DIGITAL TRANSFORMATION AND ADMINISTRATION INNOVATION

Citation: Ahmed Abd Ali Alfayyadh, H., Mirtavousi, S. H., Shlaka, T. K., & Aghasi, S. (2024). Designing an Organizational Green Chain Model Based on Intellectual Capital. *Digital Transformation and Administration Innovation*, 2(4), 9-15.

Received: date: 2024-07-29 Revised: date: 2024-09-12 Accepted: date: 2024-09-21 Published: date: 2024-10-01

Designing an Organizational Green Chain Model Based on Intellectual Capital

Hasanain Ahmed Abd Ali Alfayyadh[1], Sayyed Hamidreza Mirtavousi[2*], Tariq Kadhim Shlaka[3], Saeid Aghasi[4]

1. PhD Student, Department of Public Administration, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran
2. Assistant Professor, Department of Public Administration, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, Iran
3. Assistant Professor, Department of Public Administration, Faculty of Management, Sumer University, Sumer, Iraq
4. Assistant Professor, Social and Cultural Researches Center, Dehaghan Branch, Islamic Azad University, Dehaghan, Iran

*****Correspondence: e-mail: hamidreza_mirtavousi@yahoo.com

Abstract

The objective of the present study is to design an organizational green chain model based on intellectual capital. The study is applied in terms of purpose, survey-based in terms of method, and qualitative in terms of research type. The statistical population includes experts and managers in Iraq's textile industry as well as university faculty members. The sampling method is snowball sampling, and 10 experts were interviewed. The research sample was selected purposefully from among experts, based on the principle of theoretical saturation. The sampling method used in this study is theoretical and purposive. Data analysis was conducted using the thematic analysis method. The research instrument was a semi-structured interview. The study's findings indicate that five main dimensions, along with their components, were extracted from expert interviews. These dimensions include green raw materials, green production processes, sustainable transportation, collaboration with green suppliers, and transparency in sustainable communication. This study recommends the utilization of modern technologies for data collection and analysis, which can aid in identifying strengths and weaknesses in the chain and facilitate better decision-making. The study also suggests designing systems for performance evaluation and feedback collection regarding environmental and social aspects, which can enhance collaboration with customers and suppliers and promote continuous improvement.

Keywords: Green logistics, green chain, green intellectual capital, environment.

1. Introduction

Economic development and environmental protection are the dual objectives of every country. Corporate environmental protection activities are highly valued, as stakeholders are increasingly prioritizing environmental concerns over financial performance. Green initiatives can help businesses expand their markets and enhance competitiveness (Asiaei et al., 2022). However, economic growth is always accompanied by increased consumption of goods and services. Transportation, storage, maintenance, and consumption of large volumes of goods have led to environmental issues such as resource exploitation, excessive use of natural and non-renewable materials, waste recycling, and carbon dioxide emissions, which are among the primary drivers of climate change and global warming. These consequences are closely related to the environmentally unfriendly nature of logistics companies' activities (Afum et al., 2022). Meanwhile, under significant stakeholder pressure, companies must demonstrate their environmental commitment through initiatives that promote a green environment (Hu &

Tresirichod, 2024). Logistics companies are no exception to this rule and must adopt appropriate green policies and strategies, such as green logistics practices (Mohsin et al., 2022).

Green logistics is considered an integral part of the green chain and refers to strategies and practices in supply chain management aimed at minimizing the negative environmental impact associated with the distribution of goods (Agyabeng-Mensah et al., 2020). This approach requires businesses to assume environmental responsibility by focusing on waste management, material recycling, packaging, and transportation. From the perspective of sustainable development, green logistics is defined as "the production and distribution of goods in a sustainable manner, considering environmental and social factors" (Li et al., 2022; Li & Zhang, 2018). Additionally, green logistics can offer several environmental benefits that exceed customer expectations and create a ripple effect in the chain due to the growing environmental awareness of suppliers and customers. Several empirical studies have measured the impact of green logistics practices on environmental and social performance. However, this impact has been extensively tested only in China, Australia, Ghana, and South Africa, highlighting a gap in empirical evidence from other regions (Bag & Gupta, 2020).

The green chain context presents an opportunity for the transportation industry to adopt an environmentally conscious image, following the belief since the late 1980s that transportation practices, infrastructure, and traffic contribute to environmental degradation. The terms "green logistics" and "reverse logistics" were first coined in 1980 (Gu et al., 2020). Green logistics encompasses the production and distribution of goods in an environmentally and socially responsible manner and is defined as a set of supply chain management strategies aimed at reducing the ecological footprint of goods distribution by focusing on material transportation, waste management, packaging, and shipping. The primary objectives of the green chain are to minimize the environmental impacts of logistics activities (Wang & Juo, 2021), reduce energy consumption and waste, enhance brand value, improve operational efficiency, and achieve cost savings (Tat & Sulaiman, 2015). The implementation of the green chain requires logistics companies to comply with environmental regulations and regulate the use of natural resources for the production and distribution of environmentally friendly goods and services, thereby reducing environmental pollution. Green logistics is a vital component of the green chain and a roadmap for sustainable development, as it helps businesses optimize their supply chain by identifying and selecting environmentally friendly material suppliers, offering sustainable solutions, and implementing green transportation systems for optimal consumer delivery (Zhang et al., 2021).

Intellectual capital refers to a collection of knowledge and intangible assets that can be leveraged to create new value by transforming them into new methods, processes, products, and services (Rehman et al., 2022). In every company, intellectual capital is considered the primary resource for fostering innovation (Kianto et al., 2017), improving operational efficiency (Smriti & Das, 2018), and enhancing competitive advantage (Yaseen et al., 2016). From an environmental perspective, intellectual capital pertains to intangible resources, knowledge, capabilities, and relationships aimed at environmental protection and green innovation practices. In fact, intellectual capital plays a crucial role in promoting environmentally friendly behaviors within organizations, such as limiting the use of non-renewable materials, conserving electricity and water, increasing environmental training for employees, hiring environmentally knowledgeable staff, evaluating environmental management practices, and adopting clean technologies to prevent pollution (Wang & Juo, 2021).

Recent studies have highlighted the crucial role of green supply chain management (GSCM) and intellectual capital in enhancing sustainable performance across various industries. Hu et al. (2024) demonstrated that green entrepreneurial orientation positively influences sustainable performance in China's manufacturing sector, with green intellectual capital and sustainable supply chain management serving as mediators in this relationship. Their findings suggest that fostering environmental awareness and proactive initiatives within firms enhances the development of green intellectual capital and GSCM, ultimately improving sustainability outcomes (Hu & Tresirichod, 2024). Similarly, Dahinine et al. (2024) examined the combined effects of transformational green leadership and green human resource management on GSCM, underscoring their critical impact on advancing green supply chain practices (Dahinine et al., 2024). Murad and Zou (2023) further supported this by illustrating that green human capital significantly correlates with GSCM practices, including environmental training and internal environmental management, which in turn positively affect sustainable chain performance in Chinese manufacturing firms. Their findings establish green human capital as a key enabler of effective GSCM implementation, driving

superior environmental, financial, and social performance (Murad & Zou, 2023). Khan et al. (2023) extended this perspective by analyzing 381 manufacturing firms in the UK, confirming that supply chain connectivity and information sharing positively influence GSCM through senior management commitment and the adoption of green procurement and logistics practices. They also identified senior management commitment as a mediating factor in these relationships, reinforcing the necessity of leadership engagement in GSCM adoption (Khan et al., 2023). Additionally, Lutfi et al. (2023) provided empirical evidence from Jordan's renewable energy sector, demonstrating that GSCM enhances service quality and that intellectual capital strengthens this impact. Their study highlighted the proactive measures taken by renewable energy firms to align production inputs with environmental specifications, suggesting the importance of continuous monitoring of supplier processes to ensure environmental compliance (Lutfi et al., 2023). Collectively, these studies emphasize the interconnectedness of green intellectual capital, leadership, human capital, and supply chain management in fostering sustainable business practices and enhancing corporate environmental responsibility.

Given the increasing importance of environmental issues and the environmental pollution caused by the industry, this study aims to design an organizational green chain model based on intellectual capital in the textile industry. Generally, the green chain in the textile industry, supported by intellectual capital, can serve as an effective solution for improving the competitiveness of logistics companies in emerging economies. Additionally, pollution reduction and cost reduction in the textile industry's green chain can be examined across all dimensions, including social and environmental aspects.

Thus, this study poses the following research question:

What is the organizational green chain model based on intellectual capital?

2. Methods and Materials

Given that the objective of this study is to design an organizational green chain model based on intellectual capital, the research method is classified as exploratory-applied in terms of purpose, cross-sectional in terms of data collection timing, inductive-deductive in terms of philosophical approach, and survey-based in terms of data collection method and research nature. The thematic analysis method was employed to conduct the study. The thematic analysis method involves the use of a qualitative approach aimed at identifying, categorizing, and extracting concepts based on the perspectives of experts and relevant professionals.

The statistical population consists of experts and managers in Iraq's textile industry as well as university faculty members. The sampling method is snowball sampling, and 10 experts were interviewed. The research sample was selected purposefully from the aforementioned experts based on the principle of theoretical saturation. The sampling method used in this study is theoretical and purposive. In essence, individuals were selected as samples based on their expertise and prominence in this field. The qualitative data collection instrument consisted of semi-structured interviews. To ensure validity and reliability, Creswell's eight strategies were employed to verify the accuracy of the findings.

3. Findings and Results

An analysis of the average age of the experts surveyed revealed that university faculty members and academic experts had the highest age category, with a mean age of 50.21 years, while managers in the textile industry had the lowest age category, with a mean age of 39.66 years. An analysis of the average years of work experience indicated that university faculty members and academic experts had the highest level of experience, with an average of 18.33 years, whereas managers in the textile industry had a lower level of work experience, with an average of 12.26 years. Among the participants in this study, six individuals held a Doctor of Philosophy (PhD) degree, while four individuals held a Master of Science (MSc) degree.

Researchers first carefully examine the text and then extract secondary codes from it. The secondary codes, derived from primary codes and re-extracted from the interviews conducted in this study, are reported in Table 1.

Table 1. Extracted Dimensions and Secondary Codes

No.	Core Code	Primary Codes
1	Use of Renewable Resources	Utilizing renewable resources such as solar and wind energy, reducing reliance on traditional energy sources like fossil fuels, water recycling, use of recovered boilers, using renewable resources such as natural fibers and dyes.

2	Reduction of Natural Resource Consumption	Reducing natural resource consumption in the green chain, lowering operational costs, promoting resource continuity, protecting the organization from dependence on unlimited natural resources, mitigating rising costs, using clean technologies and resource management, increasing intellectual knowledge, experience, and skills to reduce resource consumption.
3	Focus on Local Value Addition	Strengthening local connections, sharing knowledge and experiences, building meaningful relationships and collaborative networks, fostering local industries, creating shared value, preserving local resources, maintaining cultural and local identity, supporting local business and production.
4	Intellectual Commitment to Environmental Preservation	Compliance with legal and environmental regulations, addressing pollutant limits and consumption of water and energy resources, waste management and resource optimization, increasing innovation and research and development, continuous improvement and innovation in green products and processes, using recycled materials to optimize production processes.
5	Proper Waste Management and Material Recycling	Using recyclable materials such as leftover fabrics, old coverings, and production waste, improving processes to prevent unnecessary waste production, increasing material recycling, collecting, sorting, and recycling usable materials, enhancing intellectual capital, increasing employees' knowledge and experience in waste optimization methods, strengthening connections with the green chain, suppliers, and customers.
6	Energy Consumption Optimization	Enhancing energy efficiency, improving the organization's intellectual capital in energy optimization, reducing energy-related risks, ensuring organizational sustainability, creating a positive reputation for the organization.
7	Sustainable Product Design	Increasing value addition through sustainable product design, meeting customer demands through sustainable products, improving reputation and responsibility through sustainable product design.
8	Water Resource Management	Optimizing water consumption, using renewable water sources, protecting water resources, preserving surface and groundwater resources, innovating in water management, developing water-saving technologies, improving resource forecasting and management under variable conditions.
9	Support for Local Primary Production	Reducing environmental impacts through local primary production, lowering fuel consumption and greenhouse gas emissions, fostering local development and job creation, improving local production capacity, increasing production units and job opportunities, enhancing flexibility in the supply chain.
10	Establishment of Green Structural Capital	Improving the sustainability of the supply chain, creating environmental management systems, optimizing production processes through advanced technologies, using high-quality materials.
11	Reduction of Greenhouse Gas Emissions	Enhancing market competitiveness by reducing greenhouse gas emissions, optimizing natural resource use to cut emissions, reducing operational costs, decreasing dependency on unlimited resources to protect the environment, researching and developing new technologies to minimize greenhouse gas pollution, focusing on innovation and technological advancements for organizational improvement, mitigating environmental and regulatory risks related to climate change.
12	Use of Public Transport Aligned with the Supply Chain	Coordinating public transportation with the supply chain, optimizing resource use to reduce traffic, air pollution, and fuel consumption, cutting costs while improving efficiency, minimizing traffic congestion and road delays, better coordinating with other institutions, enhancing brand image, improving marketing efforts.
13	Optimization of Transportation Distances	Utilizing more efficient transport methods such as rail or maritime transport, reducing fuel and maintenance costs, lowering repair and transportation-related expenses, improving delivery times, increasing flexibility.
14	Expansion of Hybrid Vehicle Usage	Promoting the adoption of hybrid vehicles, improving resource efficiency through hybrid transport, enhancing competitiveness by integrating hybrid vehicle technology.
15	Utilization of Advanced Routing Systems	Optimizing routing, employing algorithms and advanced technologies for better route planning, improving inventory management, reducing waste and material loss, accurately estimating material needs, increasing transparency and traceability, strengthening supplier relationships, improving green chain sustainability, implementing intelligent routing systems, optimizing raw material management to shorten delivery times and reduce risks.
16	Selection of Sustainable Suppliers Based on Intellectual Capital	Choosing suppliers based on sustainability criteria, evaluating supplier sustainability, establishing long-term partnerships with other organizations, fostering strategic supplier relationships, increasing transparency in the supply chain, providing accurate and updated information on production processes, financial transparency, and sustainability performance, enhancing organizational value by selecting suitable suppliers.
17	Development of Relational Capital with Suppliers	Strengthening relationships with suppliers, improving processes, promoting innovation and knowledge sharing, assessing and selecting sustainable suppliers, exchanging knowledge and innovation, maintaining continuous engagement as a key factor in building a green chain, reducing supply chain risks, organizing resources for higher efficiency.
18	Measurement and Reporting of Suppliers' Green Performance	Defining evaluation criteria, focusing on energy consumption management, waste management, and sustainable raw material use, collecting data on organizational green performance, obtaining supplier reports and environmental performance evidence, collecting green certification information, conducting quantitative and qualitative assessments, benchmarking green performance against standards, using scenario modeling and dynamic analysis, reporting through textual, graphical, or numerical formats.
19	Supply Chain Risk Assessment and Management	Identifying risks, recognizing dependencies on specific suppliers or resources, monitoring environmental regulations, detecting supplier instability, identifying labor rights violations, assessing emissions and sustainability-related risks, evaluating risk impacts on product and service sustainability, considering reputational risks among stakeholders, estimating cost impacts, defining standards and criteria, complying with environmental and labor regulations, using sustainable natural resources, reducing pollutant emissions, adhering to ethical business practices, managing risks, drafting contracts based on green standards, forming strategic partnerships with sustainable suppliers, diversifying resources, utilizing modern technologies for enhanced transparency and sustainability.
20	Knowledge Transfer and Supplier Empowerment	Facilitating knowledge transfer through training, workshops, and publications, fostering two-way communication with suppliers, increasing suppliers' awareness of production processes and sustainable standards, empowering suppliers, ensuring regular interactions, establishing collaborative environments, sharing best practices, providing guidance on process optimization, emphasizing sustainable raw materials and product design, considering energy efficiency, natural resource management, and waste reduction.

21	Effective Stakeholder Communication in the Supply Chain	Understanding market expectations, providing information on product quality, pricing, and raw materials, sharing innovative capabilities and environmental concerns, evaluating and selecting sustainable suppliers, considering factors such as resource use, waste management, and labor conditions, focusing on knowledge transfer and innovation, sharing new ideas and technical expertise, increasing trust and added value for the organization.
22	Sustainability Reporting Based on Intellectual Capital	Ensuring compliance with labor rights and social justice, identifying sustainability risks, improving sustainable performance, proposing improvement programs to enhance sustainability efforts, providing training, advertising, and direct communication with suppliers, offering incentives for sustainable behavior, setting standards and benchmarks for sustainable performance, increasing transparency and trust, producing reliable and verifiable reports, creating competitive advantages.
23	Customer Relationship Management	Strengthening customer trust, providing precise and transparent information on supply chain policies, standards, and sustainability performance, addressing sustainable production methods and environmental impacts, understanding customer needs, establishing strategic customer partnerships, collaborating on sustainable product development, sharing technical knowledge, improving mutual green chain practices, serving as customer representatives, monitoring sustainable supplier performance, offering guidance on sustainability standards.
24	Continuous Green Intellectual Collaboration with Other Organizations	Exchanging information, case studies, publications, and reports, participating in joint conferences and workshops, engaging in collaborative research and development projects, forming cooperative networks, establishing shared objectives, joining specialized forums for green chain discussions, offering collaboration opportunities, sharing resources, promoting fair and sustainable resource distribution, advancing green technologies, leveraging advanced equipment for improved green chain performance, enhancing cross-organizational collaboration in green initiatives.
25	Transparency in the Supply Chain	Enhancing transparency, providing accurate and updated information on production processes, ensuring financial transparency and sustainability performance reporting.

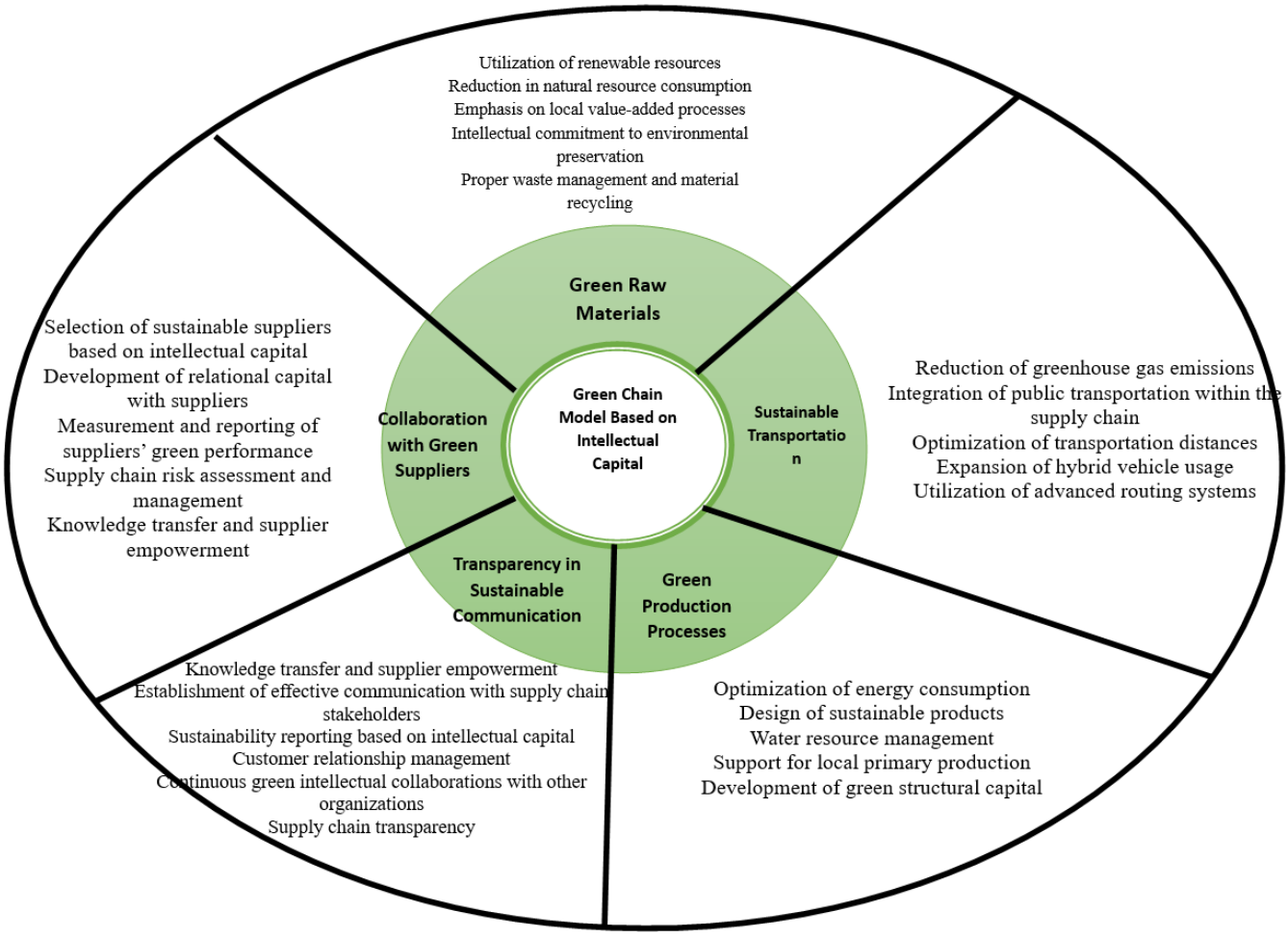

Figure 1. Final Model of The Study

4. Discussion and Conclusion

This study aimed to design an organizational green chain model based on intellectual capital. Using the thematic analysis method, the following research question was addressed.

From the thematic analysis, five dimensions were identified: green raw materials, green production processes, sustainable transportation, collaboration with green suppliers, and transparency in sustainable communication. The findings suggest that utilizing intellectual capital, including knowledge, skills, and innovations, enhances processes within the green chain. This leads to reduced resource waste and improved efficiency in transportation.

Organizations that emphasize intellectual capital often focus on employee training, increasing their awareness of the benefits and methods of sustainable transportation. Intellectual capital also drives innovation in sustainable transportation technologies, leading to optimized designs and the use of new tools that reduce emissions and enhance efficiency. Organizations adopting a green chain model can collaborate more effectively with stakeholders, suppliers, and customers, promoting best practices in sustainable transportation. Furthermore, intellectual capital enables organizations to identify and mitigate the environmental impacts of their activities, influencing strategic decisions toward more sustainable transportation options. This study aligns with the prior findings (Dahinine et al., 2024).

Additionally, in this study, intellectual capital comprises the knowledge, skills, and experience of human resources. Leveraging this capital within the green chain allows organizations to develop better resource management methods and waste reduction strategies, leading to lower operational costs. Intellectual capital also enhances transparency in communication, enabling individuals and teams to share ideas and innovations more effectively. This fosters the development of new and innovative solutions for green chain management.

Transparency in communication ensures that stakeholders (such as suppliers, customers, and social actors) are informed about the organization's operations and decisions, increasing trust in the organization. This trust facilitates sustainable and effective relationships. The findings of this study are consistent with prior studies (Khan et al., 2023; Mohsin et al., 2022; Muhammad et al., 2023; Murad & Zou, 2023).

Intellectual capital includes employees' experiences, knowledge, and skills, which contribute to process improvements and innovation in green production. Employees with strong knowledge bases can identify more sustainable and efficient production solutions. Within the green chain, optimal resource utilization and waste reduction are critical. Intellectual capital facilitates the identification and implementation of best practices and techniques to enhance process efficiency.

The adoption of green and innovative technologies requires specialized knowledge and skills. Organizations with substantial intellectual capital can more readily adopt these technologies and integrate them into their green production processes. Furthermore, intellectual capital fosters a sustainable organizational culture, positively impacting the implementation of green policies and advancing environmental objectives. The results of this study align with the prior research (Hu & Tresirichod, 2024).

Recommendations

1. Utilizing modern technologies for data collection and analysis can help identify strengths and weaknesses within the supply chain, facilitating better decision-making.
2. Designing systems for performance evaluation and feedback on environmental and social aspects can strengthen collaboration with customers and suppliers while promoting continuous improvement.
3. Collaborating with designers and engineers to develop innovative and sustainable textile products, such as eco-friendly fabrics and green sewing techniques, can enhance market acceptance.
4. Providing transparent sustainability and environmental reports to stakeholders and customers can enhance brand credibility.
5. Focusing on waste reduction in the early stages of the supply chain, such as product design, manufacturing, and packaging, is recommended. This can involve using higher-quality raw materials, improving production processes, and designing recyclable or reusable packaging.
6. Establishing efficient systems for waste collection, sorting, and recycling throughout the supply chain is advised.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

Acknowledgments

Authors thank all participants who participate in this study.

Conflict of Interest

The authors report no conflict of interest.

Funding/Financial Support

According to the authors, this article has no financial support.

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