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BETWEEN GLOBAL DEPENDENCE AND LOCAL RESILIENCE: STRATEGIES FOR STRENGTHENING MONTENEGRO'S SUPPLY CHAIN

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Apstrakt

Ovaj rad ispituje kako mala ekonomija koja zavisi od uvoza, koristeći Crnu Goru kao studiju slučaja, može ojačati otpornost i održivost svojih lanaca snabdijevanja kroz diverzifikaciju izvora, lokalizaciju proizvodnje i digitalnu transformaciju. Primjenjuje se pristup kombinovanih metoda, zasnovan na SCOR i CSAR okvirima, kako bi se identifikovale strukturne ranjivosti i strateške mogućnosti u sektorima hrane, energije i logistike. Ključne oblasti fokusa uključuju ulogu Luke Bar, razvoj digitalne infrastrukture, revitalizaciju poljoprivrede i povezanost drumskog saobraćaja. Nalazi ukazuju na značaj integracije fleksibilnih i bezbjednih sistema, koje podržavaju institucionalne reforme i profesionalizacija sektora, kao ključne pretpostavke za otpornost lanaca snabdijevanja. Rad se završava setom preporuka politika prilagođenih crnogorskom kontekstu i ukazuje na pravce budućih istraživanja usmjerenih na mjerenje i operacionalizaciju otpornosti u malim ekonomijama. Doprinosi široj literaturi o strategiji lanaca snabdijevanja nudeći primijenjeni model za izgradnju otpornosti u otvorenim, uvozno zavisnim nacionalnim kontekstima.

Ključne riječi: *Otpornost lanca snabdijevanja, Crna Gora, SCOR model, digitalna transformacija, lokalna proizvodnja, logistička infrastruktura*

Abstract

This paper examines how a small, import-reliant economy, using Montenegro as a case study, can strengthen the resilience and sustainability of its supply chains through source diversification, production localisation, and digital transformation. It adopts a mixed-methods approach, grounded in the SCOR and CSAR frameworks, to identify structural vulnerabilities and strategic opportunities in the food, energy, and logistics sectors. Key focus areas include the role of the Port of Bar, digital infrastructure development, agricultural revitalisation, and road transport connectivity. The findings highlight the importance of integrating flexible and secure systems, supported by institutional reform and sectoral professionalisation, as critical enablers of supply chain resilience. The paper concludes with a set of policy recommendations tailored to the Montenegrin context and outlines directions for future research centred on measuring and operationalising resilience in small economies. It contributes to the broader literature on supply chain strategy by offering an applied model for resilience-building in open, import-dependent national contexts.

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INTRODUCTION: THE IMPORT PARADOX OF A SMALL ECONOMY

How can the broader context of small economies' dependence on global supply chains be understood? This paper provides a detailed examination of the specific case of Montenegro. With a population of approximately 624,000[1] and limited domestic resources, Montenegro has maintained a high level of import dependence for decades, especially in the food and energy sectors (World Bank, 2024). While global market integration brings certain benefits, such as a wider range of products and more competitive prices, it simultaneously increases national vulnerability to external shocks. As noted by Gunasekaran, Lai and Cheng (2008), modern supply chains must be both flexible and responsive to meet the ever-changing demands of the market (Gunasekaran, Lai & Cheng, 2008, p. 550).

Furthermore, agility, flexibility and process robustness are highlighted as critical goals in supply chain improvement, particularly through the reengineering of order fulfilment processes in supply networks (Lin & Shaw, 1998, pp. 197–198). Similar demands for adaptability are emphasised in studies employing the DMAIC methodology in the electronics industry, which identified key inefficiencies such as excess transportation, waiting times and inventory. These were then addressed through precise and controlled interventions (Makinde et al., 2022, p. 26). According to Kot, Haque and Baloch (2020), in contemporary business environments, it is no longer individual firms that compete, but entire supply chains, where success depends on the ability to integrate and manage complex networks of relationships (Kot, Haque & Baloch, 2020, p. 88). This is further supported by Lin and Shaw (1998), who argue that order fulfilment process optimisation must be integrated across networks of autonomous or semi-autonomous business entities to achieve overall system agility (Lin & Shaw, 1998, pp. 199–201).

Identifying sources of uncertainty in decision-making is a vital step in redesigning supply chains to reduce vulnerability (Van der Vorst & Beulens, 2002, pp. 409–411). The COVID-19 pandemic and the crisis in Ukraine clearly illustrated the risks posed by such structural dependencies (UNDP, 2022).

Montenegro possesses several advantages that can serve as a foundation for building a more resilient supply system. These include a developed tourism sector, favourable climatic conditions for agriculture, and considerable potential for renewable energy, particularly hydro and solar energy. Nevertheless, limited domestic production capacities, a small market size and a continued import dependency make the Montenegrin economy highly susceptible to global disruptions.

Import dependency is not solely a matter of trade balance. It touches upon critical issues of food and energy security, national resilience and long-term sustainable development. In this context, it is important to note that implementing international quality standards, such as ISO 9000, can help

[1] Based on the 2023 census conducted by the Statistical Office of Montenegro (MONSTAT), the country's population totals 623,633, of whom 565,804 (90.73%) hold only Montenegrin citizenship, 10,691 (1.71%) hold dual citizenship of Montenegro and another country, 46,878 (7.52%) hold only the citizenship of another country, 240 (0.04%) are stateless, and 20 individuals did not declare their citizenship status (MONSTAT, 2024).

firms position themselves more effectively within supply chains by improving inventory management, supplier relations and customer communication (Casadesús & de Castro, 2005, pp. 349–353).[2]

Research suggests that supply chain management is becoming an increasingly important tool not only for optimising flows of goods and information, but also for enhancing national economies' resilience to global disruptions, particularly in the small and medium enterprise sector (Kot, Haque & Baloch, 2020, p. 89).

Beyond resilience, recent studies emphasise that companies should pursue strategies aimed at efficient resource use to reduce reliance on scarce natural resources while simultaneously gaining competitive advantage. The implementation of buffering[3] and bridging[4] strategies in supply chains has proven crucial for improving resource efficiency, with bridging strategies being the only ones directly contributing to competitive advantage (Kalaitzi et al., 2024, pp. 1–2). Literature increasingly highlights the need for resilience to replace efficiency as the primary objective of supply chain management. The study by Kiers et al. (2022) demonstrates that most global supply chains lacked sufficient resilience during the COVID-19 pandemic, revealing the need for strategic changes including supplier diversification, localisation and digital transformation as key risk management mechanisms (Kiers et al., 2022, pp. 2–5). This paper analyses Montenegro's current import dependence, identifies key challenges and explores potential pathways towards a more sustainable and resilient supply system.

This study seeks to answer several scientific questions:

1. How can small economies like Montenegro enhance their resilience to global trade disruptions through source diversification, development of domestic production capacities and supply chain digitalisation?
2. How can the SCOR model be applied to systematically improve the resilience, efficiency and sustainability of food and energy supply chains in Montenegro?
3. In light of the increasing importance of technological infrastructure, how can improvements in digital infrastructure and the integration of security standards further strengthen supply chain resilience in small and open economies such as Montenegro?
4. What role can domestic agriculture development and the establishment of commodity reserves play as key instruments for enhancing supply chain resilience and reducing import dependency?

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[2] Although the study by Casadesús and de Castro (2005) was based on the ISO 9000 version available at that time, many of its findings remain relevant and applicable following the adoption of more recent iterations of the standard, such as ISO 9001:2015, as the core quality principles and their implications for supply chains have remained consistent.

[3] Buffering strategies within supply chains refer to the deliberate accumulation of reserves, whether in the form of resources, raw materials, finished goods or production capacity, with the aim of mitigating the impact of uncertainty and potential disruptions. Such strategies contribute to organisational resilience by absorbing fluctuations in supply and demand (Tang, 2006a).

[4] Bridging strategies within supply chains refer to the development of close collaborations and strategic partnerships with key stakeholders, such as suppliers and customers, through mechanisms such as information sharing, joint planning and integrated operations. The core objective of these strategies is to reduce uncertainty, increase flexibility and reinforce the overall resilience of the supply network in the face of disruptions (Tang, 2006a).

5. Given the strategic importance of the Port of Bar for the national and regional transport system, how might the development of the "Smart Port[5]" concept contribute to strengthening logistics resilience, reducing operational risks and improving energy efficiency in Montenegro's supply system?

Iran provides a relevant example, where multi-layered strategies were developed under the pressure of politico-economic sanctions to enhance the resilience of its pharmaceutical supply chain. Nine main thematic areas were identified, including distribution mechanisation, strengthening local capabilities, reliance on electronic prescriptions and the integration of health information systems, supported by a strong role for the media and international cooperation (Bastani et al., 2021, pp. 2–9).

Beyond classical models, the Conceptual System Assessment and Reformulation (CSAR) approach developed by Perez-Franco et al. (2016) provides a relevant framework for understanding supply chain strategy development. The CSAR model enables comprehensive mapping, evaluation and reformulation of supply chain strategy as a conceptual system, with particular emphasis on the alignment between business strategy and operational activities (Perez-Franco et al., 2016, pp. 8–12). This approach also stresses the importance of internal strategic integration within the firm as a prerequisite for effective external collaboration with partners.

Concurrently, recent concepts from Industry 4.0[6] underscore the importance of supply chain mapping as a key to achieving better visibility and resilience, while also enabling cleaner production and more efficient resource management (Mubarik et al., 2021).

Alongside the CSAR model and supply chain mapping, the Supply Chain Operations Reference (SCOR) model, developed by the Supply Chain Council, makes a significant contribution to supply chain analysis and improvement. The SCOR model standardises key supply chain processes across five core stages: planning, sourcing, making, delivering and returning, thereby enabling comprehensive performance measurement, process optimisation and better strategic alignment (Supply Chain Council, 2012).

The SCOR model provides a standardised framework for analysing and optimising supply chains through five primary processes: Planning, Sourcing, Making, Delivering and Returning (Supply Chain Council, 2012). Through the application of the SCOR model, Montenegro could systematically map and improve its supply chains, particularly in the food and energy sectors. In the planning phase, predictive models could be developed for more accurate forecasting of import and domestic production needs, reducing the risk of shortages and surpluses. In sourcing, the

[5] The concept of the Smart Port refers to the integration of digital technologies into port management, including the use of the Internet of Things (IoT), blockchain, artificial intelligence, and automation, with the aim of optimising logistics operations, reducing cargo handling times, improving security, and increasing energy efficiency. A Smart Port enables real-time, transparent cargo tracking, intelligent operations planning, and improved decision-making based on data analytics (Heilig, Lalla-Ruiz and Voß, 2017).

[6] Industry 4.0 is defined as the fourth industrial revolution, characterised by the digitalisation of manufacturing processes and the integration of advanced technologies, including the Internet of Things (IoT), artificial intelligence (AI), robotics, big data analytics, and cyber-physical systems. The primary aim is to establish smart factories that enable autonomous decision-making, improve operational efficiency, and enhance flexibility throughout supply chain networks. *(Schwab, K. (2016). The Fourth Industrial Revolution. Geneva: World Economic Forum, pp. 15–35.)*

SCOR approach would entail supplier diversification and the strengthening of local supply sources, thereby increasing resilience to global disruptions. In production, the focus would be on enhancing domestic agro-processing, adding value and reducing import dependency. Delivery optimisation through modernisation of logistics infrastructure would facilitate faster and more secure distribution of goods, while improvements in return processes and waste management, particularly in the food sector, would contribute to more sustainable supply chain operations. Applying the SCOR model would enable Montenegro to systematically enhance resilience, reduce operational losses and improve overall efficiency in critical supply sectors.

To successfully identify the causes of supply chain vulnerabilities, it is recommended to combine process mapping with cause-and-effect modelling (Van der Vorst & Beulens, 2002, pp. 421–422). Analytical tools include comparative analysis of macroeconomic indicators, thematic reports and databases such as FAOSTAT, Eurostat and the OECD's supply chain resilience tracking platform. This approach is further strengthened by the application of Fourth Industrial Revolution technologies, where supply chain mapping is used to reinforce resilience through improved visibility and monitoring of critical points (Mubarik et al., 2021, pp. 2–4).

Research indicates that aligning buffering strategies (e.g. product redesign, maintaining safety stock) with bridging approaches (e.g. developing supplier partnerships) can further mitigate risks associated with natural resource shortages, enhance resource efficiency and strengthen firms' long-term market positions (Kalaitzi et al., 2024, pp. 17–19).

In the current context, global supply chains are undergoing a profound transformation driven by rapid technological advancements, growing ecological imperatives and lessons learned from recent global disruptions (All Things Supply Chain, 2025). Artificial intelligence (AI) and automation are increasingly becoming pillars of modern supply chain management, enabling advanced demand forecasting, inventory optimisation and reduced human error in operations. Automation through autonomous mobile robots and robotic process automation (RPA) accelerates warehousing and transportation processes, while the use of AI tools supports faster and more accurate data-driven decision-making (All Things Supply Chain, 2025).

At the same time, sustainability is emerging as a key criterion for business competitiveness. The adoption of circular economy models, use of renewable materials and transition to environmentally friendly transportation are becoming not only regulatory requirements but also market imperatives. Transparency and accountability in managing environmental impact are increasingly determining consumer and investor loyalty. Digital supply networks (DSNs) are replacing traditional linear models, enabling comprehensive real-time data integration and enhancing resilience through flexible and adaptive structures. Full supply chain visibility and the capacity for dynamic response to disruptions are becoming strategic advantages in global competition (All Things Supply Chain, 2025). Supply chain resilience is further enhanced through supplier diversification and relocation of production closer to consumers, while the Internet of Things (IoT) facilitates device connectivity and real-time process optimisation. Combining IoT technology with advanced analytics and machine learning elevates the efficiency, safety and sustainability of supply chains. Increasing consumer expectations for product personalisation and rapid delivery are driving companies to adapt their production and logistics systems using technologies such as 3D printing and modular manufacturing (All Things Supply Chain, 2025). Thus, supply chain management is

entering a new phase in which companies are required to integrate innovation, resilience and sustainability simultaneously. The future of competitiveness will depend on the ability to adapt to these trends, where digitalisation, green initiatives and customer orientation serve as key levers for long-term success (All Things Supply Chain, 2025).

This paper places particular emphasis on analysing several key case studies that illustrate real-world challenges and opportunities within Montenegro's supply chain. The importance of forecast accuracy in supply chain planning is underscored by the findings of Fildes et al. (2009), who analysed more than 60,000 forecasts across four companies. Their research shows that while large forecast adjustments can improve accuracy, small adjustments often degrade it, with positive corrections more likely to introduce bias in demand estimation (Fildes et al., 2009, pp. 4–6). This highlights the need for a cautious and structured approach to forecast adaptation, especially in volatile market conditions such as those in Montenegro.

The first case study, conducted by UNDP (2022), focuses on circular economy development and opportunities to use local resources through sustainable production and consumption models. The second study, the SMART Balkans analysis (2025), examines cross-border flows of food and energy, identifying key vulnerability points and potential regional synergies. The third, a macroeconomic analysis by the World Bank (2024), provides a broader context for Montenegro's economic dependence, with particular emphasis on the structure of its imports and limited export capacities.

This paper offers an original contribution by analysing and applying modern conceptual frameworks such as the SCOR and CSAR models within the specific context of Montenegro's economy. This allows for a more comprehensive understanding of strategic supply chain management in Montenegro through the lens of resilience, sustainability and local production, with a particular focus on reducing import dependency.

By integrating these case studies with relevant quantitative data, this paper delivers a comprehensive assessment of the current state of Montenegro's supply chains. This synthesis provides a solid foundation for the formulation of concrete policy recommendations in subsequent chapters. To address the complexity of the identified challenges, the following chapter outlines the research methodology adopted to guide the systematic analysis of resilience-building strategies and development opportunities across critical sectors.

METHODOLOGY: AN ANALYTICAL FRAMEWORK FOR THE ANALYSIS OF VULNERABILITY AND RESILIENCE

The methodological framework of this study is grounded in a combination of qualitative and quantitative approaches, aimed at addressing the core scientific questions outlined in the introductory section. The research seeks to understand how small economies, such as Montenegro, can enhance supply chain resilience through the diversification of supply sources, the development of domestic production capacities, and the digitalisation of supply chains. Furthermore, it examines the theoretical applicability of the Supply Chain Operations Reference (SCOR) model for the systematic improvement of resilience, efficiency, and sustainability. In addition, the study explores

how advancements in digital infrastructure and the development of domestic agriculture may contribute to strengthening the national supply system.

This study employs a descriptive-analytical method, drawing on secondary data from internationally recognised sources, including the World Bank (2024), OECD (2023), UNDP (2022), Eurostat (2023), as well as scholarly literature in the field of supply chain management (e.g. Gunasekaran, Lai and Cheng, 2008, Van der Vorst and Beulens, 2002). The analysis encompassed the following dimensions: a comparative assessment of macroeconomic indicators, trade balances, and import–export structures; an examination of sector-specific vulnerabilities, with particular emphasis on the food and energy sectors; the identification of critical points of uncertainty within supply chains, categorised according to product, process, supply, and demand uncertainties (Van der Vorst and Beulens, 2002); and an analysis of the potential for localising production and establishing strategic commodity reserves.

Although the SCOR model is considered for its theoretical relevance to enhancing supply chain resilience and operational efficiency, it is not employed as the principal methodological instrument. Rather, it is Kalaitzi utilised as an analytical framework for evaluating the optimisation of planning, procurement, production, delivery, and return processes.

Qualitative analysis of selected case studies was also conducted, including the development of circular economy initiatives (UNDP, 2022) and cross-border trade in food and energy (SMART Balkans, 2025), to illustrate existing vulnerabilities and opportunities within Montenegro's supply system.

The study achieves data triangulation by integrating multiple data sources and analytical methods, thereby enhancing the validity and reliability of the findings. Comparative approaches were employed to benchmark Montenegro's practices against those of other small economies, with particular regard to resilience-building strategies based on diversification and localisation of supply sources.

The methodological framework further incorporates insights from contemporary literature on supply chain resilience strategies, including buffering, bridging, diversification, and localisation (Kalaitzi et al., 2024, Kiers et al., 2022); the role of digital transformation and cybersecurity in improving supply chain visibility and resilience (Mubarik et al., 2021, Urciuoli and Hintsa, 2017); and the interrelationship between domestic agricultural development, the formation of commodity reserves, and long-term supply security (Blečić, 2025, UNDP, 2022).

Building on this methodological foundation, the subsequent sections of the paper examine one of the key structural vulnerabilities, namely Montenegro's pronounced dependence on imports and its implications for national supply chain resilience.

IMPORT DEPENDENCE AND SUPPLY CHAIN VULNERABILITY: A STRUCTURAL CHALLENGE WITH PROFOUND IMPLICATIONS

Montenegro's dependence on imports represents one of the most significant obstacles to achieving economic stability and enhancing supply chain resilience. Over the past decade, the trade deficit

has steadily widened, with notable challenges in the food and energy sectors, both of which are strategic for societal welfare and economic functionality. According to data from the World Bank (2024), Montenegro imports over 80 per cent of its food requirements and nearly all fossil fuels, rendering the country highly vulnerable to global market disruptions.

Identifying the inherent characteristics of products, processes, supply, and demand as primary sources of uncertainty allows for the development of more precisely targeted resilience strategies (Van der Vorst and Beulens, 2002, pp. 424–426). These vulnerabilities were particularly evident during the COVID-19 pandemic, when international supply chains were severely disrupted, leading to shortages of essential goods and escalating prices. SMART Balkans (2025) reports that import restrictions and increased transportation costs during this period directly affected the availability of food and energy in Montenegro, thereby exposing the country's deep reliance on external markets and limited domestic production capacity. Similarly, following the outbreak of war in Ukraine, Montenegro was compelled to redirect its grain imports from traditional suppliers such as Serbia to Bulgaria, further illustrating its susceptibility to global supply chain disruptions (Forecast Report, 2022, p. 92).

Recent global developments have further highlighted these risks. As outlined in the March 2025 issue of *Macroeconomic Analyses and Trends* (MAT), the introduction of new United States tariffs on steel, aluminium, and Chinese-manufactured goods threatens the stability of global supply chains, with particularly adverse effects on the technology and automotive industries. These measures may carry broader repercussions for developing economies that are heavily reliant on international trade (Nikolić, 2025). In this context, Montenegro, as an import-dependent economy, is directly exposed to the consequences of global trade disruptions, particularly in industrial goods, technology, and energy. The imposition of such tariffs may result in increased prices for imported products, prolonged delivery times, and reduced availability of essential goods, disproportionately affecting smaller economies. Of particular concern are potential interruptions in the supply of technological components, motor vehicles, and industrial equipment, which may indirectly impact logistics, transport, and the wider Montenegrin economy. As a developing country highly dependent on tourism, trade, and construction, Montenegro remains vulnerable to cascading effects from distant external shocks, including rising costs, inflationary pressures, and diminished competitiveness. It is therefore imperative that small economies, such as Montenegro, invest continuously in supplier diversification, the development of domestic capacities, and the enhancement of supply chain resilience in order to mitigate the impacts of international disruptions.

At the March 2022 session of the Chamber of Commerce of Montenegro's Trade Association Board, it was confirmed that, although the supply chain had not been directly endangered, disruptions caused by the war in Ukraine led to increased prices of essential foodstuffs and energy. This further underscored the urgent need to develop domestic production capacities and to identify alternative sources of supply (PKCG, 2022).

According to Eurostat data (2023), Montenegro's import structure reveals that food, beverages, and tobacco products account for over 20 per cent of total imports, while energy commodities (including oil, gas, and electricity) comprise an additional 18 per cent. Such a structure implies that even relatively minor disruptions in global procurement channels may result in cascading

effects within the domestic economy, ranging from inflation and industrial stagnation to decreased supply security for the population. Moreover, Montenegro is significantly "importing inflation," as food and energy prices, which dominate the import structure, are directly influenced by global price fluctuations (Forecast Report, 2022, pp. 92–93).

Montenegro also faces limited domestic capacity for storage and processing, which further exacerbates its vulnerability. In response to its significant dependence on oil and petroleum imports, the country initiated a process in 2025 to establish mandatory oil reserves, aiming to secure stocks sufficient for three months of national consumption by 2029, in alignment with European Union standards. The reconstruction of storage facilities at the Port of Bar enables the Hydrocarbons Administration and major importers to assume joint responsibility for forming strategic reserves, representing a key step towards enhancing the country's energy security (SeeNews, 2025). The closure of Uniprom, the country's largest industrial producer, has further reduced domestic production capacity and increased reliance on the services sector (Forecast Report, 2022, p. 92). As Stolze et al. (2007, pp. 5–7) observe, high operating costs, coupled with limited stakeholder collaboration in logistics and inventory decision-making, can constrain investment in research and development, ultimately compromising product quality and safety.

According to the UNDP (2022), Montenegro's food and energy storage and distribution infrastructure remains unevenly developed, with rural areas particularly affected by shortages and irregular supply during crises. As demonstrated by Alzoubi and Yanamandra (2020, pp. 273–274), effective management of supply chain vulnerability requires a high degree of flexibility, visibility, and reliability, along with the efficient utilisation of information across the entire chain—factors that are critical for timely responses to disruptions. In this context, Kiers et al. (2022, pp. 6–10) developed a framework linking specific strategies, such as decentralisation, digitalisation, and dual sourcing[7], with the competencies required for their implementation. Special emphasis is placed on the importance of managerial capital—defined as knowledge, social networks, and cognitive models—implying the need for ongoing human capital development in supply chain management. A similar conclusion is drawn by Kuei et al. (2002), who propose a two-phase model of supply chain strategy development based on quality management and technological advancement, with a particular focus on IT infrastructure and quality-based processes as key determinants of organisational efficiency. Gunasekaran, Lai, and Cheng (2008, pp. 551–552) stress that the development of a responsive supply chain (RSC) requires a combination of agility, partner integration, and the application of information technologies to ensure adaptability and cost efficiency.

As seen in other developing economies, supply chain disruptions in countries with weak political and institutional capacities are not solely triggered by large-scale catastrophic events, but also by

[7] Dual sourcing is a procurement strategy within supply chain management wherein an organisation engages two independent suppliers for the same critical product or raw material, rather than relying on a single source. This approach mitigates the risk of supply disruptions, enhances operational flexibility, and strengthens the organisation's bargaining power. In the event of disruptions with one supplier, such as delays, failures, or market shocks, the firm can maintain operational continuity by relying on the alternative source. Moreover, dual sourcing serves as a strategic investment in supply chain resilience, functioning as an insurance mechanism against future opportunism by providing access to competitive global markets, even if the alternative source is not actively utilised under normal conditions (Gehrig & Stenbacka, 2023).

chronic, recurring issues such as delivery delays, substandard raw material quality, informal economic practices, and corruption. These factors further complicate risk management and resilience strategies (Tukamuhabwa, Stevenson and Busby, 2017, pp. 487–493). Tukamuhabwa et al. (2015, pp. 5593–5594) also highlight that certain strategies—such as lean operations[8] or single-supplier sourcing—while operationally efficient, may substantially reduce supply chain resilience by eliminating buffers and limiting response capacity in crisis situations.

In addition to infrastructural challenges, Montenegro's market dynamics are characterised by low levels of competition in the retail sector, particularly in food and chemical products. Beyond market concentration, further vulnerabilities exist within the national supply chain in the form of security threats, particularly in relation to transport and cybersecurity. As Urciuoli and Hintsa (2017, pp. 282–285) note, modern supply chains are increasingly exposed to risks such as cargo theft, document forgery, cyberattacks, and insider fraud, all of which necessitate the integration of security management into overarching supply chain strategies. Despite the lack of domestic production in certain segments, existing distribution structures play a crucial role in determining the availability and accessibility of goods. This market concentration may delay the entry of international retailers offering broader assortments and more competitive prices, thereby increasing long-term risks for consumers through higher costs and reduced choice (OECD, 2023; UNCTAD, 2023).

Moreover, the limited quality and availability of transport infrastructure and logistics services constitute an additional barrier to Montenegro's integration into regional and global supply chains. As highlighted by UNCTAD (2023, p. 12), developing countries often lag behind global standards in logistics connectivity, and the limited number of shipping providers, coupled with insufficient competition in the transport sector, further hinders market access.

Import dependence impacts not only the economic balance, but also the social stability and political autonomy of the country. In recent years, rising food and energy prices have contributed to increased social tensions, while geopolitical instability across Europe has underscored the strategic importance of diversifying and localising supply sources (OECD, 2023).

Building on lessons from the COVID-19 pandemic, further professionalisation of the supply chain workforce is recommended. Kiers et al. (2022, pp. 10–12) argue that the implementation of more resilient strategies requires a diverse set of competencies, including supplier relationship management, innovative sourcing methods, digital and technical skills, as well as interpersonal capabilities such as negotiation, strategic thinking, and change management. These competencies are essential for proactively managing uncertainty and reducing systemic vulnerabilities.

[8] Lean initiatives denote a set of principles and practices designed to eliminate all forms of waste within production processes and supply chains, including excess inventory, unnecessary transportation, waiting times, and production defects, with the overarching objective of maximising value for the end customer. While lean strategies enhance efficiency and reduce operational costs, they may also undermine supply chain resilience by constraining buffer capacities and limiting the flexibility required to respond effectively to disruptions (Christopher and Peck, 2004).

Current data indicate that the average annual salary for supply chain analysts in Montenegro is approximately EUR 18,000, suggesting a relatively low degree of professionalisation and institutional recognition in this field. This finding highlights the urgent need for greater investment in skills development and capacity building in supply chain management (Jobicy, 2025).

This chapter clearly demonstrates that, despite its membership in international organisations and access to global markets, Montenegro must develop internal mechanisms to reduce dependency and build resilience—issues examined in greater detail in the following section.

An additional challenge in addressing supply chain vulnerabilities lies in the absence of integrated quality control mechanisms across the entire chain, from production to distribution. Moreover, research involving nearly 400 firms has shown that ISO 9000 certification significantly enhances supplier relationships (in 62 per cent of cases), reduces non-quality-related costs (80 per cent), and increases customer satisfaction (80 per cent), thereby directly improving supply chain performance and resilience (Casadesús and de Castro, 2005, pp. 353–354). As Jraisat and Sawalha (2013, pp. 194–207) argue, quality control (QC) must be holistically embedded across all stages of the supply chain, as it enables more effective risk management, stakeholder communication, and responsiveness to market changes. Their research on fruit and vegetable supply chains illustrates that QC is a critical factor in strengthening long-term stakeholder relationships and enhancing the resilience of export systems.

Although numerous vulnerabilities have been identified, Montenegro also possesses considerable opportunities to strengthen the resilience and self-sufficiency of its supply chains—a topic explored further in the next chapter.

OPPORTUNITIES FOR LOCALISATION AND SUSTAINABLE DEVELOPMENT: STRATEGIES FOR INTERNAL RESILIENCE AND RECOMMENDATIONS

Amid growing pressures on natural resources, strategies that simultaneously enhance resource efficiency and strengthen competitive advantage are gaining prominence. Firms that adopt both buffering and bridging approaches tend to achieve superior outcomes in terms of long-term sustainability and supply chain resilience (Kalaitzi et al., 2024, pp. 8–10).

Although Montenegro remains heavily reliant on imports, there exist realistic capacities and opportunities to enhance internal resilience through the development of domestic production and sustainable energy sources. With appropriate policy direction, targeted investment, and the strengthening of human capital, it is feasible to reduce import dependence, increase self-sufficiency, and improve the overall resilience of national supply chains.

Development of Local Agriculture: From Potential to Practice

In the current context of global disruptions, strengthening domestic agriculture and supporting local producers is not merely an economic goal but a strategic imperative for supply chain sustainability. By developing commodity reserves based on domestic resources, Montenegro can simultaneously reduce import dependence, enhance supply security and stabilise market prices, which is particularly relevant amid global trade instability (Blečić, 2025).

Small states such as Montenegro face limited internal resources, a high degree of import dependence and weak bargaining power in international markets. This makes them especially vulnerable to global disruptions such as wars, trade conflicts, pandemics and climate change. In times of crisis, major powers prioritise their own interests, while small economies are left without access to critical goods or face inflated prices and delayed deliveries. By developing domestic production and establishing commodity reserves, small countries can reduce such dependence, increase food and economic security, stabilise prices, protect their populations from shortages and, ultimately, strengthen supply chain resilience. For Montenegro, this is not merely an issue of economic development, but of national survival and stability in increasingly turbulent global conditions.

Agriculture in Montenegro possesses significant but underutilised potential. Although approximately 38 per cent of the country's land area is classified as agricultural land, active cultivation remains well below capacity (FAO, 2024). Most producers are smallholder family farms facing challenges such as low yields, limited market access and a lack of modern technology.

The literature on supply chains in developing countries underscores the importance of enabling direct market access for producers, as this reduces reliance on intermediaries and enhances profitability. Sodhi and Tang (2013) discuss digital approaches that link small-scale producers to markets in a way that reduces transaction costs and improves earnings in resource-constrained settings (Sodhi and Tang, 2013). According to CE-HUB (n.d.), key challenges include weak institutional support, land fragmentation, low mechanisation and poor integration between production and processing. Investment in storage, distribution and processing infrastructure, as well as digitalisation of agricultural production, are identified as priority measures for revitalising the sector. Digital solutions such as the e-Kanban system[9] have proven effective in electronic manufacturing contexts, enabling automatic resource replenishment and increasing efficiency (Junior & Godinho Filho, 2010; Makinde et al., 2022, p. 2). Technologies such as SMS services for market prices and agricultural advice have been beneficial in increasing farmer income in India (e.g. Reuters Market Light), though findings on income impact vary (Fafchamps & Minten, 2012). The systematic use of digital tools to support human judgement in demand forecasting may significantly enhance performance. Fildes et al. propose structured error bootstrapping[10] models to address systematic bias and inefficiency, noting that positive forecast adjustments tend to be overly optimistic, while negative adjustments generally improve accuracy (Fildes et al., 2009, pp. 13–17).

Montenegro shows a lack of specialisation in many agricultural products and suffers from low price competitiveness compared to regional neighbours and EU member states. Moreover, the country is a net importer of agri-food products, with a trade deficit of €250–300 million annually.

[9] Electronic Kanban (e-Kanban) is a digital adaptation of the traditional Kanban system, which uses electronic signals in place of physical cards to automate inventory tracking and resource replenishment. This system improves speed, transparency, and efficiency within production and logistics processes, leading to reduced inventory levels, shorter lead times, and enhanced control over material flows (Jarupathirun et al., 2009, pp. 55.1–55.3).

[10] Error bootstrapping u kontekstu prognoziranja označava tehniku u kojoj se sistematske greške (pristrasnosti) iz prethodnih predviđanja analiziraju i koriste za automatsko podešavanje budućih prognoza. Cilj ove metode je da se identifikuju obrasci grešaka i da se nove prognoze koriguju u skladu s njima, čime se poboljšava ukupna tačnost predviđanja i smanjuje učestalost ponavljajućih pristrasnosti u procjenama potražnje (Proppe i Reiher, 2017, str. 3297–3298).

While agricultural land constitutes 37.4 per cent of the national territory, its potential remains underutilised, with some 33,000 hectares still uncultivated (Jovanović, 2024).

These data point to serious bottlenecks in the development of a sustainable and resilient supply chain in Montenegro. The absence of product specialisation and weak market competitiveness reduce the agricultural sector's capacity to ensure stable and high-quality supply, while the large share of uncultivated land represents a missed opportunity to strengthen domestic supply sources. From a resilience-building perspective, the development of specialised production chains, competitiveness improvement and activation of idle land should be strategic priorities. These measures would reduce import dependence, diversify supply sources and increase the resilience of Montenegro's economy to global shocks.

The Strategy for the Development of Agriculture and Rural Areas (2023) outlines measures to strengthen contractual supply chains, increasing market security for producers and supply stability for processors and retailers. Sectoral operational programmes for fruit, vegetables, meat and dairy aim to enhance planning, quality promotion and collective market access. Emphasis is placed on local markets and web platforms that promote and sell domestic products, thereby improving food availability to Montenegrin consumers. The strategy also highlights investment in on-farm processing and the development of small local processing capacities, reducing waste and adding value to agricultural products. The development of short supply chains, with a minimal number of intermediaries between producers and consumers, is recognised as essential to increasing producer income and reducing delivery times.

The UNDP (2022) reports that pilot projects in organic production and short supply chains have yielded positive results in some rural communities. Initiatives connecting local producers with the tourism sector – as the largest food consumer – hold potential for stimulating the local economy, reducing imports and promoting sustainable practices.

Further challenges identified in the strategy include weak vertical integration between primary agriculture and processing, low market orientation and insufficient use of tourism demand for marketing local produce. To strengthen supply chain resilience, the strategy stresses the need for land consolidation, the establishment of quality control systems and alignment with HACCP[11] and ISO standards. Strengthening institutional support for agriculture, including a more robust agricultural administration and increased investment in rural development, is seen as a key precondition for the sector's long-term progress (Jovanović, 2024).

Sustainable Energy and Logistical Solutions: The Port of Bar as a Cornerstone of Supply Chain Resilience

Montenegro's energy sector is characterised by a high dependence on fossil fuels, particularly in transport and industry. However, the country possesses considerable potential in renewable energy generation, notably in hydroelectric, solar, and wind sources. According to IRENA (2023),

[11] HACCP (Hazard Analysis and Critical Control Points) predstavlja sistematski preventivni pristup sigurnosti hrane, koji identifikuje, procjenjuje i kontroliše potencijalne biološke, hemijske i fizičke opasnosti tokom svih faza proizvodnje, prerade i distribucije hrane, s ciljem obezbjeđenja njene sigurnosti za krajnjeg potrošača (FAO/WHO, 2003, str. 3)

Montenegro has the technical potential to generate over 2,000 GWh annually from solar energy, which could significantly reduce its reliance on imports.

Moreover, green energy transition has been identified as a strategic necessity for Montenegro's economic and environmental resilience. The national framework envisions increased energy efficiency and decarbonisation as pillars of long-term sustainability (Kot, Haque & Baloch, 2020).

Through its Energy Strategy to 2030, the Government of Montenegro has outlined plans to increase the share of renewables in total consumption, alongside market liberalisation and incentives for private investment (Ministry of Capital Investments, 2021). However, the achievement of these objectives faces challenges related to bureaucracy, access to financing, and local resistance to large infrastructure projects.

In addition to the challenges of energy production, the development of reliable logistics infrastructure is essential for a sustainable transition, ensuring the secure and efficient distribution of resources. Logistics systems – particularly maritime terminals – serve as vital links between production capacities and end users, with their efficiency directly influencing the resilience of the energy sector and broader economic stability (OECD, 2023, p. 82). In this context, the Port of Bar warrants particular attention as Montenegro's strategic logistical hub, whose performance is critical to the functioning of national and regional supply chains.

As Montenegro's largest and most important seaport, the Port of Bar holds a strategic location on the Adriatic and is directly connected to the rail and road networks (the Bar–Belgrade railway and key arterial roads), making it a crucial infrastructural point for supply chains (UNCTAD, 2023, p. 42). However, according to UNCTAD's analysis, despite its geographic advantages, the port's logistics capacities are constrained by outdated infrastructure, low levels of digitalisation, and operational inefficiencies (UNCTAD, 2023, p. 45).

Capacity limitations at the Port of Bar increase cargo handling times and logistics costs substantially, thereby amplifying the vulnerability of Montenegro's supply chain, especially in times of crisis when alternative routes are limited (OECD, 2023, pp. 78–80). OECD findings indicate that countries that have developed multimodal transport systems with efficient seaports demonstrated greater resilience during the COVID-19 pandemic and subsequent geopolitical disruptions (OECD, 2023, p. 82).

In the context of sustainable energy and logistics development, the modernisation and digital transformation of the Port of Bar constitute key levers for enhancing resilience. The introduction of intelligent management systems (Smart Port concept) and blockchain-enabled cargo tracking could significantly reduce handling times, improve traceability, and facilitate more rapid responses to supply disruptions (Mubarik et al., 2021, pp. 4–5).

Academic literature confirms that Smart Port implementation is a critical pathway for modernising logistics capacity and improving the resilience and sustainability of maritime ports. According to Belmoukari et al. (2023, pp. 4–6), a Smart Port encompasses seven core domains: operations, infrastructure and technology, energy, environmental protection, security, human resources, and social responsibility. These enable intelligent resource management and improve overall port

performance. The transformation from traditional to Smart Port systems leads to lower operational costs, enhanced cargo handling efficiency, improved traceability, and increased resilience to global supply chain disruptions (Belmoukari et al., 2023, pp. 7–8).

Developing a Smart Port model at Bar could yield multiple benefits: faster cargo processing, reduced logistics costs, greater energy efficiency through smart grids and integration of renewables, as well as improved transport security. Furthermore, digital port transformation allows for the automation of key operations, use of Internet of Things (IoT) technology for real-time monitoring and optimisation, and implementation of blockchain for secure, transparent cargo flow management (Karas, 2020, pp. 407–409). These innovations enable quicker throughput, reduced emissions, energy optimisation, and more effective risk management. The application of advanced analytics and predictive modelling in smart ports further contributes to strengthening supply chain resilience against global shocks (Karas, 2020, pp. 410–411).

Accordingly, the digitalisation of the Port of Bar in line with Smart Port principles would not only improve operational efficiency but also substantially enhance the sustainability and long-term resilience of Montenegro's logistics system. Moreover, modern Smart Port frameworks emphasise the role of servitisation[12] and value co-creation among all logistics stakeholders, including port operators, freight forwarders, carriers, and end-users. Rather than focusing solely on cargo handling, the Smart Port concept integrates advanced services based on real-time analytics, data sharing, and adaptive logistics solutions (Heilig et al., 2017). Such transformation enhances port flexibility, reduces transit times, improves user experience, and strengthens resilience to supply chain disruptions. In the case of the Port of Bar, adopting this approach could enhance regional competitiveness and attract international partners.

Although the Port of Bar is a strategic maritime logistics point, Montenegro's internal transport connectivity remains inadequate. The country currently has only one completed motorway section – Bar to Boljare – approximately 41 km in length, linking Podgorica and Kolašin. Limited road capacity increases costs and prolongs delivery times, especially for food and energy goods. The planned construction of the full motorway route towards the Serbian border and on to Central Europe is a critical prerequisite for the development of a competitive and resilient supply chain (Government of Montenegro, 2024).

Beyond technical upgrades, institutional reform is also essential to simplify customs and administrative procedures, as complex formalities further delay deliveries and reduce port competitiveness (World Bank, 2024, pp. 56–57). According to the World Bank Logistics Performance Index, streamlining port procedures can reduce total transport time by up to 20 per cent and logistics costs by as much as 15 per cent (World Bank, 2024, p. 59). Thus, strategic investment in the modernisation of Bar's capacities, adoption of digital technologies, and improvement of the regulatory framework form the basis for reinforcing Montenegro's supply system in the face of increasingly frequent global disruptions.

[12] Servitization refers to the innovation of an organisation's capabilities and processes to better create mutual value through a shift from selling products to selling integrated Product-Service Systems (Baines et al., 2009, p. 547).

In addition to optimising logistics nodes such as the Port of Bar, the development of decentralised energy systems represents a complementary pathway for strengthening Montenegro's resilience. Promoting household solar panels, microgrids, and energy-efficient buildings offers a more sustainable and rapidly deployable model. According to OECD (2023), localised solutions can enhance energy security, stabilise prices, and reduce environmental impact.

In addition to the decentralisation of physical systems, the decentralisation and dissemination of knowledge through education and forecast error feedback can also improve planning, as suggested by Fildes et al. (2009), who emphasise the need for structured systems to record reasons for forecast adjustments and thereby reduce unnecessary and harmful interventions (Fildes et al., 2009, pp. 18–19).

Nevertheless, the implementation of digital infrastructure also brings security challenges. As shown in the Iranian case, mechanised distribution not only enables medicine availability tracking but also significantly reduces the number of intermediaries and improves transparency in relation to costs and consumption (Bastani et al., 2021, p. 7). Research by Urciuoli and Hintsa (2017) demonstrates that cybersecurity has become a key concern in supply chains, as attacks on information systems may cause severe operational and logistical disruptions. IT systems, while engineered for efficiency, often increase exposure to digital threats, especially when outsourced without adequate control over physical infrastructure security (Urciuoli & Hintsa, 2017, pp. 286–288).

Recommendations: Strategic Directions for Strengthening Resilience and Sustainability

Based on the challenges and opportunities identified in the previous sections, this paper proposes a set of concrete recommendations aimed at enhancing the resilience and sustainability of Montenegro's supply chain. All recommendations are grounded in the sources already analysed in the study, particularly UNDP (2022), OECD (2023) and FAO (2024), and are formulated as best practices derived from international supply chain resilience strategies, tailored to the Montenegrin context.

Supply source diversification: Montenegro must reduce its dependence on a limited number of foreign suppliers, especially in the food and energy sectors. As Milovanović (2018) highlights, while globalisation offers opportunities to expand and optimise supply chains, it simultaneously increases their complexity, extends lead times and generates additional risks, thus underscoring the need to design flexible and competitive supply networks that are resilient to global shocks (Milovanović, 2018, pp. 4–5). Based on the reviewed literature (OECD, 2023), it is recommended to establish more flexible and decentralised supply networks that include a broader range of sources, including regional partners and domestic capacities.

Supply chain resilience management requires continuous monitoring of the interdependencies among threats, strategies and outcomes, recognising that measures designed to mitigate one risk may create new vulnerabilities or shift the risk to other parts of the supply network (Tukamuhabwa, Stevenson and Busby, 2017, pp. 494–496). According to Tukamuhabwa et al. (2015), strategies aimed at enhancing resilience, such as flexibility, collaboration and redundant capacities, can be synergistic but may also conflict if not carefully aligned. For instance, excessive redundancy may

increase costs, while collaboration may compromise flexibility or result in the leakage of sensitive information (Tukamuhabwa et al., 2015, pp. 5605–5606).

Recommended measures (based on literature analysis):

- Promote bilateral and regional trade agreements in strategically important sectors.
- Establish strategic reserves of essential goods to cushion supply shocks.
- Develop mechanisms for rapid response in emergency situations, in line with OECD (2023) guidance.

Additionally, according to the model proposed by Mishra et al. (2016), companies can choose between two key strategies for supply chain risk management: buffering (building reserves, diversifying sources) and bridging (intensified collaboration and information sharing with partners). Kuei et al. (2002) also emphasise that successful strategies must include not only technical innovations but also the development of a "quality culture" among all supply chain actors, in order to achieve long-term resilience and synergy among suppliers (Kuei et al., 2002). Empirical evidence confirms that firms implementing ISO 9000 standards report improvements in key segments of the chain, including reduced delivery times and enhanced coordination with suppliers and customers, demonstrating that systematic quality management has a direct positive impact on SCM performance (Casadesús and de Castro, 2005, pp. 351–355). However, more recent research suggests that relying solely on standardised approaches such as ISO 9000 may be insufficient in complex and dynamic supply chain environments. Jahre (2017) finds that organisations, particularly in the humanitarian sector, are increasingly adopting combined risk mitigation strategies, including flexible contracts, collaboration with local partners, dynamic planning and digital tools, to achieve higher levels of resilience and adaptability (Jahre, 2017).

It is especially important to emphasise that, according to Alzoubi and Yanamandra (2020), information-sharing strategies within agile supply chains act as a key mediator in improving overall performance, enabling firms to respond more effectively to market changes and turbulence (Alzoubi and Yanamandra, 2020, pp. 273–275).

Support for local producers: Based on UNDP (2022) and CE-HUB (n.d.), local production is a fundamental pillar of a resilient supply system. UNDP explicitly highlights the importance of creating an enabling institutional environment through education, subsidies and market development. Sodhi and Tang (2013) also emphasise the importance of reducing transaction and search costs through digital platforms that connect micro-entrepreneurs and consumers, thereby expanding the value chain and facilitating distribution in infrastructure-poor communities (Sodhi and Tang, 2013).

Recommended measures (formulated based on international practice, adapted to Montenegro):

- Increase public subsidies for small and medium-sized agricultural producers.
- Develop digital platforms for the direct sale of local products and the promotion of short supply chains.

- Establish mechanisms that encourage the use of local food in public institutions (e.g., schools, hospitals), in line with practices endorsed by UNDP in comparable transitional countries.

Infrastructure investment: FAO (2024) identifies inadequate logistics infrastructure as a key driver of food supply chain losses, particularly in countries with socio-economic profiles similar to Montenegro. Based on these sources, investments in modern and sustainable logistics infrastructure are recommended. Organisational capabilities, such as supplier and customer relationship management and internal logistics improvement, significantly influence overall supply chain performance. Empirical data from Dwitaa et al. (2021) show that effective implementation of SCM strategies directly enhances company performance by strengthening organisational capacities (Dwitaa et al., 2021, p. 164). Moreover, integrating marketing and supply chain strategies at four key levels, corporate, customer, supplier and chain-wide, improves alignment between business objectives and value creation for end-users and shareholders alike (Jüttner, Christopher and Godsell, 2010, pp. 111–113).

Strategic liberalisation of transport services is also recommended to increase competition and reduce distribution costs. UNCTAD (2023) notes that countries with five or more competitors in the maritime sector experience transport costs up to 30 per cent lower, making them more competitive in regional and global markets (UNCTAD, 2023, p. 16).

Similar to findings from Indonesia, the study by Sukati et al. (2012) indicates that supply chain management strategies, such as lean, agile and hybrid models, have limited impact on performance unless embedded in concrete practices such as strategic supplier partnerships, customer relationships and information sharing. These three components were identified as the most significant performance determinants (Sukati et al., 2012, pp. 229–230). The authors conclude that desired outcomes can only be achieved if strategies are effectively translated into operational practices, thereby reinforcing the recommendations proposed in this paper.

Recommended measures (based on literature analysis):

- Modernise food storage and processing capacities.
- Improve transport infrastructure (roads, railways) to reduce distribution costs.
- Invest in the construction of cold storage and regional distribution centres, particularly in rural areas (FAO, 2024).

Research shows that linking agile practices with information-sharing strategies significantly improves the operational and competitive performance of supply chains (Alzoubi and Yanamandra, 2020, pp. 276–278).

Digital solutions implementation: OECD (2023) highlights that digital transformation can substantially improve supply chain efficiency, transparency and security. Similarly, Mubarik et al. (2021) note that integrating technologies such as supply chain mapping and real-time visibility enables firms to identify vulnerabilities more quickly and respond more effectively to disruptions. In this context, blockchain technologies have emerged as a key tool for mapping and integrating

supply chains, allowing firms to visualise and track product flows in real-time across all stages, from raw material suppliers to end consumers (Khan et al., 2022, pp. 3743–3745).

A regional example is Coca-Cola HBC Serbia and Montenegro, which demonstrates that implementing digital solutions such as Blue Yonder, Sim Cad and Vision Picking, alongside logistics automation and optimisation, significantly enhances efficiency and competitiveness in Southeast European markets (Stančik, 2024). This technology enhances traceability and accountability, contributing to supply sustainability and resilience, especially in complex, multilayered networks. Based on this source, the following measures are proposed to make digital tools accessible and useful in the Montenegrin context. Research from PT Pos Indonesia finds that digital SCM integration improves supplier and customer relationship management, resource allocation and ultimately results in faster delivery and greater customer satisfaction (Dwitaa et al., 2021, pp. 157–158).

Recommended measures (based on OECD best practice, adapted to the local context):

- Introduce digital tools for tracking product origin and movement (e.g., blockchain technology).
- Support the digital transformation of small producers through training and technology subsidies.
- Develop a national database for rapid crisis response and decision-making.

Standardising data exchange among supply chain actors can further increase efficiency and reduce errors. GS1 standards[13], which enable unified and harmonised storage and transmission of information among partners, demonstrate that applying a common logistics language significantly improves product tracking, reduces administrative costs and enhances security, especially in retail, healthcare and transport. Standardised systems allow for precise tracking of products across all stages of the supply chain, which is crucial for achieving resilience and sustainability in complex market conditions (GS1, 2025).

Similarly, the study by Qrunfleh and Tarafdar (2014) demonstrates that aligning information systems with supply chain strategies, such as lean and agile, significantly improves overall chain and firm performance, with efficiency and flexibility-focused information systems playing a critical role in achieving operational agility and resilience (Qrunfleh and Tarafdar, 2014).

In line with the above recommendations, the study by Khan et al. (2022) confirms that while blockchain may not have a direct impact on supply chain sustainability, its implementation indirectly enhances sustainability through improved supply chain mapping and integration. Furthermore, as noted by Zamarripa (2012), the use of information technologies for optimising and visualising supply chain flows enables not only improved performance but also better decision-making through scenario simulations. The author suggests the integration of so-called

[13] GS1 standards regulate the standardised exchange of data and product traceability in supply chains. Unlike ISO standards, which focus on quality management and internal organisational processes, GS1 standards provide globally harmonised frameworks for identification, data capture, and data sharing among supply chain partners, thereby enabling interoperability, efficiency, and visibility in complex logistical environments (GS1 AISBL, 2021).

model-based decision support systems[14], which enhance preparedness for supply chain disruptions by developing digital twins that simulate the behaviour of complex supply systems in real-time (Zamarripa, 2012). Clearly mapped chains facilitate risk identification and mitigation of unsustainable practices (Khan et al., 2022, pp. 3746–3750). Similarly, Carvalho et al. (2012) argue that supply chain resilience depends on balancing capabilities and vulnerabilities through sound chain design, where connectivity, flexibility and visibility among partners play key roles in mitigating the impact of disruptions (Carvalho et al., 2012, pp. 330–331). A well-designed chain, therefore, is one that is interconnected, adaptable and transparent, qualities that facilitate more effective crisis management.

It is particularly important to develop integrated processes that align marketing and SCM activities around a common objective, delivering value to the customer through fast, flexible and differentiated supply chains, as outlined in the framework by Jüttner et al. (2010, pp. 114–115).

In addition to implementing digital tools for traceability, it is essential to integrate security standards into the digitalisation process. Urciuoli and Hintsa (2017) stress the importance of establishing shared incident databases, improving awareness of criminal trends and strengthening partner verification systems to prevent fraud and abuse in complex supply networks (Urciuoli and Hintsa, 2017, pp. 285–287).

The proposed measures provide a starting point for further exploration of their implications for practical decision-making, which will be the focus of the following discussion.

RESEARCH IMPLICATIONS

Building upon the conducted research, this paper addresses critical scholarly questions, informed by contemporary literature, case studies, and data from relevant international institutions.

Resilience of Small Economies through Diversification, Production Development, and Digitalisation – Small, import-dependent economies such as Montenegro can enhance their resilience to global trade disruptions by diversifying supply sources, expanding domestic production capacities, and digitally transforming supply chains. These factors constitute the foundation of modern resilience, enabling a reduction in reliance on volatile markets, strengthening the domestic economy, and supporting more effective risk management (Gunasekaran, Lai and Cheng, 2008; Kot, Haque and Baloch, 2020; Kiers et al., 2022; Mubarik et al., 2021). The introduction of flexible, agile, and integrated supply networks has become crucial for enterprises and governments seeking stability during unpredictable shocks such as pandemics, geopolitical conflicts, and climate-related challenges.

Application of the SCOR Model to Enhance Resilience and Efficiency – The SCOR model facilitates the systematic mapping, identification of critical points, and optimisation of processes

[14] Model-based decision support systems are information systems that employ mathematical models, simulations, and optimisation tools to assist decision-making in complex, dynamic environments, such as supply chains. These systems facilitate the creation of digital replicas of physical processes, commonly referred to as digital twins, which can be used to analyse various scenarios, predict performance outcomes, and optimise responses to disruptions and risks (Zamarripa et al., 2012, pp. 178–179).

in Montenegro's food and energy sectors. The standardised stages – planning, sourcing, production, delivery, and return – ease performance measurement and strategic alignment (Supply Chain Council, 2012). The implementation of the SCOR model allows for accurate demand forecasting, diversification of supply sources, development of domestic processing, and optimisation of logistics (Kalaitzi et al., 2024; Van der Vorst and Beulens, 2002). In Montenegro, the SCOR model could specifically support the development of the dairy sector, strengthening domestic production and improving supply security (Fildes et al., 2009).

Role of Digital Infrastructure and Security Standards in Supply Chain Resilience – Digital transformation, accompanied by the implementation of security standards, significantly contributes to strengthening supply chain resilience. Increased visibility, traceability, and predictive analytics enable earlier identification of issues, while cybersecurity has become a critical component of supply chain efficiency (Urciuoli and Hintsa, 2017; Mubarik et al., 2021; Kiers et al., 2022). The adoption of GS1 standards and blockchain technology enables secure data exchange and real-time tracking of goods, which is particularly important in complex, multilayered supply networks (Khan et al., 2022; Zamarripa, 2012).

Development of Domestic Agriculture and Strategic Reserves as Pillars of Internal Resilience – Strengthening local agriculture and establishing strategic reserves are essential to reducing import dependence and building resilience. Investments in infrastructure, digital tools, and vertical integration of agriculture enhance the self-sufficiency of the supply system (UNDP, 2022; Jovanović, 2024). Strategic reserves based on domestic resources help stabilise markets during crises, while digital support for rural producers facilitates direct product placement and reduces losses (Fildes et al., 2009).

The Port of Bar and the Smart Port Concept as a Strategic Avenue for Transport Resilience – The development of the Smart Port concept at the Port of Bar constitutes a critical strategic direction for enhancing the resilience of Montenegro's transport system and improving its energy efficiency. Through the integration of digital technologies, automation, and sustainable energy solutions, ports can enhance traceability, reduce operational risks, and improve the overall efficiency of logistics processes (Belmoukari et al., 2023; Karas, 2020; Mubarik et al., 2021). The servitisation of ports, along with IoT and blockchain technologies, supported by predictive analytics, enables more efficient operations, faster crisis response, and better integration into regional and global markets (Heilig et al., 2017; OECD, 2023; UNCTAD, 2023).

Based on the findings presented in this paper, several strategic directions emerge that could enhance the resilience and sustainability of Montenegro's supply system. Rather than partial interventions, the results point to the need for a structural approach to resilience, grounded in localisation, digitalisation, and institutional integration.

First and foremost, the paper confirms that resilience must become a central component of all economic and development policies. The current vulnerability is driven not only by a high level of import dependence, but also by insufficient diversification of supply sources and limited domestic capacities (World Bank, 2024; UNDP, 2022). Market diversification, development of internal production capacities, and digital integration have been identified as three key pillars of resilience (Gunasekaran, Lai and Cheng, 2008; Kalaitzi et al., 2024).

Fiscal and institutional support for domestic production is particularly significant. Connecting local producers with dominant consumer sectors, such as tourism and public institutions, provides an important channel for stabilising demand and enhancing economic security (UNDP, 2022; CE-HUB, n.d.). At the same time, digital platforms that facilitate links between small producers and consumers are recognised as promising mechanisms for building shorter and more inclusive supply chains in developing economies, thereby reducing intermediation costs and supporting local economic resilience (Sodhi and Tang, 2013).

In the area of infrastructure, the research highlights the urgent need for the modernisation of logistics hubs, particularly the Port of Bar, as well as for expanding storage and processing capacities for essential goods. Digital transformation – through the implementation of blockchain technology, product tracking systems, and IoT tools – is widely recognised in the literature as a means to improve visibility and supply chain security (Mubarik et al., 2021; Khan et al., 2022). While these authors do not specifically address the Port of Bar, their findings can be extrapolated to similar infrastructure contexts, including that of Montenegro.These steps must be accompanied by regulatory reforms, including data standardisation, promotion of competition, and the implementation of security protocols (Urciuoli and Hintsa, 2017; GS1, 2025).

The institutional dimension remains of critical importance. Given the pronounced shortage of professionals in supply chain management (SCM), it is essential to develop specialised educational programmes and enhance the professionalisation of the field (Kiers et al., 2022; Jobicy, 2025). Strengthening knowledge, as well as organisational competences, is key to implementing digital and strategic transformation in both the public and private sectors.

In the field of energy and strategic reserves, the findings confirm the importance of decentralised systems and domestic food and energy production. Establishing strategic stockpiles, developing micro-production capacities, and encouraging the use of local sources reduce vulnerability to global disruptions (Blečić, 2025; OECD, 2023). The Smart Port concept, as exemplified by the Port of Bar, further reinforces supply chain robustness and allows for more rational energy management (Karas, 2020; Belmoukari et al., 2023).

Multiplier Effect of Road Infrastructure – It is crucial to emphasise that, without developed road infrastructure, a functional supply chain cannot be realised. In this regard, the completion of the remaining sections of the Bar–Boljare motorway, as well as its integration into regional corridors, will have a multiplier effect in reducing logistics costs, improving the integration of domestic producers into market flows, and enhancing Montenegro's competitiveness as a regional logistics hub (Government of Montenegro, 2024).

Taken together, the findings suggest that the national supply chain should be approached as an integrated system – one that must be simultaneously localised, digitalised, professionalised, and institutionally supported.

The insights from this paper open up several new avenues for further research. First, it is necessary to develop quantitative models for measuring resilience in small, open economies such as Montenegro, incorporating macroeconomic, logistical, and institutional indicators (Kalaitzi et al., 2024). Second, experimental and evaluative studies should be conducted on the impact of strategic

reserves on price stability and product availability during crises (Blečić, 2025). Third, the potential of blockchain and IoT to improve traceability and security in complex supply networks in small states remains underexplored (Khan et al., 2022; Zamarripa, 2012). Fourth, further research should explore the role of educational institutions in developing resilience competencies through mapping existing curricula and identifying knowledge gaps (Kiers et al., 2022).

Ultimately, supply chain resilience is not merely a technical or economic challenge, but one that requires strategic planning, institutional coherence, and political will. This paper contributes to that broader framework, with the aim of laying the foundation for a sustainable and stable supply system in Montenegro. The study also confirms that resilience in small economies such as Montenegro cannot be achieved without simultaneously developing internal capacities, fostering digital innovation, and strengthening local production. By integrating these strategies, Montenegro can significantly reduce its exposure to global disruptions and build a sustainable economic system capable of withstanding future challenges.

CONCLUSION: TOWARDS A MORE RESILIENT AND SUSTAINABLE SUPPLY SYSTEM IN MONTENEGRO

Montenegro's dependence on imports, particularly in the food and energy sectors, constitutes one of its principal structural vulnerabilities, a weakness that has become increasingly evident during recent global crises such as the COVID-19 pandemic and ongoing geopolitical instability. This research confirms that supply chain resilience must be established as a central pillar of economic and strategic policy. Despite its limited resource base, Montenegro holds considerable potential to improve systemic resilience through supply source diversification, the expansion of domestic production, digital transformation, and institutional capacity building.

Drawing upon theoretical models (SCOR, CSAR, CAS), international frameworks (OECD, UNDP, FAO), and case-based evidence, this study identifies four core levers of transformation: the strengthening of domestic production, investment in logistics and digital infrastructure, the development of human capital in supply chain management, and the establishment of strategic reserves. The Port of Bar occupies a pivotal role in this configuration; its digital modernisation under the Smart Port concept has the potential to substantially enhance transport resilience, reduce operational risks, and improve the national energy balance.

The deployment of blockchain technologies, Internet of Things (IoT) applications, and standardised digital systems improves visibility, traceability, and agility within supply chains. Simultaneously, the implementation of internationally recognised quality certifications (e.g. ISO 9000) and the functional integration of marketing and supply operations support system-wide cohesion and efficiency. Evidence from comparable contexts confirms that digital integration, supported by skilled human resources, forms the basis of organisational resilience, underscoring the urgency of investing in targeted education and the professionalisation of the supply chain sector in Montenegro.

In view of tightening global regulatory frameworks concerning sustainable supply chains, Montenegro must proactively embed social, environmental, and security considerations into its strategic agendas. While foreign direct investment can support these objectives, its effectiveness

remains contingent upon clearly defined development priorities and robust institutional governance.

This research underscores that resilient and sustainable supply chains are not emergent properties of market dynamics, but rather the outcome of a deliberate, systemic, and interdisciplinary approach involving all key stakeholders – including government, private sector actors, academic institutions, and civil society. Accordingly, the framework proposed herein may serve not only as a strategic guide for Montenegro, but also as a replicable model for other small, import-reliant economies.

By integrating recent theoretical advances in supply chain resilience and sustainability with an applied methodological approach, this paper offers a foundation for further research in economies with comparable structures. In doing so, it contributes to a broader strategic reflection on supply security in small, open, and import-dependent states.

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