGs 6 (clean water), 8 (decent work), 11 (sustainable cities), 13 (climate action), 14 (life below water), and 15 (life on

land) (see UN/DESA, 2021). SDG 6 benefits from circular economy through water recycling and reuse systems. Wastewater could potentially irrigate an additional 40 million hectares or 15% of all irrigated land while reducing pollution (see Ellen MacArthur Foundation, 2019). The relationship with SDG 8 is complex, involving both opportunities and challenges. Circular economy can create employment opportunities, particularly in repair, remanufacturing, and waste management, while potentially displacing workers in traditional linear industries. Climate action (SDG 13) represents another area where circular economy can contribute significantly. By reducing virgin material extraction, extending product lifecycles, and improving resource efficiency, circular economy approaches can substantially reduce greenhouse gas emissions. The Ellen MacArthur Foundation estimates circular economy could reduce global CO2 emissions by 39% by 2030 in key sectors (see Ellen MacArthur Foundation, 2024).

Policy Integration Challenges

The European Green Deal represents the most comprehensive policy framework for integrating circular economy with sustainable development objectives (see the European Green Deal, 2021). The Circular Economy Action Plan establishes specific targets and measures for implementing circular economy across sectors, including agriculture. The Farm to Fork Strategy sets ambitious targets, including reducing chemical pesticide use by 50%, reducing nutrient losses by 50%, and reducing fertilizer use by 20% by 2030 (see Farm to Fork Strategy, 2020). However, implementation faces significant challenges including lack of awareness among policymakers, insufficient financial resources, regulatory frameworks favoring linear approaches, and limited technological capacity (see UN, 2023). These challenges are particularly pronounced in developing countries where resource constraints and institutional weaknesses create additional barriers.

SUSTAINABLE AGRICULTURE AND CIRCULAR ECONOMY

Agriculture represents a unique sector for implementing circular economy principles due to its biological nature, critical role in food security, and significant environmental impacts. Circular agriculture focuses on "*using minimal amounts of external inputs, closing nutrients loops, regenerating soils, and minimizing environmental impact*" (Cai & Wolff, 2023).

Circular Agriculture Principles

The principle of minimal external inputs emphasizes reducing dependence on synthetic fertilizers and pesticides through improved system design and management. Research suggests circular approaches could reduce chemical fertilizer use by 80% in Europe (see UN,

2023). Closing nutrient loops involves designing systems where nutrients cycle continuously within agricultural systems rather than being lost as waste, including composting, manure use, crop-livestock integration, and cover cropping. The FAO estimates improved nutrient cycling could reduce global fertilizer use by 20-30% while maintaining yields (see FAO, 2019).Soil regeneration constitutes a critical component, recognizing soil as a living system requiring active management to maintain health and productivity. Regenerative practices include minimizing soil disturbance, maintaining soil cover, diversifying rotations, integrating livestock, and incorporating organic matter. These practices improve soil health while contributing to carbon sequestration, biodiversity conservation, and water quality protection (Otero et al., 2023). Mixed crop-livestock farming represents a key strategy for implementing circular agriculture principles. Mixed systems capitalize on synergies between crop and animal production, using locally produced feed and manure instead of external inputs. Research in Europe demonstrates that mixed farms have lower costs, less sensitivity to market fluctuations, and lower nitrogen pollution compared to specialized systems (Ryschawy et al., 2012).

Organic Farming and Agroecological Approaches

Organic farming represents an established approach to implementing circular agriculture principles, emphasizing elimination of synthetic inputs and adoption of ecological management practices. Global organic area has grown from 11 million hectares in 1999 to 72.3 million hectares in 2019 (see UN, 2024). Organic principles align with circular economy objectives through biological nutrient cycling, ecological pest management, and soil health maintenance through organic matter incorporation. Agroecological approaches extend beyond organic farming to encompass broader principles of ecological design and social sustainability. Agroecology emphasizes applying ecological principles to agricultural system design, incorporating diversity, synergy, efficiency, and resilience (Wezel et al., 2011). These approaches often integrate traditional knowledge with modern scientific understanding to develop context-specific solutions. Agroforestry integration represents another important component, combining tree planting with crop or livestock production to create diverse and resilient systems. Agroforestry contributes to circular agriculture by reducing external input dependency, improving soil fertility, providing additional income sources, and enhancing biodiversity conservation (see UN, 2023).

Benefits and Impacts

Implementation of circular agriculture practices generates significant benefits across environmental, economic, and social dimensions. Environmental benefits include reduced

greenhouse gas emissions, improved soil health and carbon sequestration, enhanced biodiversity conservation, reduced water pollution, and decreased dependence on non-renewable resources (Esposito et al., 2020).Economic benefits include reduced input costs, improved resilience to market fluctuations, diversified income sources, and enhanced value creation through waste utilization. Circular agriculture is typically more labor-intensive than conventional farming, providing opportunities for rural employment creation (see UN, 2023). Social benefits include improved food security and nutrition, enhanced rural livelihoods, greater gender equality, and strengthened community resilience. Gender implications deserve particular attention, as women often face greater barriers to accessing productive resources in conventional systems. Circular agriculture practices, requiring less capital investment in external inputs, can lower barriers for women's participation while reducing time spent collecting firewood and fodder (see UN, 2023).

IMPLEMENTATION BARRIERS AND CHALLENGES

The transition from linear to circular agricultural systems faces numerous barriers operating at multiple levels across different dimensions. Understanding these barriers is critical for developing effective strategies to accelerate circular economy adoption in agriculture (Holly et al., 2023).

Financial and Economic Barriers

Financial barriers represent significant impediments to circular economy implementation. Holly et al. (2023) identify the need for more financial government support as one of the biggest barriers, particularly for small and medium-sized enterprises lacking capital resources for system transformation. High upfront investment costs, uncertain returns, and longer payback periods create significant financial challenges. Economic structure of conventional agricultural markets often favors linear approaches through pricing mechanisms that do not account for environmental externalities. Low cost of virgin materials and external inputs, combined with lack of market premiums for circular products, creates economic incentives favoring conventional practices (Nujen et al., 2023). This market failure reflects absence of pricing mechanisms internalizing environmental and social costs of linear production systems. Access to credit and financial services represents another significant barrier, particularly for smallholder farmers in developing countries. Traditional financial institutions often lack understanding of circular agriculture practices and may perceive them as higher risk investments. Government subsidy systems often create perverse incentives favoring linear approaches over circular alternatives (see UN, 2024).

Supply Chain and Infrastructure Barriers

The complexity of establishing effective circular supply chains represents a major barrier. Holly et al. (2023) identify challenges with setting up effective circular supply chains as primary obstacles. Linear structure of conventional agricultural supply chains, emphasizing efficiency and cost minimization, is often incompatible with circular approaches requiring more complex coordination among stakeholders. Limited availability of suppliers for circular inputs and services creates challenges for farmers seeking to implement circular practices. Lack of suppliers for organic fertilizers, biological pest control agents, and other circular inputs can make it difficult and expensive for farmers to access needed materials (Campoli et al., 2024). Infrastructure barriers include inadequate facilities for processing, storing, and distributing circular products, as well as insufficient waste management and recycling infrastructure. Transportation and logistics challenges further complicate circular supply chain implementation. Circular approaches often require more complex logistics to coordinate movement of materials, products, and waste streams among stakeholders. Higher transportation costs and coordination complexity can undermine economic viability compared to linear alternatives (Gasimli et al., 2022).

Technological and Regulatory Barriers

Technological barriers include limited availability of appropriate technologies for implementing circular practices, particularly in developing countries. While many circular agriculture technologies exist, they are often not accessible or affordable for smallholder farmers (Amo, 2023). The complexity of circular agriculture technologies can create adoption barriers, particularly for farmers with limited technical knowledge and training. Regulatory and policy barriers represent significant impediments, often reflecting historical focus of agricultural policies on supporting conventional production systems. Holly et al. (2023) identify regulatory environment barriers as major challenges, including insufficient political support in the form of incentives and subsidies for circular practices. Absence of clear policy frameworks creates uncertainty for farmers and investors, limiting willingness to invest in circular practices (Barreiro-Gen & Lozano, 2020).

Cultural and Social Barriers

Cultural and social barriers include resistance to change, lack of awareness and understanding, and social norms favoring conventional practices (Borrello et al., 2017). Consumer behavior and preferences can create significant barriers, with consumer demand for uniform, aesthetically perfect products limiting markets for circular products. Farmer attitudes

and beliefs, including resistance to change and skepticism about new practices, can limit adoption of circular practices (Dieckmann et al., 2020). Knowledge and awareness barriers include limited understanding of circular economy principles, lack of information about circular practices, and insufficient training and education opportunities. Gender and social equity barriers can limit access to circular agriculture opportunities for marginalized groups, perpetuating existing inequalities (Gudekli et al., 2023).

REGIONAL FOCUS: ALBANIA AND WESTERN BALKANS

The Western Balkans region, including Albania, presents a unique context for examining sustainable development and circular economy implementation in agriculture. As countries pursue EU accession while addressing legacy challenges from economic transition, they face particular opportunities and constraints in developing sustainable agricultural systems (Kiri, 2023).

Agricultural Sector Characteristics and Challenges

Albania's agricultural sector plays a central role in the national economy, contributing significantly to employment, GDP, and rural livelihoods. The sector is characterized by small-scale farming operations, limited mechanization, and traditional production methods presenting both challenges and opportunities for circular economy implementation (see the World Bank, 2024). The structure reflects historical patterns of land redistribution following communist system collapse in the 1990s, resulting in highly fragmented land holdings with average farm sizes less than 2 hectares. Agricultural production is dominated by small-scale, family-operated farms practicing mixed farming systems combining crop and livestock production. These traditional systems exhibit some circular agriculture characteristics, including animal manure use as fertilizer, crop rotation practices, and integration of different production activities. However, they face challenges related to low productivity, limited market access, and inadequate technical support (see National Strategy for Agriculture and Rural Development 2019-2030 of Albania).

The agricultural sector faces significant environmental challenges, including soil degradation, water pollution, and biodiversity loss. Intensive use of chemical fertilizers and pesticides, combined with poor land management practices, has resulted in environmental degradation threatening long-term sustainability. Climate change impacts, including increased frequency of droughts and floods, further compound these challenges (see UNDP Albania, 2024).

Policy Frameworks and EU Integration

Albania's pursuit of EU membership creates both opportunities and challenges for implementing sustainable development and circular economy principles. The EU accession process requires alignment with European environmental and agricultural policies, including the Common Agricultural Policy and environmental directives emphasizing sustainability and circular economy approaches (see European Commission, 2020). The Environmental Performance Review for Albania indicates that the Albanian Government has made progress in aligning national priorities with the 2030 Agenda for Sustainable Development. However, significant challenges remain, including the need to establish a national vision for 2030 and synchronize SDG implementation with EU accession processes (see UNECE, 2018). The review identifies notable deficiencies in knowledge regarding SDGs among central government officials, while awareness at local government levels, civil society, academic institutions, and private sector remains markedly low. Albania's National Strategy for Development and Integration attempted to align national priorities with sustainable development objectives, but implementation has been hampered by limited financial resources, institutional weaknesses, and competing priorities. The strategy introduced "circular economy" concepts but lacked specific targets or dedicated legislation for implementation (see National Strategy for Development and Integration 2015-2020 of Albania).

Implementation Challenges and Opportunities

Albania faces several specific challenges in implementing circular economy principles reflecting both regional characteristics and national circumstances. The recycling rate in Albania is 18.7%, significantly below EU averages, indicating limited development of circular economy infrastructure and practices (see European Environment Agency, 2020). The country operates seven legal landfills and 285 illegal dumpsites, with inadequate waste management infrastructure for supporting circular economy implementation. Financial constraints represent a major barrier. Lack of financial support, qualified human resources, and difficulty in delivering and monitoring sustainable policies within local municipalities create significant implementation challenges. These constraints are compounded by corruption and informal economy activities undermining policy implementation (see UNDP Albania, 2020). The absence of designated financial allocations for environmental protection creates additional barriers to circular economy implementation. Despite significant challenges, Albania also presents important opportunities for implementing circular economy principles. The predominance of small-scale, mixed farming systems provides a foundation for developing integrated approaches aligning with circular economy principles (see FAO, 2019). The EU accession process creates incentives and support

mechanisms for implementing sustainable development and circular economy approaches through EU funding programs, technical assistance, and policy frameworks. Traditional knowledge and practices present in Albanian agriculture, including mixed farming systems, organic production methods, and local food systems, provide a foundation for developing circular economy approaches building on existing practices while incorporating modern technologies and management approaches (see Agricultural Practices in Albania. Republic of Albania, 2020).

INDUSTRY 4.0 AND TECHNOLOGICAL INTEGRATION

The integration of digital technologies and Industry 4.0 concepts with circular economy principles in agriculture represents an emerging frontier offering significant potential for advancing sustainable development objectives. Industry 4.0 encompasses implementation of integrated and interconnected technologies including Cyber-Physical Systems, Cloud Computing, Internet of Things (IoT), Big Data, and System Integration (Khan et al., 2021).

Digital Technologies for Circular Agriculture

IoT technologies in agriculture enable real-time monitoring and optimization of resource use, supporting circular economy objectives through improved efficiency and waste reduction. IoT sensors can monitor soil conditions, weather patterns, crop health, and livestock behavior, providing data enabling precision management of inputs such as water, fertilizers, and pesticides (Salam, 2020). This precision approach aligns with circular economy principles by minimizing waste and optimizing resource utilization. Big data analytics and artificial intelligence can process vast amounts of data generated by IoT systems to identify patterns, predict outcomes, and optimize decision-making in agricultural systems. These technologies can support circular economy implementation by identifying opportunities for waste reduction, optimizing nutrient cycling, and improving supply chain efficiency (Dantas et al., 2021). Blockchain technology offers potential for enhancing traceability and transparency in circular agricultural systems, enabling tracking of materials and products throughout their lifecycle. This capability is particularly important for circular economy implementation, as it enables verification of circular practices and supports development of markets for circular products (Kurpiela & Teuteberg, 2022).

Implementation Challenges and Opportunities

While digital technologies offer significant potential for supporting circular economy implementation in agriculture, they also present challenges related to access, affordability, and

technical capacity. The digital divide between developed and developing countries, and between urban and rural areas, can limit access to these technologies for many agricultural producers (Baidya & Saha, 2024). High costs of digital technologies and need for technical skills to operate them can create barriers to adoption, particularly for smallholder farmers with limited resources. However, decreasing costs of many digital technologies and development of user-friendly interfaces are making them more accessible to broader range of users (Boyle et al., 2021) . Integration of digital technologies with circular economy approaches requires new business models and value chain configurations that can capture and distribute benefits of technological innovation.

DISCUSSION

The current review reveals several key themes and patterns providing insights into current knowledge state and future research needs. Theoretical foundations of sustainable development and circular economy provide complementary frameworks for understanding and addressing complex challenges in agricultural systems, but their integration in practice remains limited and faces significant barriers.

Key Findings and Patterns

The literature demonstrates strong theoretical alignment between sustainable development and circular economy principles, particularly in their emphasis on systems thinking, integration of multiple dimensions, and long-term perspective. However, significant gaps remain in understanding how these theoretical frameworks can be effectively operationalized in diverse agricultural contexts, particularly in developing countries where resource constraints and institutional weaknesses create additional challenges (Centobelli et al., 2020). Implementation barriers operate at multiple levels and across different dimensions, creating complex challenges requiring integrated approaches to address effectively. Financial and economic barriers, including high upfront costs and lack of market incentives, represent significant impediments requiring policy intervention and innovative financing mechanisms. Supply chain and infrastructure barriers highlight the need for systemic approaches addressing entire value chains rather than focusing solely on farm-level practices (Holly et al.,2023).

Research Gaps and Future Directions

The analysis reveals several critical areas where additional research is needed to advance understanding and implementation of circular economy principles in agriculture for sustainable development. There is need for more sophisticated methodological approaches

that can capture complex relationships between circular economy practices and sustainable development outcomes, including development of integrated assessment frameworks evaluating environmental, economic, and social impacts simultaneously (see European Commission, 2018). Research on policy integration and coordination represents a critical need, particularly in understanding how agricultural policies can be better aligned with environmental and development policies to support circular economy implementation. Comparative policy analysis across different countries and regions can provide insights into effective approaches and identify best practices adaptable to different contexts (Stojcheska et al., 2024).

CONCLUSION

This literature review has examined the intersection of sustainable development, circular economy principles, and agricultural systems, revealing both significant potential and substantial challenges for advancing sustainability objectives through circular approaches. The theoretical foundations provide complementary frameworks emphasizing systems thinking, integration of multiple dimensions, and long-term perspective, but practical implementation faces numerous barriers operating at multiple levels requiring integrated approaches to address effectively. The analysis demonstrates that circular economy principles offer important mechanisms for achieving sustainable development goals, particularly SDG 12 on responsible consumption and production, while contributing to multiple other goals including climate action, biodiversity conservation, and rural development. Agriculture, with its central role in food security, rural livelihoods, and environmental stewardship, represents a critical area for implementing circular economy approaches advancing multiple sustainability objectives simultaneously. However, implementation faces significant barriers across financial, technological, regulatory, and social dimensions. These barriers are particularly pronounced in developing countries and regions undergoing economic transition, where resource constraints, institutional weaknesses, and competing development priorities create additional challenges. The analysis of Albania and the Western Balkans region illustrates these challenges while highlighting opportunities created by EU accession processes and regional cooperation initiatives. The integration of digital technologies and Industry 4.0 concepts with circular economy approaches offers significant potential for optimizing resource use and enhancing sustainability, but also creates new challenges related to access, affordability, and technical capacity. Development of appropriate technologies and business models that can capture and distribute benefits of technological innovation represents an important area for future research and development. The findings have important implications for policy and practice. Policymakers need to develop integrated

approaches addressing multiple barriers simultaneously while creating incentives and support mechanisms for circular economy implementation. This includes eliminating harmful subsidies, investing in infrastructure and capacity building, and developing regulatory frameworks supporting circular approaches while ensuring food safety and quality. The transition toward circular economy in agriculture represents both a significant challenge and enormous opportunity for advancing sustainable development objectives. While substantial barriers exist, the potential benefits for environmental protection, economic development, and social inclusion make this transition a critical priority for achieving the 2030 Agenda and addressing pressing global challenges. Success will require sustained commitment, integrated approaches, and collaborative efforts among all stakeholders to overcome barriers and realize the full potential of circular economy principles in agriculture.

FUTURE RESEARCH DIRECTIONS AND POLICY IMPLICATIONS

The literature review identifies several critical areas requiring additional research to advance understanding and implementation of circular economy principles in agriculture for sustainable development. Development of standardized measurement frameworks for circular economy in agriculture represents an important research priority, as current measurement approaches often focus on material flows and resource efficiency without adequately addressing social and economic dimensions of sustainability (Ferasso et al., 2020). Innovation research should focus on developing appropriate technologies for different agricultural contexts, particularly those suitable for smallholder farming systems in developing countries. This includes research on low-cost, user-friendly technologies that can be easily adopted and maintained by farmers with limited technical resources (Awan et al., 2020). Research on integration of digital technologies with circular economy approaches requires interdisciplinary collaboration addressing both technical challenges and social and economic implications. Policy research priorities include understanding how agricultural policies can be better aligned with environmental and development policies to support circular economy implementation. This includes research on policy instruments, incentive mechanisms, and governance arrangements that can effectively support circular economy transitions (Awan et al., 2020). International cooperation and support mechanisms play critical roles in enabling circular economy implementation, particularly in developing countries where resource constraints and capacity limitations create significant barriers.

REFERENCES

Amo, E. (2023). The Slow Food Movement and the Terra-Madre project: food sovereignty and translocal assemblages. *Globalizations*, *20*(4), 644–660. https://doi.org/10.1080/14747731.2022.2149158

Awan, U., Kanwal, N., & Bhutta, M. K. S. (2020). A Literature Analysis of Definitions for a Circular Economy. In *Ecoproduction* (pp. 19–34). https://doi.org/10.1007/978-3-642-33857-1_2

Awan, U., Nauman, S., & Sroufe, R. (2020). Exploring the effect of buyer engagement on green product innovation: Empirical evidence from manufacturers. *Business Strategy and the Environment*, *30*(1), 463–477. https://doi.org/10.1002/bse.2631

Baidya, A., & Saha, A. K. (2024). Exploring the research trends in climate change and sustainable development: A bibliometric study. *Cleaner Engineering and Technology*, *18*, 100720. https://doi.org/10.1016/j.clet.2023.100720

Barreiro-Gen, M., & Lozano, R. (2020). How circular is the circular economy? Analyzing the implementation of circular economy in organisations. *Business Strategy and the Environment*, *29*(8), 3484–3494. https://doi.org/10.1002/bse.2590

Borrello, M., Caracciolo, F., Lombardi, A., Pascucci, S., & Cembalo, L. (2017). Consumers' Perspective on Circular Economy Strategy for reducing Food Waste. *Sustainability*, *9*(1), 141. https://doi.org/10.3390/su9010141

Boyle, A. D., Leggat, G., Morikawa, L., Pappas, Y., & Stephens, J. C. (2021). Green New Deal proposals: Comparing emerging transformational climate policies at multiple scales. *Energy Research & Social Science*, *81*, 102259. https://doi.org/10.1016/j.erss.2021.102259

Cai, Y., & Wolff, L. (2023). Education and sustainable development goals. Sustainability, 15(1), 643. https://doi.org/10.3390/su15010643

Campoli, J. S., Kodama, T. K., Nagano, M. S., &Burnquist, H. L. (2024). Advancing circular Economy: G20 Nations' path towards 12th Sustainable Development Goal. *Circular Economy and Sustainability*. https://doi.org/10.1007/s43615-024-00415-0

Centobelli, P., Cerchione, R., Chiaroni, D., Del Vecchio, P., & Urbinati, A. (2020). Designing business models in circular economy: A systematic literature review and research agenda. *Business Strategy and the Environment*, *29*(4), 1734–1749. https://doi.org/10.1002/bse.2466

Dantas, T., De-Souza, E., Destro, I., Hammes, G., Rodriguez, C., & Soares, S. (2021). How the combination of Circular Economy and Industry 4.0 can contribute towards achieving the Sustainable Development Goals. *Sustainable Production and Consumption*, *26*, 213–227. https://doi.org/10.1016/j.spc.2020.10.005

Dieckmann, E., Sheldrick, L., Tennant, M., Myers, R., & Cheeseman, C. (2020). Analysis of Barriers to Transitioning from a Linear to a Circular Economy for End of Life Materials: A Case Study for Waste Feathers. *Sustainability*, *12*(5), 1725. https://doi.org/10.3390/su12051725

Ellen MacArthur Foundation. (2024). What is a circular economy? https://www.ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview

Ellen MacArthur Foundation. (2024). Circular economy principles. https://www.ellenmacarthurfoundation.org/circular-economy-principles

Ellen MacArthur Foundation. (2019). Completing the Picture: How the Circular Economy Tackles Climate Change. https://www.ellenmacarthurfoundation.org/completing-the-picture

Esposito, B., Sessa, M. R., Sica, D., & Malandrino, O. (2020). Towards Circular Economy in the Agri-Food Sector. A Systematic Literature Review. *Sustainability*, *12*(18), 7401. https://doi.org/10.3390/su12187401

Ferasso, M., Beliaeva, T., Kraus, S., Clauss, T., & Ribeiro-Soriano, D. (2020). Circular economy business models: The state of research and avenues ahead. *Business Strategy and the Environment*, *29*(8), 3006–3024. https://doi.org/10.1002/bse.2554

European Commission. (2020). Albania Report 2020. https://ec.europa.eu/neighbourhood-enlargement/countries/detailed-country-information/albania_en

European Commission. (2020). Farm to Fork Strategy. https://ec.europa.eu/food/horizontal-topics/farm-fork-strategy_en

European Commission. (2018). Monitoring framework for the circular economy. https://ec.europa.eu/eurostat/web/circular-economy/indicators

European Environment Agency. (2020). Albania country profile - SDGs and the environment. https://www.eea.europa.eu/themes/sustainability-transitions/sustainable-development-goals-and-the/country-profiles/albania-country-profile-sdgs-and

FAO. (2019). The State of Food and Agriculture: Moving forward on food loss and waste reduction. http://www.fao.org/3/ca6030en/ca6030en.pdf

FAO. (2019). Country Programming Framework for Albania 2019-2023. http://www.fao.org/3/ca5441en/ca5441en.pdf

Fusco, G., et al. (2023). The environmental impact of agriculture: An instrument to support public policy. Ecological Indicators, 147, 109961. https://doi.org/10.1016/j.ecolind.2023.109961

Gasimli, O., Haq, I. U., Munir, S., Khalid, M. H., Gamage, S. K. N., Khan, A., & Ishtiaq, M. (2022). Globalization and Sustainable Development: Empirical Evidence from CIS Countries. *Sustainability*, *14*(22), 14684. https://doi.org/10.3390/su142214684

Government of Albania. (2015). National Strategy for Development and Integration 2015-2020. https://www.kryeministria.al/

Gudekli, A., Dogan, M. E., Dogan, T. G., & Gudekli, D. (2023). Gender, Sustainability, and Urbanism: A Systematic Review of Literature and Cross-Cluster Analysis. *Sustainability*, *15*(20), 14994. https://doi.org/10.3390/su152014994

Holly, F., Kolar, G., Berger, M., Fink, S., Ogonowski, P., & Schlund, S. (2023). Challenges on the way to a circular economy from the perspective of the Austrian manufacturing industry. *Frontiers in Sustainability*, *4*. https://doi.org/10.3389/frsus.2023.1243374

Kirchherr, J., Yang, N. N., Schulze-Spüntrup, F., Heerink, M. J., & Hartley, K. (2023). Conceptualizing the Circular Economy (Revisited): An analysis of 221 definitions. *Resources Conservation and Recycling*, *194*, 107001. https://doi.org/10.1016/j.resconrec.2023.107001

Kiri, L. (2023). *Challenges of the Implementation of the 2030 Agenda Objectives of Sustainable Development (The case of Albania)*. https://www.boletindeliteraturaoral.com/index.php/bdlo/article/view/244

Khan, I. S., Ahmad, M. O., &Majava, J. (2021). Industry 4.0 and sustainable development: A systematic mapping of triple bottom line, Circular Economy and Sustainable Business Models perspectives. *Journal of Cleaner Production*, *297*, 126655. https://doi.org/10.1016/j.jclepro.2021.126655

Korhonen, J., Nuur, C., Feldmann, A., & Birkie, S. E. (2018). Circular economy as an essentially contested concept. *Journal of Cleaner Production*, *175*, 544–552. https://doi.org/10.1016/j.jclepro.2017.12.111

Korhonen, J., Honkasalo, A., &Seppälä, J. (2017). Circular Economy: The Concept and its Limitations. *Ecological Economics*, *143*, 37–46. https://doi.org/10.1016/j.ecolecon.2017.06.041

Kurpiela, S., & Teuteberg, F. (2022). Strategic planning of product-service systems: A systematic literature review. *Journal of Cleaner Production*, *338*, 130528. https://doi.org/10.1016/j.jclepro.2022.130528

Kuźniarska, A., Mania, K., & Jedynak, M. (2023). Organizing sustainable development. In *Routledge eBooks*. https://doi.org/10.4324/9781003379409

Mensah, J. (2019). Sustainable development: Meaning, history, principles, pillars, and implications for human action. Cogent Social Sciences, 5(1). https://doi.org/10.1080/23311886.2019.1653531

Ministry of Agriculture and Rural Development. (2019). National Strategy for Agriculture and Rural Development 2019-2030. Republic of Albania

Ministry of Agriculture and Rural Development. (2020). Traditional Agricultural Practices in Albania. Republic of Albania.

The European Green Deal. (2021, July 14). European Commission. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

Nujen, B. B., Kvadsheim, N. P., Mwesiumo, D., Reke, E., & Powell, D. (2023). Knowledge obstacles when transitioning towards circular economy: an industrial intra-organisational perspective. *International Journal of Production Research*, *61*(24), 8618–8633. https://doi.org/10.1080/00207543.2022.2158243

Otero, P., Echave, J., Chamorro, F., Soria-Lopez, A., Cassani, L., Simal-Gandara, J., Prieto, M. A., & Fraga-Corral, M. (2023). Challenges in the application of Circular Economy Models to Agricultural By-Products: Pesticides in Spain as a case study. *Foods*, *12*(16), 3054. https://doi.org/10.3390/foods12163054

Ryschawy, J., Choisis, N., Choisis, J., Joannon, A., & Gibon, A. (2012). Mixed crop-livestock systems: an economic and environmental-friendly way of farming? *Animal*, *6*(10), 1722–1730. https://doi.org/10.1017/s1751731112000675

Salam, A. (2020). Internet of things for sustainable community development. In *Internet of things*. https://doi.org/10.1007/978-3-030-35291-2

Stojcheska, A. M., Zhllima, E., Kotevska, A., &Imami, D. (2024). Western Balkans agriculture and rural development policy in the context of EU integration - The case of Albania and North Macedonia. *Regional Science Policy & Practice*, *16*(8), 100049. https://doi.org/10.1016/j.rspp.2024.100049

Tennakoon, W. D. N. M. S., Janadari, M. P. N., &Wattuhewa, I. D. (2024). Environmental sustainability practices: A systematic literature review. *European Journal of Sustainable Development Research*, *8*(3), em0259. https://doi.org/10.29333/ejosdr/14604

Vallance, S., Perkins, H. C., & Dixon, J. E. (2011). What is social sustainability? A clarification of concepts. *Geoforum*, *42*(3), 342–348. https://doi.org/10.1016/j.geoforum.2011.01.002

Wezel, A., Bellon, S., Doré, T., Francis, C., Vallod, D., & David, C. (2011). Agroecology as a science, a movement and a practice. In *Springer eBooks* (pp. 27–43). https://doi.org/10.1007/978-94-007-0394-0_3

World Bank. (2024). Albania Overview. https://www.worldbank.org/en/country/albania/overview

World Commission on Environment and Development. (1987). Our Common Future. Oxford University Press. https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf

United Nations. (2018). Circular Economy for the SDGs: From Concept to Practice. https://www.un.org/en/ga/second/73/jm_conceptnote.pdf

United Nations. (2024). Progress toward the Sustainable Development Goals: Report 2024. https://unstats.un.org/sdgs/report/2024/

United Nations. (2024). *Transforming our world: the 2030 Agenda for Sustainable Development | Department of Economic and Social Affairs*. (2024). https://sdgs.un.org/2030agenda

United Nations Sustainable Development. (2023, October 20). *Sustainable consumption and production*. https://www.un.org/sustainabledevelopment/sustainable-consumption-production/

UN/DESA. (2021). Policy Brief #105: Circular agriculture for sustainable rural development. https://desapublications.un.org/policy-briefs/undesa-policy-brief-105-circular-agriculture-sustainable-rural-development

UNECE. (2018). Environmental Performance Review: Albania. https://unece.org/environment/publications/environmental-performance-review-albania-third-review

UNDP Albania. (2020). Sustainable Development Goals in Albania. https://www.undp.org/albania/

UNDP Albania. (2024). Sustainable, resilient, and green economic growth and resource management. https://www.undp.org/albania/