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GREEN ENTREPRENEURSHIP AND THE CIRCULAR ECONOMY IN THE EUROPEAN UNION: INNOVATIVE MODELS FOR THE AGRI-FOOD SECTOR

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Abstract: This article investigates how green entrepreneurship and the circular economy are reshaping the European agri-food sector in the post-pandemic period (2020–2025) and distils lessons relevant to the Republic of Moldova. The study pursues two aims: (i) to map innovative models that reduce waste, close resource loops, and decarbonize agri-food value chains; and (ii) to assess the policy and market conditions that enable their scaling. Methodologically, we conduct a structured review of recent peer-reviewed literature and EU policy documents (European Green Deal, Circular Economy Action Plan, Farm to Fork Strategy, and the 2023–2027 CAP), complemented by comparative analysis and a synthesis of Member-State case studies. Findings indicate that the EU has established a robust strategic and financing architecture that incentivizes viable circular models—such as biogas from agricultural residues, valorization of secondary biomass streams, alternative proteins, food-waste reduction, and organic farming—yet implementation remains uneven across countries. Key constraints include high upfront investment needs, regulatory uncertainty, infrastructure deficits, and skills gaps. Enablers include dedicated green finance, green public procurement, extended producer-responsibility schemes, coordinated multi-level governance, and local innovation ecosystems (incubators and agri-bio consortia). We conclude that green entrepreneurship in agri-food generates economic, social, and environmental co-benefits; however, scaling depends on predictable policies, market-creation instruments, and circular infrastructure. For Moldova, we recommend full legal alignment with the EU acquis, targeted financial tools for green SMEs, investments in waste management and rural renewable energy (e.g., anaerobic digestion), public procurement with circularity criteria, workforce education and vocational training, and demonstration pilots to accelerate the uptake of circular practices.
Keywords: green entrepreneurship; circular economy; agri-food; EU policy; waste reduction; renewable energy
JEL Classification: Q01; Q18; Q57; L26; O13

1. Introduction

The global agri-food sector is currently facing an unprecedented combination of pressures: climate change, biodiversity loss, soil degradation and international market volatility. According to estimates by the Food and Agriculture Organisation of the United Nations (FAO, 2021), approximately one third of global food production – equivalent to 1.3 billion tonnes annually – is lost or wasted along the value chain, while agri-food systems contribute about 25% to global greenhouse gas emissions (Foodvalley; MIT Climate, 2025). These realities highlight the need for structural changes that reconcile economic productivity with environmental and social objectives.

In the European Union (EU), the pressure for green transition has been translated into a series of wide-ranging policies. The European Green Deal, launched in December 2019, sets the goal for Europe to become climate neutral by 2050 (European Commission, 2019; European Commission, 2020). Complementary to this, the Circular Economy Action Plan (CEAP) adopted in March 2020 aims to decouple economic growth from the use of natural resources through legislative and market measures, with a focus on resource-intensive sectors, including agriculture and the food industry (European Commission, 2020). The Farm to Fork Strategy, in turn, proposes an ambitious set of

targets for 2030: a 50% reduction in the use of chemical pesticides, a 20% reduction in nutrient losses, the expansion of organic farming to 25% of the EU's agricultural area, and a 50% reduction in per capita food waste (European Commission, 2021).

These policy initiatives are not only responses to environmental crises, but also opportunities for the development of new economic models. In this context, the circular economy is seen as a paradigm capable of reducing waste and transforming secondary flows into resources, providing integrated solutions for the decarbonisation and resilience of food systems (Kirchherr, Reike and Hekkert, 2017). Green entrepreneurship is also emerging as a key driver of this transition, through its ability to generate technological and organisational innovations that simultaneously meet competitiveness and sustainability objectives (OECD, 2021).

The literature highlights that the green economy is growing at a faster pace than the overall economy in the EU: between 2000 and 2018, the contribution of the environmentally friendly goods and services sector to the Union's GDP increased from 1.6% to 2.3%, and employment in the green economy increased from 3.1 to 4.4 million full-time equivalents (Eurostat, 2023a; Eurostat, 2023b). These developments indicate a structural trend that cannot be ignored and position green entrepreneurship as a strategic element for the future of European agri-food.

At the same time, the COVID-19 pandemic has highlighted vulnerabilities in agri-food chains – dependence on imports, logistical bottlenecks and inequalities in access to resources. The Recovery and Resilience Facility (NextGenerationEU), the largest financial package in the history of the EU, has allocated over 37% of its total funds to the green transition, providing an unprecedented framework of support for the modernisation of agriculture and the development of circular businesses (European Commission, 2021).

For the Republic of Moldova, a candidate country for EU accession in 2022, these processes have double relevance. On the one hand, European integration requires legislative harmonisation and adaptation to EU standards. On the other hand, the Moldovan agricultural economy, marked by structural vulnerabilities – low productivity, exports concentrated on raw materials and poor infrastructure – can benefit from the adoption of circular models and green entrepreneurship, gaining added value and international competitiveness (Government of the Republic of Moldova, 2024).

Thus, this article aims to investigate: (i) how green policies and entrepreneurship are transforming the agri-food sector in the EU in the post-pandemic period (2020–2025); (ii) emerging innovative circular economy models applied in practice; and (iii) relevant lessons for the Republic of Moldova, with a focus on policy recommendations and support mechanisms for green SMEs.

2. Methodology.

The methodological approach of this study was designed to address two central objectives: (i) mapping innovative models of green entrepreneurship and circular economy in the European agri-food sector in the period 2020–2025 and (ii) identifying lessons applicable to the Republic of Moldova in the context of its transition towards European integration.

The study adopts a qualitative exploratory approach, appropriate for emerging fields where practices are still evolving and where analysis is based on policy documents, institutional reports and recent academic literature. The methodology was designed to provide both a systematic synthesis of the existing literature and a comparative analysis of European experiences, integrated into a framework applicable to the Republic of Moldova.

A first step was to conduct a systematic literature review using major scientific databases. Keywords included terms such as *"green entrepreneurship", "circular economy", "sustainable agri-food", "EU Green Deal", "Farm to Fork"* (ETC/CE, 2022; EU4Environment, 2023). To ensure relevance and timeliness, the selection was limited to works published between 2020 and

2025. Both conceptual contributions and empirical studies on the implementation of circularity in agriculture and the food industry were retained.

The second stage involved examining the European strategic framework, with a focus on the main documents: the European Green Deal (European Commission, 2019), the Circular Economy Action Plan, the Farm to Fork Strategy (European Commission, 2020) and the Common Agricultural Policy 2023–2027 (European Commission, 2021). These were supplemented by thematic reports published by international institutions and Eurostat statistics on material circularity and the dynamics of the green sector.

In order to capture differences in implementation across Member States, the methodology included a comparative analysis based on case studies. Three representative countries were selected:

- The Netherlands – a pioneer in circularity and agri-food innovation, with circular farms and biotech industries (Protix, Kipster).
- Poland – an example of an emerging economy with green transition policies currently being consolidated.
- Romania – an illustrative case for the challenges faced by Eastern European countries that are just starting to implement circularity.

The selection aimed to ensure diversity in terms of development level, infrastructure and degree of EU policy integration.

3. The context of the Republic of Moldova.

For contextualisation, the analysis integrated national and regional documents such as *the National Programme for the Promotion of the Green and Circular Economy 2024–2028* (Government of the Republic of Moldova, 2024), the Environment Strategy 2030 and the EU4Environment programme evaluations. This stage allowed for a comparison of the European experience with the situation in Moldova, identifying structural barriers (poor waste infrastructure, lack of green capital) and opportunities (access to European funding, legislative alignment).

The data and information collected were processed through content analysis and triangulation to correlate academic, institutional and empirical perspectives. This methodological approach ensures scientific validity by drawing on multiple sources and practical relevance by integrating case studies and the Moldovan context.

4. Results.

The analysis of post-2020 European policies highlights a significant strengthening of the strategic framework for the transition to a greener and more circular agri-food sector. The European Green Deal, the Circular Economy Action Plan and the Farm to Fork Strategy have established a set of clear objectives and financial support mechanisms that have begun to generate structural changes in agriculture and the food industry. However, the degree of implementation varies considerably between Member States, highlighting both good practices and persistent obstacles.

On the one hand, countries such as the Netherlands have made considerable progress through coherent policies, developed infrastructure and an already established green culture. This context has fostered the emergence of innovative models such as circular farms or large-scale biogas production, which demonstrate the economic viability of circular principles. In contrast, countries such as Poland and Romania illustrate the structural challenges typical of Central and Eastern Europe: difficulties in modernising waste management infrastructure, limited access to dedicated funding and low levels of environmental awareness among farmers and consumers.

Eurostat data confirms these differences. The circular material utilisation rate stands at almost 27.5% in the Netherlands, compared to only 8.4% in Poland and 1.4% in Romania, highlighting the major gaps between the West and East of the Union. At the same time, the level

of packaging waste recycling or the integration of secondary raw materials into production chains remains below the European average in many of the Union's emerging economies.

One positive development at European level is the expansion of organic farming, supported by the Common Agricultural Policy 2023–2027, which introduces eco-schemes designed to reward environmentally friendly practices. For example, Poland has set a target of achieving 25% organic agricultural land by 2030, developing national plans that combine financial incentives with farmer education. The rapid growth in organically farmed land shows that the EU's financial and legislative levers can produce tangible results in a relatively short time.

However, literature and case studies reveal that these favourable results are offset by a number of structural challenges. The high costs of transitioning to circular models discourage SMEs in particular, which often lack the capital needed to invest in green technologies. In addition, regulatory uncertainties and complex administrative procedures can discourage entrepreneurial initiatives, especially in countries with weak institutional capacity.

Despite these constraints, examples of green entrepreneurship in Europe demonstrate the positive economic and social impact of the circular economy. Whether it is the recovery of organic waste through innovative biotechnologies, the integration of industrial symbiosis between farms and processors, or digital initiatives to reduce food waste, these models show that sustainability and competitiveness are not mutually exclusive. On the contrary, where favourable conditions have been created, green entrepreneurship has proven to be a generator of added value, jobs and social cohesion.

Overall, the results show that the European Union has succeeded in creating a favourable framework, but effective implementation depends on a number of critical factors: the stability of national policies, the existence of basic infrastructure, the level of environmental education and the capacity for innovation of the entrepreneurial environment. Without these, the transition to a circular agri-food model risks remaining fragmented and uneven across countries.

To better understand the differences and similarities between the countries analyzed, it is useful to make a systematic comparison based on a set of criteria relevant to the transition to green entrepreneurship and the circular economy. The narrative analysis presented above captures the general aspects, but a synthetic representation in the form of a table allows for a more precise highlighting of the level of circularity, the public policies adopted, the existing infrastructure, access to financing, but also the structural challenges specific to each country. This comparative approach is important because it facilitates the identification of factors that accelerate or slow down the transition and provides a solid basis for formulating recommendations applicable to the Republic of Moldova.

Table 1. Comparative analysis of the transition to green entrepreneurship and the circular economy in the agri-food sector (the Netherlands, Poland, Romania, and the Republic of Moldova)

Analysis criteria	Netherlands	Polonia	Romania	Republica Moldova
Level of material circularity (%)	~27,5% (Eurostat, 2023)	~11,2%	~1,4%	<1%
Relevant national policies	Circularity Strategy 2050; Sectoral Green Deals	Program for bioeconomy and organic farming; Rural Development Plan 2023–2027	National Waste Management Strategy; anti-waste pilot programs	National Program for the Promotion of the Green and Circular Economy 2024–2028

Organic farming (area % of total)	>12%	~5% (target: 25% by 2030)	~3%	~1%
Infrastructure for agri-food waste management	Developed (integrated systems, biogas, industrial symbiosis)	Expanding, EU-supported regional projects	Deficient, lack of rural infrastructure	Very poor, most waste in non-compliant landfills
Access to green finance	High, national + European funds; public-private partnerships	Moderate, dependence on European funds	Reduced, fragmented projects	Very low, incipient programs, dependence on external support
Examples of good practices	*Kipster* farm (climate-neutral production); Protix (insect biotechnology)	Support schemes for organic SMEs; growth of the organic market	Anti-waste pilot projects in retail and HoReCa	Local recycling initiatives; pilot projects supported by EU4Environment
Main challenges	Scaling and cross-sector coordination	Insufficient administrative capacity and infrastructure	Deficient infrastructure and cultural resistance	Fragmentation of agriculture, lack of green capital and infrastructure

Source: Author's compilation based on Eurostat (2023), European Commission (2020; 2021), OECD (2021), Government of the Republic of Moldova (2024).

The table highlights the significant contrasts between the countries analyzed. The Netherlands stands out with superior performance on most criteria, thanks to a long-term strategic vision, massive investments in infrastructure, and a well-established ecological culture. Poland, which is at an intermediate stage, reflects the importance of using European funds and planning geared towards clear objectives, such as expanding organic farming areas. Romania, although benefiting from the same European instruments, faces major implementation difficulties due to poor infrastructure and cultural resistance to change.

Compared to these countries, the Republic of Moldova appears to be a distinct case, characterized by initiatives that are just getting started and a regulatory framework that is still being developed. The low level of organic farming, the lack of modern infrastructure, and limited access to green capital are obvious barriers. However, similarities with the experience of Romania and Poland suggest that Moldova can make rapid progress through a combination of strong public policies, strategic investments, and education programs focused on green skills. In this sense, the comparison provided by the table not only highlights current gaps, but also outlines the directions of action needed to transform structural vulnerabilities into opportunities for sustainable development.

5. Discussions.

The results show that the transition to green entrepreneurship and a circular economy in the European agri-food sector is based on a combination of political, economic and social factors, but is also constrained by multiple structural challenges. The experience of Member States shows that the successful adoption of circular practices depends, in the first place, on the coherence and predictability of public policies. Countries such as the Netherlands have managed to send a strong signal to the business community through clear long-term objectives, such as the commitment to become 100% circular by 2050. This strategic direction has mobilised private investment and

created a stable framework for entrepreneurs. In contrast, the lack of continuity and legislative inconsistencies encountered in other countries have generated uncertainty and slowed down innovative initiatives, with visible effects on competitiveness and investment attractiveness.

From an economic and technological perspective, the high costs of green infrastructure – from biogas plants to digital technologies for product traceability – continue to be a major barrier for SMEs. In particular, entrepreneurs in agriculture and the food industry face limited access to finance and a lack of dedicated mechanisms to offset the high risks of circular innovation. At the same time, the digital divide between western and eastern Europe is slowing down the adoption of innovative solutions in emerging countries, accentuating performance gaps. The Republic of Moldova, with its fragmented agricultural structure dominated by small farms, faces similar difficulties, highlighting the need for tailored financial instruments such as low-interest green loans, start-up grants and public-private venture capital funds.

Another key aspect is the creation of markets for green products, without which circular innovations cannot be scaled up. In the European Union, green public procurement, eco-labelling schemes and product labelling have stimulated demand and helped to strengthen competitive value chains. These instruments not only provide green producers with access to stable markets, but also send a cultural and social signal about the value of sustainability. For the Republic of Moldova, replicating such policies could encourage local producers to adopt circular practices, while also facilitating their access to foreign markets that are sensitive to environmental criteria.

The educational dimension plays an equally important role. The lack of green skills and practical knowledge in the field of circularity limits the entrepreneurial environment's ability to capitalise on existing opportunities. Examples from the Nordic countries show that integrated educational programmes and continuous professional training are essential for building human capital prepared to manage the green transition. For the Republic of Moldova, the introduction of circular economy and green entrepreneurship modules in university programmes, as well as the development of training programmes for farmers and managers in the agri-food sector, are basic conditions for strengthening long-term economic resilience.

Overall, the discussion confirms that the circular economy and green entrepreneurship can become drivers of economic and social development in the agri-food sector, but only under the conditions of an integrated framework of policies, infrastructure and education. The Republic of Moldova has the opportunity to learn from the experience of the European Union and directly adopt the most effective practices, avoiding some of the difficulties encountered by Member States. However, this process requires a systemic approach, in which legislative alignment, green financing, waste management infrastructure and human capital are developed simultaneously and in a coordinated manner. Without this integration, there is a risk that the green transition will remain fragmented, with limited effects on the competitiveness and sustainability of the agri-food economy.

6. Conclusions and recommendations.

The analysis confirms that the transition to green entrepreneurship and the circular economy in the agri-food sector is not just a political aspiration, but a structural necessity to ensure economic and environmental sustainability in contemporary Europe. Through the Green Deal, the Circular Economy Action Plan and the Farm to Fork Strategy (WBCSD, 2020), the European Union has succeeded in creating a robust policy framework and dedicated financing mechanisms that have begun to bring about real change in agricultural and food practices. The emergence of innovative models – from circular farms that recycle waste to biotechnologies capable of transforming organic residues into resources, or digital platforms designed to reduce food waste – demonstrates that sustainability and competitiveness can be reconciled and that the green economy can become an engine of development.

However, differences in implementation between Member States indicate that this process is far from uniform. Western countries, supported by advanced infrastructure and solid institutional frameworks, have managed to achieve high levels of circularity, while Central and Eastern European countries still face financial, institutional and cultural barriers. These gaps reveal that European policies, however ambitious, must be accompanied by mechanisms for adaptation to the local context and instruments to reduce inequalities in capacity and resources between regions.

For the Republic of Moldova, the conclusion is clear: integrating the principles of the circular economy and promoting green entrepreneurship in agri-food is not only a condition for joining the European Union, but also a unique opportunity for the structural modernisation of the national economy. The Republic of Moldova has the opportunity to learn from the experiences of Member States, avoiding mistakes and directly adopting solutions that have proven effective. In this regard, legislative alignment with the European acquis, investments in waste management infrastructure and renewable energy sources, as well as the promotion of education and vocational training in the field of circularity are essential areas for action. Furthermore, the creation of internal markets for green products through sustainable public procurement policies and eco-labelling schemes could ensure both the development of local entrepreneurs and access to premium markets in the European Union.

Overall, the transition to green entrepreneurship and a circular economy in agri-food should be seen as an integrative process that goes beyond the purely environmental dimension and has far-reaching economic, social and political implications. Strengthening the strategic framework, developing appropriate financial mechanisms, stimulating innovation and investing in human capital are sine qua non conditions for the success of this process. The Republic of Moldova now has the opportunity to turn its current vulnerabilities into competitive advantages, benefiting from the support of the European Union and the lessons already learned by Member States.

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