

EMPIRICAL INSIGHTS AND STRATEGIC DIRECTIONS OF GREEN LOGISTICS ADOPTION IN REPUBLIC OF MOLDOVA

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Abstract. *Objective.* The notion of green logistics is witnessing a surge in prominence in the Republic of Moldova, assuming a pivotal role in fostering environmental sustainability while concurrently enhancing economic competitiveness. Notwithstanding the potential benefits of eco-friendly logistics solutions, considerable obstacles are faced in their adoption, especially by small and medium-sized enterprises (SMEs). The present study explores the current implementation of green logistics in Moldova, highlighting the key factors driving its adoption, existing challenges, and strategic measures needed to facilitate further progress in this area. *Methodology.* The research employs a qualitative approach, integrating policy analysis and case studies to evaluate the influence of external actors, financial constraints, and regulatory frameworks on green logistics implementation. *Results.* The findings indicate that sustainability initiatives in Moldova are primarily influenced by supply chain leaders, NGOs, and international organisations, rather than by government policies that are poorly enforced. Moreover, financial constraints pose a substantial obstacle to the adoption of energy-efficient technologies and sustainable infrastructure by SMEs. In order to facilitate the transition, it is crucial that co-operation is fostered among policymakers, businesses, and civil society. Key measures to be implemented include the improvement of fiscal incentives, the strengthening of public-private partnerships, and the refinement of regulatory mechanisms to encourage green logistics practices. It is submitted that the alignment of Moldova's logistics sector with EU environmental standards has the potential to engender further enhancement of economic resilience and global market integration. *Originality.* This study provides a comprehensive evaluation of green logistics adoption in Moldova, emphasising the specific challenges encountered and proposing actionable strategies to address them. By contributing to the broader discourse on sustainable supply chain management in emerging economies, the research presents a roadmap for Moldova's alignment with international sustainability goals.

Keywords: green logistics, sustainable supply chain, Moldovan SMEs, environmental sustainability, public-private partnerships.

JEL Classification: M31, Q01, Q50

1. Introduction

In the context of Moldova's transitional economy, the adoption of green logistics practices is influenced by a variety of stakeholders. In accordance with the tenets of stakeholder theory, commercial enterprises do not function in a state of isolation; rather, they engage in interaction with a multitude of actors who exert influence upon their decision-making processes. In Moldova, it is the actions of international institutions, non-governmental organisations (NGOs) and supply chain leaders that exert the most significant influence on the adoption of green logistics, as opposed to government policies. This phenomenon is indicative

of a broader economic trend, characterised by an increasing awareness of environmental issues. However, regulatory enforcement and financial incentives for sustainable practices remain inadequate.

This section presents an analysis of the key stakeholders influencing the development of green logistics among Moldovan small and medium-sized enterprises (SMEs). Drawing upon a comprehensive review of the extant literature, a detailed stakeholder mapping exercise, and the findings from a survey of relevant stakeholders, this discussion explores the impact of various stakeholder groups on the adoption of sustainable logistics practices. The analysis assesses

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the extent of the impact of each group and how their role shapes the transition to eco-friendly logistics solutions. Green logistics can be defined as a set of practices and strategies that have been designed to minimise the environmental impact of logistics activities throughout the entire supply chain. The objective of this initiative is to optimise energy consumption, reduce waste generation, promote the use of sustainable and recyclable materials, and improve transportation efficiency. Moreover, green logistics emphasises collaboration between companies, suppliers, and other stakeholders to develop environmentally friendly solutions – from product design and packaging to distribution and end-user consumption – ensuring that each stage of the process aligns with sustainability principles (Carp, 2024).

A review of research on the green economy highlights the significant role of multiple stakeholders in guiding the sustainability efforts of small and medium-sized enterprises (SMEs). Research conducted by Erhan and Paladi (2023) and Ungur and Ciobanu (2019) indicates a progressive integration of environmentally responsible logistics solutions within Moldovan SMEs. However, this shift is largely influenced by supply chain pressures, NGO support and consumer expectations rather than by direct government policies or regulatory interventions. Given the complexity of stakeholder involvement in the adoption of green logistics, a key research question emerges: "Which stakeholders have the greatest influence on the development of sustainable logistics practices in Moldovan SMEs?" To address this, a survey-based study was conducted between May and August 2024, targeting a sample of small and medium-sized enterprises operating in Moldova.

2. Methodology and Data

The survey was administered electronically and disseminated among SME owners and managers via professional business networks, chambers of commerce, and industry associations. The Department of Economy, Marketing, and Tourism at Moldova State University assumed a facilitative role in the distribution of the questionnaire, thereby ensuring access to the relevant respondents.

The selection of respondents was based on a non-probability sampling method, specifically convenience sampling, considering their availability and willingness to participate in the online survey. In order to guarantee a diverse representation of SMEs across sectors and regions within Moldova, concerted efforts were made. The questionnaire comprised a series of structured items, the aim of which was to address awareness, perceived benefits and barriers, available resources, and the willingness of SMEs to invest in sustainable logistics solutions. A total of 105 entities

were contacted, of which 65 provided valid responses (response rate: 61.9%), comprising 52 small enterprises (logistics, retail, manufacturing) and 13 medium-sized enterprises (primarily supply chain and transportation).

The selection of respondents was carried out using a non-probability sampling method, taking into account their availability and accessibility in the online environment. In the context of the present study, endeavours were undertaken to ensure a balanced diversity within the sample in terms of industry sector, company size, and geographical region. This was done in order to provide relevance and applicability to the conclusions formulated.

It was not possible to implement a random sampling approach due to financial and logistical limitations. Instead, a quota sampling method was employed, as recommended by Săvoiu and Ionescu (2020). This approach necessitated a comprehensive understanding of the structural composition of Moldovan SMEs, thereby ensuring that the sample reflected the actual distribution of businesses in the country.

The study's sample was constructed to reflect a diverse cross-section of Moldovan SMEs, guided by three core parameters:

- Enterprise size. To assess differences in green logistics adoption relative to organisational scale, both small and medium-sized enterprises were included.
- Sectoral diversity. To ensure broad industry representation, businesses were classified according to the Moldovan Classification of Economic Activities (CAEM).
- Geographic distribution. Enterprises from a variety of regions were deliberately included to capture the differences in sustainability practices across the regions.

This framework reflects the methodologies promoted in previous SME research, including the focus on sectoral and geographical inclusivity advocated by Dascăliuc and Pascu (2021).

By adopting this stratified sampling strategy, the study ensures robust insights into how stakeholders shape green logistics uptake within Moldovan SMEs. The analysis identifies the following key actors influencing sustainability transitions:

- Government & Public Authorities (Moldovan Ministry of Environment, EU regulatory bodies).
- NGOs and advocacy groups (international programs (e.g., GIZ, UNDP, USAID)).
- Society (rising consumer demand for eco-conscious practices).
- Supply chain partners (pressure to align with green procurement standards).
- Market competitors (minimal impact due to fragmented industry dynamics).
- Multinational corporations (imposition of stringent sustainability requirements).
- Clients (preference for sustainable offerings).

- Logistics providers (incremental integration of low-emission solutions).
- Leadership and management (cost-driven interest in green practices, hindered by funding gaps).
- Employees (partial engagement in sustainability initiatives).
- Other actors: academia, media, and tech firms supporting innovation.

These findings elucidate the complex interplay between SMEs and stakeholders, offering actionable insights for policymakers and scholars. The research advances understanding of sustainable supply chain dynamics in emerging economies while underscoring pathways to align Moldova's SME sector with global environmental objectives.

Integrating sustainable practices into the logistics of small and medium-sized enterprises (SMEs) is crucial for economic and environmental transformation, especially in Moldova and Eastern Europe. This study summarises important findings from recent research into the challenges, opportunities and strategic approaches to implementing green logistics and sustainable business practices among SMEs. Several studies, including those by Erhan and Paladi (2023) and Dascăliuc and Pascu (2021), emphasise the vulnerability of SMEs during times of crisis and their vital role within national economic structures. Meanwhile, Ungur and Ciobanu (2019) and Sirbu (2022) emphasise that financial constraints are a major barrier to the adoption of green logistics. They advocate increased financial assistance and policy support. Carp (1) and Gherman (2021), on the other hand, explore conceptual and strategic approaches to green logistics, stressing the need for structured environmental policies. Additionally, McKinnon et al. (2015) and Sarkis et al. (2004) offer broader insights into sustainable logistics, demonstrating the contribution of digitalisation and e-logistics to environmental efficiency. Comparative studies, such as those by Zowada and Niestroj (2019) and Zowada (2020), shed light on the challenges that Eastern European SMEs face when adopting sustainable logistics. This synthesis highlights the need for policy reforms, financial incentives and digital innovations to speed up the transition to green logistics and sustainability in Moldova, as discussed in other scientific papers (2024).

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3. Research Results and Comments

The Republic of Moldova has a diverse economy, with key sectors including agriculture, industry, and services. Agriculture is of pivotal importance, with exports being a significant contributor to the national economy, particularly in the domains of wine production, fruit cultivation, and cereal farming. The industrial sector is undergoing significant transformation, with notable advancements observed in the domains of manufacturing, textiles, and food processing. Concurrently, the services sector, notably IT, finance, and retail, is demonstrating consistent growth, propelled by mounting digitalisation and foreign investments.

The disparities in disposable income and sectoral wage gaps among SMEs indicate differing capacities to invest in sustainable infrastructure. It is hypothesised that sectors with lower average earnings, such as agriculture and hospitality, may face greater financial constraints in allocating resources for green logistics initiatives. Consequently, an analysis of SME characteristics is imperative to comprehend the potential and challenges for green logistics adoption.

Nevertheless, the economy is confronted with considerable challenges, including income disparities between urban and rural regions, reliance on external trade, and energy vulnerability. Chisinau, the capital, continues to function as the economic centre, serving as a nexus for financial and business operations. In pursuit of enhanced economic modernisation and closer ties with the European Union, the imperative for Moldova to focus on infrastructure development, technological advancement, and the enhancement of workforce skills is paramount for ensuring long-term growth and global competitiveness.

In 2023, the average gross monthly wage in Moldova reached 12,354.71 lei, representing a 17.3% increase in nominal terms compared to 2022. When adjusted for inflation, this figure represents a 3.4% rise in real terms. The following table presents a breakdown of gross monthly earnings across different economic sectors over the past three years (Table 1):

As was previously indicated, the sectors in which remuneration was highest were information and communication, as well as financial and insurance activities. In these sectors, wages exceeded 23,000 lei per month. In contrast, industries such as accommodation and food services, and agriculture, reported some of the lowest average earnings, thus highlighting a significant wage gap across economic activities. Whilst wages increased across all sectors, certain sectors demonstrated higher levels of growth than others. The professional, scientific, and technical activities sector demonstrated consistent enhancements, with salaries increasing to 14,659 lei,

Table 1

Average monthly gross earnings by type of economic activity (MDL)

Economic activities	2021	2022	2023
Total	8 979,8	10 447,3	12 354,7
Agriculture, forestry and fisheries	5 691,1	6 709,7	7 982,9
Industry	8 242,0	9 754,6	11 210,6
Construction	8 136,5	9 368,9	10 564,6
Wholesale and retail trade	7 609,9	9 003,0	10 721,9
Transportation and storage	7 201,2	8 506,3	9 844,3
Accommodation and food service activities	5 249,9	6 293,0	7 065,6
Information and communication	17 726,7	20 086,7	23 291,0
Financial and insurance activities	15 746,9	19 329,6	23 020,6
Real estate transactions	7 281,9	8 909,9	9 788,7
Professional, scientific and technical activities	10 108,2	12 537,2	14 659,1
Administrative and support service activities	6 303,6	7 715,9	9 525,4
Public administration and defense; compulsory social security	10 082,5	11 938,4	13 686,7
Education	7 462,3	8 423,5	10 009,6
Health and social care	9 334,3	10 145,9	12 442,0
Arts, leisure and recreation	8 112,6	9 345,5	11 061,5
Other service activities	8 269,1	11 156,8	13 251,5

Source: National Bureau of Statistics of the Republic of Moldova (2024). <https://statistica.gov.md>

while health and social care professionals experienced an increase to 12,442 lei. Concurrently, the construction and transportation industries, despite experiencing moderate wage increases, persisted in lagging behind the high-tech and financial sectors.

It is evident that disparities in wages between men and women persist in the majority of economic sectors. In 2022, a significant disparity in salary was observed between male and female employees in the information and communication sector (38.1% more for males), the financial and insurance services sector (32.5% more for males), and the health and social care sector (22.4% more for males). However, a number of sectors were found to exhibit a slight increase in the earnings of female employees. These included administrative and support services (5.7% more), education (4.3% more), and other service activities (3.6% more). These disparities highlight the persistent gender inequality in Moldova's labour market.

The monthly disposable income per capita averaged 4,915.6 lei, reflecting a 15.6% increase from 2022. Nevertheless, a marked rural-urban disparity remained evident. As shown in Figure 1, residents of urban areas exhibited significantly higher levels of earnings, with an average monthly disposable income of 6,228.5 lei. By contrast, rural inhabitants recorded average monthly earnings of 3,928.7 lei. In the given context, wages and salaries were identified as the predominant source of income, constituting 52.5% of the aggregate total. However, it should be noted that this percentage varied according to geographical location. In urban areas, salaries constituted 61.9% of household income, whereas in rural regions, they

accounted for only 41.3%. For rural households, agricultural activities played a crucial role, accounting for 13.6% of their disposable income. Conversely, social benefits constituted 20.7% of overall earnings, underscoring the reliance on government support, particularly among lower-income demographics. The vast majority of household income, amounting to 94.4%, was in the form of cash, with in-kind income accounting for a mere 5.6%. Urban households relied almost entirely on monetary income (97.5%), whereas rural areas still retained a small proportion of non-monetary earnings (9.4%). The data presented in Table 2 underscores the pronounced economic disparities between Moldova's urban and rural populaces.

The cost of living continued to rise, with monthly consumption expenditure per person reaching 4,248.4 lei, marking a 14.5% increase from the previous year. The study found that household spending was significantly influenced by family size. A comparison of household expenditure per capita revealed that single-person households incurred expenses that were 1.6 times higher than the expenditure of families consisting of five or more members. It was exclusively families comprising up to three individuals who were able to surpass the national average in terms of expenditure. Conversely, larger households demonstrated a decline in per capita expenditures.

The food category constituted the most substantial expenditure category, accounting for 39.7% of total spending. The second most significant expense categories were housing and utilities, which accounted for 17.6% of the total, and clothing and footwear, which accounted for 7.8%. These spending patterns

Table 2

Average monthly disposable income by residence

Indicators	Total	Urban	Rural
Total disposable income (monthly average per person), MDL	4 915,6	6 228,5	3 928,7
including % by sources:			
Wage activity	52,5	61,9	41,3
Individual agricultural activity	6,4	0,3	13,6
Non-agricultural individual activity	6,3	7,2	5,1
Social benefits	20,7	16,5	25,6
Other revenue	14,2	13,9	14,3
of which transfers from abroad	11,1	9,8	12,6

Source: National Bureau of Statistics of the Republic of Moldova (2024). <https://statistica.gov.md>

are indicative of the relative priority assigned to essential needs, with discretionary spending remaining comparatively negligible.

The minimum subsistence level was estimated at 2,877.1 lei per month per person, though this figure was subject to variation depending on geographical location. The highest cost of living was recorded in major cities such as Chisinau and Balti, where the subsistence minimum reached 3,237.6 lei – a figure 14% higher than in smaller cities and 19.4% higher than in rural areas. This discrepancy serves to emphasise the economic challenges faced by rural populations, where lower incomes are required to cover the same rising costs of basic necessities.

The data presented in the tables offer a contextual understanding of SMEs in Moldova, highlighting structural characteristics relevant to their adoption of green logistics practices. Such characteristics include company size, sectoral distribution, and financial capacity.

The adoption of green logistics in Moldovan SMEs is influenced by a variety of stakeholder groups, aligning with stakeholder theory. However, in contrast to more regulated economies, the primary drivers of green logistics adoption in Moldova are international institutions, NGOs, and supply chain leaders, rather than direct government policies. This phenomenon is indicative of the characteristics of Moldova's transitional economy, where environmental awareness is increasing, but regulatory enforcement and financial support remain limited.

A review of existing literature and empirical studies has highlighted the key stakeholders that impact green logistics development in Moldova. These include government bodies such as the Ministry of the Environment, EU regulatory frameworks and non-governmental organisations (NGOs), as well as international development programmes (e.g., GIZ and UNDP). Societal actors, including environmentally conscious consumers, are also important stakeholders. Additionally, suppliers, clients and leaders of the international supply chain exert significant influence, since many Moldovan SMEs operate within global

markets that demand compliance with green logistics standards.

A visual analysis of stakeholder influence reveals that the government and public administration exert minimal influence, primarily due to weak regulatory enforcement and a lack of financial incentives. By contrast, NGOs and international organisations play a more significant role, funding sustainability programmes and promoting awareness. The adoption of green logistics is increasingly driven by both clients and society as a whole, in response to growing consumer demand for sustainable practices. Concurrently, supply chain leaders and suppliers have emerged as the most influential stakeholders, as compliance with international sustainability requirements is often mandatory for market participation.

Nevertheless, financial constraints persist as a significant impediment to the comprehensive implementation of green logistics methodologies. Despite the recognition of the long-term economic advantages by business proprietors and administrators, the necessity for immediate financial contributions frequently hinders the initiation of such measures. Concurrently, employees are playing a growing yet moderate role in supporting sustainability efforts, indicating a gradual cultural shift towards environmentally responsible practices within organisations. These insights underscore the pressing need for enhanced policy incentives, financial assistance programmes, and strengthened industry collaboration to facilitate the expansion of green logistics among Moldova's small and medium-sized enterprises (SMEs) (Figure 1).

Analysing stakeholder influence on green logistics in Moldovan SMEs reveals the extent to which different groups impact sustainability practices. The findings can be categorised into three groups based on the degree of influence: low, moderate and high.

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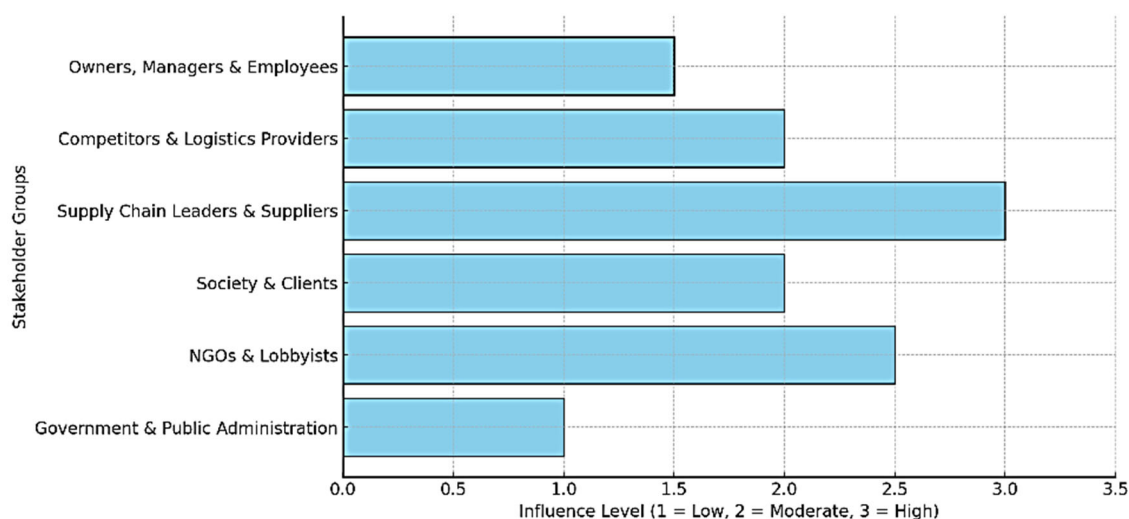


Figure 1. Stakeholder influence on green logistics in Moldovan SMEs

Source: elaborated by authors

The limited financial incentives available, such as subsidies or tax relief for sustainable investments, discourage SMEs from prioritising green logistics. The absence of structured government programmes targeting green logistics also contributes to the perception that public administration plays a minimal role.

2. NGOs and lobbyists have a moderate to strong influence. NGOs and international organisations play a critical role in shaping green logistics practices in Moldova. Entities such as the German Society for International Cooperation (GIZ) and the United Nations Development Programme (UNDP) fund sustainability initiatives, support knowledge transfer and facilitate training programmes. These organisations have raised awareness of green logistics among SMEs and provided them with the resources needed to transition towards sustainable practices. However, they have had a stronger influence in sectors that receive targeted development funding, such as renewable energy and waste management.

3. Society and clients are exerting a growing influence. As consumer awareness of sustainability increases, it is gradually impacting the way businesses approach logistics. Clients play a crucial role in demanding eco-friendly services, particularly in urban areas where sustainability trends are more prevalent. The study found that SMEs that engage with environmentally conscious consumers are more likely to adopt green logistics strategies in response to customer preferences for sustainable packaging, reducing their carbon footprint, and energy-efficient transportation.

4. Supply chain leaders and suppliers have been identified as the strongest influence. It is evident that supply chain pressures represent the most significant

driver of green logistics adoption in Moldovan SMEs. A significant proportion of commercial enterprises function within the context of international supply chains, wherein adherence to green standards is obligatory. Large multinational corporations have a responsibility to ensure that their suppliers adhere to eco-friendly practices, including the reduction of waste, the optimisation of energy efficiency, and the control of emissions. In turn, suppliers encourage their partners to adopt similar measures, thereby reinforcing a cascading effect throughout the logistics network. This dynamic is especially evident in export-driven industries, where adherence to sustainability criteria is imperative for maintaining international trade relationships.

5. Competitors and logistics service providers exert a moderate influence. Market segmentation in Moldova has been demonstrated to weaken competitive pressures for the adoption of green logistics. In contrast to the practices observed in highly regulated economies, where enterprises compete on sustainability credentials, Moldovan SMEs frequently prioritise cost efficiency over environmental responsibility. However, there has been a gradual adoption of eco-friendly solutions by logistics service providers, particularly in the context of urban delivery services and warehouse operations. Financial constraints continue to represent a significant impediment, with numerous companies encountering difficulties in allocating funds towards sustainable logistics infrastructure.

6. It is evident that owners, managers and employees act as internal drivers of change. While the benefits of green logistics are recognised by business owners and managers, financial limitations significantly hinder implementation. The survey findings suggest that

many SMEs perceive sustainability initiatives as cost-intensive rather than as long-term investments with economic benefits. Employees play a moderate role in driving sustainability, reflecting an emerging sustainability culture within organisations. Nevertheless, in the absence of robust leadership, commitment, and investment in green logistics, employee-led initiatives are constrained in their scope.

The correlation analysis reveals a substantial relationship between the environmental impact of the economy and the perceived effectiveness of sustainability practices and policies (see Table 3). Below are the key insights:

1. Strongest Positive Correlations (Significant at 0.01 Level - ** marked in the table).

A robust correlation ($p < 0.01$) has been demonstrated between the consumption of natural resources and the generation of waste resulting from economic activity. This finding suggests a correlation between unsustainable economic growth and increased waste generation in Moldova.

A highly significant relationship has been demonstrated between overburdened infrastructure (e.g., sewage systems) and water pollution. Poor infrastructure has been identified as a contributing factor to water contamination, underscoring the necessity for enhanced waste management practices in river-side areas.

A direct correlation has been demonstrated between levels of air pollution and economic infrastructure pressures. It is evident that transportation-related emissions (i.e., those stemming from cars, buses and aviation) play a pivotal role in exacerbating infrastructure degradation.

2. Moderate Correlations (Significant at 0.05 Level - * marked in the table).

There is a moderate but significant correlation between the environmental impact of the economy and the demand for green policies in energy, water and waste management. While young entrepreneurs are interested in eco-friendly solutions, adoption remains limited. There is a moderate but significant correlation between policy effectiveness and

infrastructure pressure. This suggests that current policies are insufficient to mitigate the environmental damage caused by the economy. There is a moderate correlation between technological advances in industry and sustainability awareness. Although technology is recognised as important for managing material flows and sustainability, it is not widely utilised.

Investment in sustainable infrastructure is imperative to mitigate pollution and alleviate the excessive strain on public utilities in economically dynamic regions. In order to enhance environmental performance, it is incumbent upon policymakers to proactively promote eco-friendly solutions, waste reduction initiatives, and sustainable transportation policies. The rigorous implementation of sustainability regulations is imperative to guarantee that novel developments incorporate environmentally responsible measures. Furthermore, the integration of advanced technologies, including eco-monitoring systems and AI-driven material flow management, has the potential to significantly enhance resource efficiency while minimising the environmental impact of economic activities.

In Moldova, the adoption of green logistics practices among small and medium-sized enterprises (SMEs) is influenced by various stakeholders, such as government agencies, non-governmental organisations (NGOs), suppliers, competitors and customers. While there is growing interest in sustainable solutions, regulatory challenges and economic limitations continue to restrict their widespread implementation. This highlights the need for policy improvements and financial support to drive progress in the logistics sector. Under the Moldova-EU Association Agreement, Moldova has aligned several environmental and logistical policies with European Union (EU) standards. However, these policies primarily focus on macro-level objectives and often lack the necessary mechanisms for effective micro-level implementation within SMEs. Government incentives and subsidies designed to encourage the adoption of eco-friendly logistics remain scarce, thereby limiting large-scale implementation.

Table 3

The relationship between stakeholder influence and the economic and environmental effects of green logistics in Moldova using Spearman's Rho correlation analysis

Stakeholders influence / economic & ecological effects	Ecological effects	Economic effects
Government and other institutions	0.085*	0.091*
NGOs and lobbyists	0.266**	0.295**
Society	0.314**	0.198**
Suppliers	0.355**	0.312**
Competitors	0.299**	0.214**
Supply chain leader	0.412**	0.399**
Clients	0.193**	0.189**

Source: Elaborate by authors

Although Moldova's legal framework includes certain sustainability incentives, weak enforcement mechanisms result in low compliance levels among SMEs. Unlike in larger economies, where regulatory infractions may have minimal financial repercussions, even minor penalties in Moldova can pose a significant challenge to the liquidity of SMEs. Consequently, sanctions have a particularly strong deterrent effect, often discouraging compliance with green logistics standards.

Although public awareness of environmental sustainability is gradually increasing in Moldova, businesses continue to prioritise cost efficiency over sustainability. Within the supply chain, multinational corporations exert significant pressure on small and medium-sized enterprises (SMEs) to adhere to sustainability requirements, particularly those involved in international trade. This external influence encourages certain SMEs to adopt green logistics practices in order to maintain their business relationships with global partners.

Although competition can encourage sustainability initiatives, the competitive landscape in Moldova's green logistics sector is less developed than in EU markets. The lack of market competition means that SMEs have fewer incentives to pursue environmentally sustainable practices, which delays the widespread adoption of green logistics.

The development of green logistics in Moldova can be divided into four distinct stages, each of which reflects the country's progress towards sustainable transportation and supply chain management (see Figure 2).

The green logistics evolution of Moldova should be initiated by aligning with the national and EU mandates on emissions, packaging, and waste management. At this fundamental stage, businesses adopt eco-friendly practices primarily to meet legal obligations,

reflecting a compliance-driven approach rather than proactive sustainability efforts. Regulatory frameworks have been identified as the primary drivers of change, with minimal voluntary participation from the private sector.

The second phase involves the gradual adoption of energy-efficient transport systems, digital logistics platforms and optimised warehousing. While larger enterprises are leading the way in deploying these innovations, SMEs are facing financial barriers that are stalling investments in sustainable infrastructure. Consequently, much of Moldova's logistics industry is stuck in this intermediate phase, struggling to balance cost constraints with modernisation.

In the third stage, Moldovan firms collaborate more closely with international partners and logistics providers in order to adopt global sustainability benchmarks. The focus shifts towards integrating green strategies into supply chains and fostering eco-focused alliances within the agriculture, manufacturing and trade sectors. This phase signals a growing acknowledgement of sustainability as a driver of market competitiveness.

In the final stage, green logistics principles are deeply embedded in corporate governance. Companies move beyond regulatory compliance, embedding sustainability into their operations and achieving long-term economic and environmental benefits. This maturity phase reflects a sector in which eco-consciousness has become a strategic imperative that goes beyond legal requirements.

The study highlights the disproportionate influence of external stakeholders, such as international corporations and NGOs, over the adoption of green logistics by Moldovan SMEs. However, governmental support for driving sector-wide transformation lags behind, indicating that SMEs are more responsive to external market pressures than to domestic policy

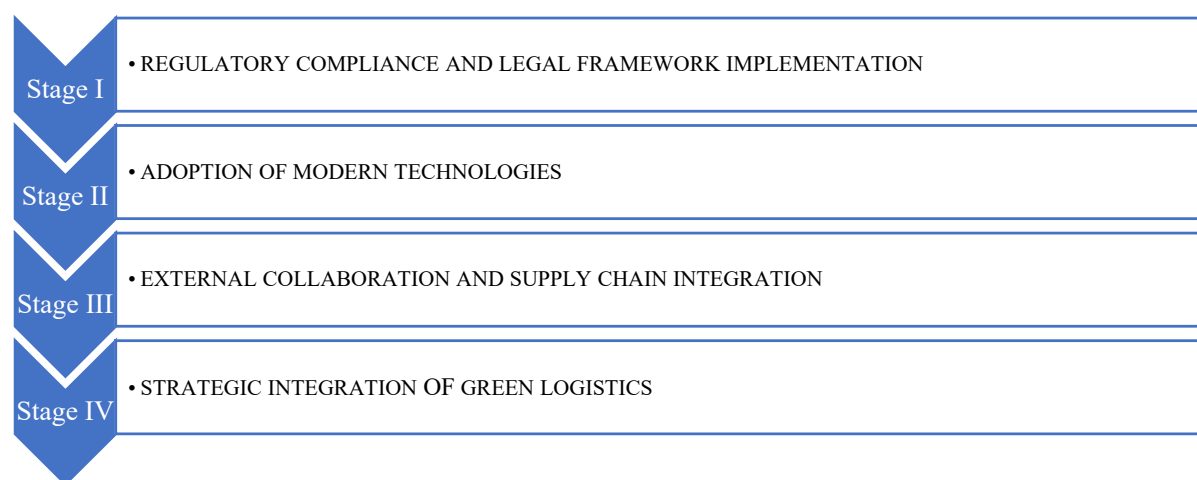


Figure 2. Stages of green logistics development in Moldova

Source: elaborated by authors, inspired by models Sarkis et al., 2004; Vasiliauskas et al., 2013

frameworks. This emphasises the need for stronger institutional engagement to support global sustainability trends.

Several policy and managerial implications emerge from these findings:

- Strengthening governmental involvement. To encourage green logistics adoption among SMEs, policymakers should consider introducing financial incentives, regulatory support and targeted programmes.
- Enhancing NGO and private sector collaboration. Partnerships between international organisations and SMEs can facilitate the transfer of knowledge and secure funding for sustainable logistics solutions.
- Increasing consumer awareness. Educating consumers about sustainability can increase demand for environmentally friendly logistics, encouraging businesses to adopt more sustainable practices.
- Encouraging innovation in supply chains. To enhance sustainability, SMEs should explore innovative solutions such as digital tracking systems, route optimisation and alternative fuels.
- Developing internal sustainability strategies. Business owners and managers should incorporate sustainability goals into their operational strategies and view green logistics as a competitive advantage, not a financial burden.

4. Conclusions

The adoption of green logistics practices among small and medium-sized enterprises (SMEs) in Moldova is primarily influenced by external stakeholders, such as supply chain leaders, non-governmental organisations (NGOs) and consumers. Although these actors play a pivotal role in advancing sustainability, government influence remains minimal and financial limitations prevent SMEs from fully embracing environmentally friendly logistics solutions. The lack of substantial government support and limited investment opportunities are key obstacles to the widespread adoption of sustainable practices in this sector.

The findings of the analysis emphasise the pivotal role of sustainable practices and stakeholder collaboration in addressing environmental challenges

in Moldova. The study demonstrates that unsustainable economic growth and infrastructure limitations substantially contribute to environmental degradation, notably in terms of waste generation, air and water pollution. Furthermore, suppliers and supply chain leaders were identified as the most influential actors in fostering green logistics, followed by NGOs, society, and competitors, whose impact is particularly visible in raising environmental awareness and promoting sustainable practices.

A multi-stakeholder approach is crucial to accelerating the transition towards green logistics. Policymakers must reinforce regulatory frameworks and ensure they are effectively enforced to establish a solid foundation for sustainable logistics. Concurrently, the implementation of financial incentives, including tax benefits, grants, and low-interest loans, will enable SMEs to invest in energy-efficient technologies and infrastructure. Furthermore, public-private partnerships have been shown to facilitate knowledge exchange and the adoption of best practices, thereby helping businesses navigate the complexities of sustainability transitions.

Furthermore, the pivotal role played by international organisations and NGOs in supporting SMEs by offering technical assistance, training programmes, and access to global sustainability standards cannot be overstated. It is vital to raise consumer awareness and to foster a market environment that rewards environmentally responsible business practices, as this will further drive demand for green logistics solutions.

As Moldova deepens its integration with the European economic framework, the importance of sustainable logistics will become increasingly apparent. The strategic prioritisation of environmentally responsible supply chain management is poised to fortify economic resilience and concurrently enhance Moldova's competitive standing in global markets. Adopting a comprehensive and collaborative strategy will enable the country to successfully overcome existing challenges and ensure the long-term sustainability of its logistics sector.

Authors contribution. Both authors contributed equally to all sections of the article.

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