

CIRCULAR POLICY FRAMEWORK IN THE FOOD SECTOR FOR BRIDGING REGULATION BUSINESS PRACTICES AND CONSUMER PROTECTION IN THE REPUBLIC OF NORTH MACEDONIA

DOI: 10.26341/issn.2241-4010-2026-1c-12

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Abstract

The transition towards a circular economy in the food sector of the Republic of North Macedonia requires a coherent policy framework capable of bridging regulatory requirements, business practices and consumer protection. This paper examines how existing regulatory instruments influence the adoption of circular strategies within agri-food companies, building upon prior national and regional research on circular economy models. Based on an empirical study conducted among food sector enterprises, the research explores the gap between regulatory knowledge and actual business practices, with particular emphasis on packaging eco-design, bio-waste management and the role of digital technologies. The analysis identifies key structural and economic barriers that hinder circular strategy adoption, while also examining the role of the business sector in informing consumers and strengthening transparency as an integral component of consumer protection. The findings provide policy-relevant insights for improving support mechanisms, enhancing regulatory coherence and facilitating the green transition of the agri-food sector in line with European Union standards and the Green Agenda for the Western Balkans.

Key words: circular economy, food sector, regulation, business practices, consumer protection, North Macedonia.

Introduction

The transition towards a circular economy (CE) has evolved from an environmental aspiration into an economic imperative for the agri-food sector in Southeast Europe. Under conditions of increasing resource scarcity, market volatility and environmental pressures, the traditional linear model of “take–make–dispose” is becoming economically and socially unsustainable, giving way to restorative systems that maximise resource efficiency and value retention (Pearce and Turner, 1990; Ghisellini et al., 2016).

For the Republic of North Macedonia, a developing economy and EU candidate country, this transition is closely linked to the implementation of the European Green Deal and the Green Agenda for the Western Balkans, as well as the Farm to Fork Strategy, which sets ambitious targets for waste reduction, sustainable packaging and food system transformation by 2030 (European Commission, 2020; Regional Cooperation Council, 2020). Previous national studies indicate that the agri-food sector holds significant potential for the adoption of circular practices, particularly in the management of by-products and waste streams (Бојковска К., 2021). However, a persistent gap remains between strategic policy objectives and the operational capacities of private sector actors.

The effectiveness of the circular transition largely depends on the interaction between three interrelated dimensions: regulatory frameworks, business practices and consumer protection. While regulatory instruments are expected to provide incentives and clear compliance mechanisms, businesses are required to invest in organisational and digital capacities that enable traceability, resource optimisation and transparency (Bote Alonso et al., 2022). At the same time, consumer protection in the context of circular economy extends beyond food safety, encompassing the right to accurate, transparent and verifiable information regarding the environmental footprint of food products.

Against this background, this paper aims to analyse how regulatory knowledge, economic constraints and digitalisation capacity influence circular strategy adoption in the Macedonian food sector, while also addressing the role of consumer information as a core component of circular policy design.

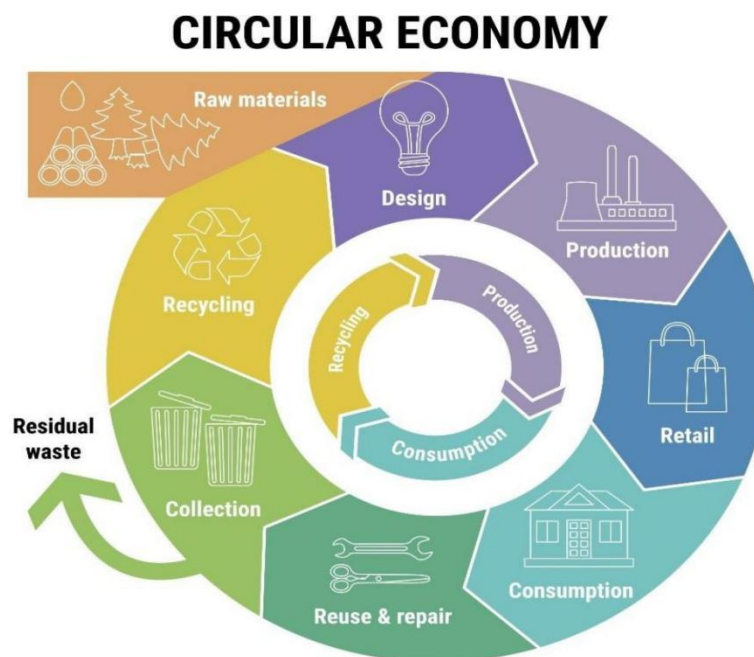
Theoretical framework and literature review

The analytical foundation of this study is grounded in contemporary circular economy theories that conceptualise the transition from linear to circular models as a systemic transformation of business philosophies, rather than a purely technical adjustment. Circular economy is commonly defined as a restorative and regenerative industrial system that replaces the concept of “end-of-life” with superior design of materials, products and business models (Ghisellini et al., 2016; Bojkovska et al., 2023). In the context of agri-food systems, this transformation is particularly relevant due to the high intensity of organic waste, packaging flows and seasonal production cycles.

The implementation of circular strategies in this research is analytically framed through the RESOLVE framework (Regenerate, Share, Optimise, Loop, Virtualise, Exchange), which provides a structured roadmap for identifying points at which resources and by-products can be reintegrated into production cycles (Bojkovska et al., 2023). Early empirical evidence from the Macedonian agri-food sector indicates that the initial phase of circular transition, observed around 2021, was primarily concentrated on the pillars of *Optimise*—through reductions in resource use and waste generation—and *Regenerate*, mainly via the use of renewable energy sources (Bojkovska et al., 2023).

The evolution of circular economy models has seen a significant shift in strategic focus. While early frameworks primarily prioritized waste management, more recent literature emphasizes the limitations of recycling-oriented approaches and calls for a shift towards preventive and redesign-based strategies, as reflected in the expanded 9R hierarchy (Kirchherr et al., 2017).

Figure 1: Circular Economy Value Chain in the Agri-Food Sector



Source: Adapted from Kirchherr et al. (2017)

Within this hierarchy, advanced circularity is achieved through higher-order strategies such as Refuse and Rethink, as well as through the Loop principle, which entails closing material cycles via systematic reuse and recycling. Empirical findings from our 2024 research indicate moderate progress in this direction within the Macedonian agri-food sector, with firms beginning to experiment with closed-loop systems. However, as noted in the reference monograph (Bojkovska et al., 2023), the transition from conceptual awareness to practical implementation is often stalled by a lack of specialized knowledge and high entry costs. Consequently, the capital-intensive nature of such investments remains a significant constraint, creating an 'investment ceiling' that limits the broader diffusion of higher-order circular strategies across the industry.

Digital transformation is increasingly recognised as a critical enabler of circular economy implementation. Technologies such as the Internet of Things (IoT), blockchain and data-driven platforms allow real-time monitoring of resource flows and enhance transparency across the value chain (Bote Alonso et al., 2022). In the agri-food sector, digitalisation extends beyond operational efficiency, functioning as a key mechanism for traceability, accountability and consumer communication.

The introduction of digital tools such as QR codes and Digital Product Passports represents a qualitative shift from traditional marketing towards evidence-based consumer information. This theoretical perspective is strongly supported by empirical findings from 2024, which confirm the mediating role of digitalisation capacity in facilitating both circular

strategy adoption and improved consumer protection. By enabling transparent disclosure of sustainability attributes, digitalisation strengthens trust and market integrity, positioning consumer information as an integral component of circular policy frameworks.

One of the core circular business models identified in the literature is *resource recovery*, which is directly dependent on eco-design principles, particularly in packaging. Eco-design facilitates material separation, recyclability and reuse, thereby enabling the closure of material loops (Bojkovska et al., 2023). In the Macedonian agri-food sector, the adoption of eco-design practices increased from below 5% in 2021 to approximately 12% in 2024, indicating an early but tangible phase of acceptance.

Despite this progress, the relatively slow growth rate suggests that companies continue to face high marginal costs associated with packaging redesign and compliance with environmental standards. This finding reinforces the identification of financial constraints as the primary structural barrier to advanced circular transformation, particularly in small and medium-sized enterprises.

A key theoretical distinction in the circular economy literature concerns the difference between formal environmental compliance and substantive circular innovation. In North Macedonia, alignment with national legislation—such as the Waste Management Law and the Law on Packaging and Packaging Waste—and the adoption of international environmental management systems, including ISO 14001 and EMAS, provide an essential institutional framework for environmental control (ISO, 2015). While ISO 14001 is the most widely adopted standard in the Macedonian agri-food sector, the EU Eco-Management and Audit Scheme (EMAS) represents a higher tier of environmental commitment. EMAS requires not only a functional management system but also mandatory public reporting and verified legal compliance (European Commission, 2009). Our findings suggest that the transition from ISO 14001 toward EMAS-level transparency remains limited, as firms are currently prioritizing basic regulatory adherence ('compliance phase') rather than the rigorous performance tracking and public disclosure required by EMAS.

However, existing studies highlight that formal certification does not automatically translate into strategic commitment to circular innovation. Empirical evidence suggests that a significant proportion of managerial staff in the Macedonian agri-food sector report insufficient knowledge of green entrepreneurship and advanced circular strategies (Bojkovska et al., 2023). This helps explain the observed disconnect between ISO certification and actual readiness for circular investments, positioning the sector predominantly within a “compliance phase”, where certification serves market legitimacy rather than transformative change.

Overall, the period between 2021 and 2024 reflects an evolutionary shift in the Macedonian agri-food sector—from a phase of conceptual awareness towards one characterised by practical implementation constrained by structural and financial barriers. While theoretical understanding, regulatory alignment and digital readiness have improved, the persistence of an “investment ceiling” continues to limit the scaling of advanced 9R strategies. This synthesis underscores the need for policy instruments that move beyond general regulatory frameworks toward targeted economic incentives capable of unlocking circular innovation and accelerating the sector’s transition.

Research methodology

The primary objective of this study is to assess the readiness and capacity of agri-food companies in North Macedonia to transition toward a circular economy. Specifically, the research aims to identify how regulatory knowledge and economic constraints influence the

adoption of circular strategies and consumer protection. Based on the theoretical framework, the following hypotheses are formulated:

- H1: A significant gap exists between formal regulatory awareness and the practical implementation of circular business models in the Macedonian agri-food sector.
- H2: Economic barriers, primarily high investment costs and lack of institutional subsidies, significantly hinder the adoption of 9R circular strategies.
- H3: Digitalisation capacity acts as a fundamental enabler that positively influences the quality of consumer information and protection.

Measuring key constructs: All key constructs were operationalized using multi-item measures developed specifically for the context of the agri-food sector in North Macedonia and informed by previous research on the circular economy. Responses were collected using five-point Likert-type scales (1 = strongly disagree / very low, 5 = strongly agree / very high).

Regulatory knowledge was measured through respondents’ self-reported familiarity with national and EU-related policy documents, including the Law on Waste Management, the Law on Packaging and Packaging Waste, the National Waste Management Plan (2020-2030) and the Green Agenda for the Western Balkans.

Economic barriers were operationalized as a composite index capturing perceived financial constraints, including high investment costs, lack of subsidies, administrative burden, lack of qualified personnel and low consumer demand for circular products.

Digitalization capacity was measured through items assessing the use of digital tools for traceability, data management, consumer communication (e.g. QR codes) and process monitoring.

Adoption of circular (9R) strategies was measured through the reported implementation of practices related to resource optimization, waste reduction, eco-design, reuse, recycling and loop-based systems.

Consumer protection and information was operationalized through indicators related to transparency, traceability and the provision of verifiable environmental information to consumers.

Table 1. Measurement of key constructs

Construct	Key indicators / survey items	Scale type
Regulatory Knowledge	Familiarity with the Law on Waste Management, Law on Packaging and Packaging Waste, National Waste Management Plan, Green Agenda for the Western Balkans	5-point Likert
Economic Barriers	Investment costs, availability of subsidies, administrative burden, lack of skilled personnel, low consumer demand	5-point Likert (composite index)
Digitalisation Capacity	Use of traceability tools, data management systems, QR codes, digital process monitoring	5-point Likert
9R Strategy Adoption	Resource optimisation, eco-design practices, reuse, recycling, loop-based systems	5-point Likert

Consumer Protection	Transparency of information, product traceability, provision of verifiable environmental information	5-point Likert
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Source: Author's own conceptualization based on the research model and survey instrument

The author's calculated the composite indices as the arithmetic mean of the corresponding items.

Reliability and validity: The internal consistency of the multi-item constructs was assessed using Cronbach's alpha coefficients. All composite indices showed acceptable reliability, with alpha values exceeding the generally accepted threshold of 0.70. Content validity was ensured by aligning with established frameworks for the circular economy (RESOLVE model and 9R hierarchy) and informed by broad circular economy research and context-specific insights drawn from sector reports and policy analyses relevant to the Macedonian agri-food sector.

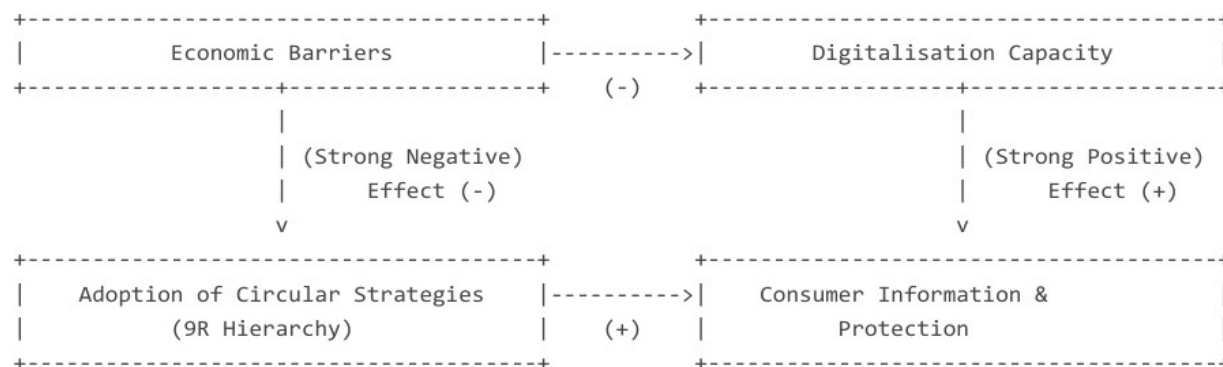
Participant recruitment followed a purposive sampling strategy, targeting decision-makers (owners and senior managers) in the agri-food sector to ensure the quality and relevance of the data. The sampling frame was derived from national business registers and regional chambers of commerce databases. A total of 135 agri-food companies were initially invited to participate via e-mail and telephone calls. Of these, 55 provided complete and valid responses, resulting in a response rate of 40.7%. This response rate is consistent with comparable corporate surveys conducted in transition economies, where access to senior management is often limited. To address potential selection bias, the sample was balanced to reflect the national economic landscape, including micro, small, medium and large enterprises from different sub-sectors. Given the exploratory nature of this research, a sample of 55 companies provides a representative cross-section for identifying key trends and barriers in the transition to a circular economy. The final sample consists of 55 agri-food companies operating in North Macedonia. The sample includes a wide array of sub-sectors, including fruit and vegetable processing (30%), dairy and meat production (30%), bakery and confectionery (20%), the beverage industry (15%), and some other industries including health food and plant-based meal production companies (5%). The sample structure was carefully selected to reflect the national economic landscape: 20% Micro-enterprises (1-10 employees), 40% Small enterprises (11-50 employees), 30% Medium enterprises (51-250 employees), 10% Large enterprises (over 250 employees).

To ensure statistical rigour and reliability, the data were processed using SPSS Statistics package. The following analytical techniques were employed:

1. Descriptive Statistics: To profile the sample and establish baseline levels of awareness and practice.
2. Chi-Square (χ^2) Analysis: To determine the significance of the relationship between company size and levels of regulatory compliance.
3. Pearson Correlation and Multiple Regression: To test the strength and direction of the associations that economic barriers and digitalisation have on circular outcomes.

The research logic is synthesized in the Conceptual Path-Diagram (Figure 2). This model illustrates the structural relationships between the key constructs of the study.

Figure 2. Conceptual path-diagram illustrating the hypothesized relationships between variables (regulatory knowledge, economic barriers, digitalisation capacity and the adoption of circular strategies) in the agri-food sector of North Macedonia



(Note: Positive (+) and negative (-) signs indicate the expected direction of associations.)

Source: Author's own conceptualization based on the research model

The logic of the research paths is interpreted as follows:

- The Regulatory Gap (Regulatory Knowledge → 9R Strategies): The model illustrates that mere awareness of legislation does not directly translate into high-level circular practices, confirming a 'compliance gap' where regulation remains a background factor rather than a driver.
- The Economic Deterrent (Economic Barriers → 9R Strategies): There is a significant negative path (-), identifying financial constraints as the primary 'bottleneck' for 9R hierarchy implementation.
- Digitalisation as a Mediator: The path-based analytical framework suggests that while economic barriers may hinder technological capacity, successful integration of digital tools acts as a powerful engine (+) for enhancing Consumer Information and Protection.
- The Circularity-Consumer Link: Adopting higher-order strategies (Rethink, Redesign) directly improves transparency and consumer rights, bridging the gap between business practice and market needs.

The integration of these constructs within the proposed path-diagram provides the analytical framework for the empirical testing and discussion of the results presented in the following section.

Research Ethics and Data Management

Participation in the survey was strictly voluntary and based on informed consent. All respondents were informed of the study's objectives and were guaranteed complete anonymity and confidentiality; no personal or sensitive corporate data was collected. The data were used solely for academic purposes and stored in aggregate form to prevent identification of individual firms. In line with transparency standards, the data sets are available from the authors upon reasonable request.

Results and discussion

Sample Profile and Regulatory Awareness

This section presents and discusses the empirical findings of the research, fully aligned with the predefined hypotheses and the conceptual model (Figure 2). The analysis follows a

stepwise logic, starting with the descriptive profile of the sample, followed by hypothesis testing and a comparative discussion with previous findings. The analysis tests the structural relationships between regulatory awareness, economic capacity, and the transition to a circular model.

The final sample of 55 agri-food companies reflects the realistic structure of the Macedonian sector, dominated by micro and small enterprises (60%). This structural composition is fundamental for interpreting the results, as smaller firms are typically more vulnerable to financial constraints and administrative complexity in the circular transition. The analysis first examines whether company size is associated with differences in regulatory awareness. As shown in Table 2, the Chi-square results ($\chi^2=14.82$, $p=0.022$) confirm a statistically significant relationship. Large enterprises exhibit substantially higher levels of familiarity with circular legislation, while micro and small firms remain predominantly partially informed.

Table 2. Awareness of circular legislation by company size

Company size	Low awareness	Moderate awareness	High awareness	Total
Micro & small enterprises	45%	33%	22%	100%
Medium & large enterprises	10%	25%	65%	100%

Pearson Chi-Square = 14.82, df = 6, p = 0.022

Source: Author's calculations based on survey data

To further explore the nature of this regulatory gap, the analysis disaggregates awareness across specific legal and strategic documents. This distinction is important, as operational compliance often differs from strategic alignment.

Table 3. Level of awareness of key regulatory and strategic documents

Document	Fully aware	Partially aware	Not aware
Law on Waste Management	62%	31%	7%
Law on Packaging and Packaging Waste	58%	22%	20%
National Waste Management Plan 2020–2026	18%	35%	47%
Green Agenda for the Western Balkans	12%	28%	60%

Source: Author's calculations based on survey data

The results reveal a clear divergence between awareness of legally binding instruments and strategic policy frameworks. While most companies are familiar with core operational laws, nearly half of the respondents are unaware of the National Waste Management Plan (2020–2030), and a majority lack familiarity with the Green Agenda for the Western Balkans. This confirms that the regulatory framework is formally in place but insufficiently communicated in strategic terms, reinforcing the conclusion that H1 reflects a policy implementation gap rather than a legislative absence.

Analysis of Barriers to Circular Transformation

After establishing the regulatory context, the analysis shifts to internal and external barriers that constrain circular implementation. Identifying these barriers is crucial for understanding why awareness does not translate into action (Table 4).

Table 4. Ranking of barriers to circular transformation

Barrier	Mean	Standard Deviation SD	Rank
Lack of financial support/subsidies	4.65	0.52	1
High investment costs for technology	4.42	0.61	2
Complex administrative procedures	3.85	0.84	3
Low consumer awareness	3.72	0.79	4
Lack of skilled personnel/knowledge	3.10	0.95	5

Source: Author's calculations based on survey data

The ranking clearly indicates that economic barriers dominate managerial perceptions. Financial constraints not only outweigh organisational and knowledge-related issues but also directly affect the feasibility of technological investments.

Statistical Analysis and Hypothesis Testing

To further examine the structural relationships proposed in the research, the conceptual relationships illustrated in Figure 2 were empirically tested using the regression model presented in Table 5. This combined correlation and regression analysis allows for a precise evaluation of how regulatory, economic, and digital factors are related to the adoption of circular strategies.

The Pearson correlation reveals two key dynamics (Table 5). First, a strong negative correlation is observed between economic barriers and digitalization capacity, indicating that financial constraints represent a major obstacle to digital upgrading and are associated with lower adoption of a circular strategy in the agri-food sector. Second, the strong positive correlation between digitalization capacity and consumer protection ($r = 0.64$, $p < 0.001$)

provides empirical support for Hypothesis H3, confirming that digital tools play a key role in improving transparency, traceability and consumer information within circular agri-food systems.

Table 5. Correlation matrix and multiple regression results for Circular Strategy Adoption

Variables	(1)	(2)	(3)	(4)	Standardised β	Standard Error (SE)	Sig. (p)
(1) Regulatory knowledge	1				0.214	0.082	0.036
(2) Economic barriers	-0.42*	1			-0.412	0.091	< 0.001

(3) Digitalisation capacity	0.35*	-0.58*	1		0.385	0.104	0.001
(4) Consumer protection	0.28*	-0.31*	0.64*	1	—	—	—
Model Fit:	$R^2 = 0.52$	Adj. $R^2 = 0.49$	F = 18.42	$p < 0.001$			

Note: Correlation is significant at the 0.05 level. VIF values for all predictors are below 2.0, indicating no multicollinearity concerns. Sig. (p) denotes the p-value of the regression coefficients.

Source: Author's calculations based on survey data

Before interpreting the regression results, standard diagnostic checks were performed. No significant violations of the assumptions of normality, homoscedasticity, or multicollinearity (VIF values below the conventional threshold) were detected. Given the observational nature of the data, the analysis focuses on statistically significant associations rather than causal links.

The regression analysis further assesses the relative explanatory power of the independent variables in predicting circular strategy adoption. Economic barriers emerged as the strongest negative predictor ($\beta = -0.412$, $p < 0.001$), providing strong empirical support for Hypothesis H2.

Digitalisation capacity remains a significant positive driver ($\beta = 0.385$, $p = 0.001$), while regulatory knowledge also demonstrates a statistically significant positive association with circular strategy adoption ($\beta = 0.214$, $p = 0.036$), supporting Hypothesis H1. Overall, the model accounts for 52% of the variance in circular strategy adoption ($R^2 = 0.52$). These results highlight the critical role of digitalisation in facilitating the transition toward a circular agri-food sector, while simultaneously identifying economic constraints as the primary inhibiting factor.

The Role of Environmental Certification and Comparative Analysis (2021–2024)

An exploratory comparison between ISO 14001-certified and non-certified firms reveals no substantial difference in circular readiness, suggesting that certification primarily serves as a compliance-oriented instrument for market legitimacy rather than as a driver of strategic innovation. The transition to the more rigorous EU Eco-Management and Audit Scheme (EMAS) remains almost non-existent due to high marginal costs and the absence of financial incentives for SMEs. As further detailed in the Conclusions, this stagnation confirms an “investment ceiling” that prevents a deeper circular transformation.

To capture the dynamic evolution of circular economy practices, a comparative analysis of key indicators between 2021 and 2024 was undertaken. For the purposes of this analysis, data from the Monograph "Circular Economy - A Global Concept for Sustainability" (Bojkovska K. et al., 2023) were used as a reference base, which refers to research conducted in 2021. This allows for precise monitoring of the progress of the Macedonian agri-food sector over a period of three years. As summarised in Table 6, the findings indicate a gradual transition from conceptual engagement toward early-stage implementation of circular strategies. While digitalisation and consumer information mechanisms have expanded notably, progress in eco-design and advanced circular practices remains slow. The comparison further reveals a structural shift in perceived

barriers—from limited awareness in 2021 to financial constraints in 2024—underscoring the need for targeted economic support mechanisms to accelerate circular transformation.

Table 6. Comparative analysis of circular economy indicators (2021 vs. 2024).

Indicator	2021 (according to Bojkovska K. et al., 2023)	2024	Trend
RESOLVE model application	Optimise, Regenerate	Inclusion of Loop	Moderate progress
Eco-design of packaging	<5%	~12%	Slow growth
Digitalisation	Almost absent	18%	Significant increase
Consumer information	Traditional marketing	QR codes, digital channels	Transparency shift
Main barrier	Lack of awareness	Financial constraints	Structural shift

Source: Author's calculations based on survey data and Bojkovska K. et al., 2023

The findings in Table 6 indicate a gradual shift from conceptual engagement to early-stage implementation of circular strategies. While digitalization and consumer information mechanisms have expanded significantly (increasing from almost non-existent to 18%), progress in ecodesign and advanced circular practices remains slow. The comparison further reveals a structural shift in perceived barriers – from limited awareness in 2021 to financial constraints in 2024 – highlighting the need for targeted economic support mechanisms to accelerate the circular transformation.

The comparison reveals a clear transition from conceptual uncertainty in 2021 toward implementation constrained primarily by financial limitations in 2024. While awareness and digital capabilities have improved, the absence of targeted financial instruments continues to hinder the scaling of circular practices across the sector.

Conclusions

The findings of this study demonstrate that the circular transition in the Republic of North Macedonia has entered a compliance-driven but investment-constrained phase.

The findings should be interpreted as indicative of statistically significant associations, not definitive causality, given the observational nature of the study design. Instead, the sector appears to have reached an “investment ceiling”, where regulatory compliance is achieved, but deeper circular transformation remains financially unattainable for most firms.

The validation of the research hypotheses confirms three structural dynamics shaping the circular transition. First, although awareness of legally binding waste management regulations is relatively high, a substantial gap persists in the understanding of strategic policy frameworks, particularly the Green Agenda for the Western Balkans. This finding indicates that the existing regulatory architecture is not deficient in formal terms but remains weakly embedded at the strategic and operational levels, especially among micro and small enterprises.

Second, economic constraints emerge as the dominant barrier to circular strategy adoption. High investment costs and limited access to financial support exert a strong negative

predictor for the implementation of 9R strategies ($\beta = -0.412$), outweighing organisational or knowledge-related limitations. The results clearly show that the main obstacle to circular transformation is not resistance or lack of awareness, but insufficient economic capacity to absorb the costs of technological and process-related innovation.

Third, digitalisation plays a critical enabling role in the circular transition. Strong empirical links between digital capacity and consumer protection ($r = 0.64$) demonstrate that digital tools significantly associated with higher transparency, traceability, and trust within agri-food value chains. While digitalisation alone cannot eliminate financial constraints, it provides a practical mechanism through which firms can improve circular performance and partially mitigate structural limitations.

The comparative analysis between 2021 and 2024 reveals a clear structural shift in the nature of barriers to circular economy adoption. Whereas limited awareness dominated earlier stages of transition, financial constraints now represent the primary bottleneck. This transition underscores the maturation of the sector from conceptual engagement toward early-stage implementation, while simultaneously exposing the absence of adequate economic instruments to support scaling.

From a policy perspective, the findings suggest that future interventions must move beyond general regulatory alignment toward targeted, outcome-oriented economic support mechanisms. Priority should be given to: direct innovation grants aimed at reducing the investment burden of 9R technologies for SMEs, incentives for digital traceability systems that strengthen consumer information and market transparency, and performance-based reward schemes that prioritise measurable waste reduction and circular outcomes over formal compliance instruments such as ISO 14001 certification.

The research highlights a significant institutional paradox: firms achieve formal environmental control through ISO 14001, yet they remain at an 'investment ceiling' that prevents them from adopting superior European standards like EMAS. To bridge this gap, policy interventions in North Macedonia should shift from promoting general certification toward performance-based reward schemes that specifically offset the costs of EMAS-level transparency and high-order 9R strategies.

In conclusion, without effectively bridging the gap between widespread awareness and limited investment capacity, the circular potential of the Macedonian agri-food sector will remain largely unrealised. A successful transition will depend not on additional regulation, but on the strategic alignment of financial, digital, and policy instruments capable of transforming compliance into genuine circular transformation.

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