

Parmawati, Rita; Mulyadi, Fadli; Rosyani, Rosyani et al.

Article

The role of environmental education and green supply chain practices in achieving sustainable development : evidence from Indonesia

International Journal of Energy Economics and Policy

Provided in Cooperation with:

International Journal of Energy Economics and Policy (IJEEP)

Reference: Parmawati, Rita/Mulyadi, Fadli et. al. (2023). The role of environmental education and green supply chain practices in achieving sustainable development : evidence from Indonesia. In: International Journal of Energy Economics and Policy 13 (1), S. 421 - 430.
<https://econjournals.com/index.php/ijEEP/article/download/14030/7152/32110>.
doi:10.32479/ijEEP.14030.

This Version is available at:

<http://hdl.handle.net/11159/631985>

Kontakt/Contact

ZBW – Leibniz-Informationszentrum Wirtschaft/Leibniz Information Centre for Economics
Düsternbrooker Weg 120
24105 Kiel (Germany)
E-Mail: [rights\[at\]zbw.eu](mailto:rights[at]zbw.eu)
<https://www.zbw.eu/econis-archiv/>

Standard-Nutzungsbedingungen:

Dieses Dokument darf zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden. Sie dürfen dieses Dokument nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, aufführen, vertreiben oder anderweitig nutzen. Sofern für das Dokument eine Open-Content-Lizenz verwendet wurde, so gelten abweichend von diesen Nutzungsbedingungen die in der Lizenz gewährten Nutzungsrechte.



<https://zbw.eu/econis-archiv/termsfuse>

Terms of use:

This document may be saved and copied for your personal and scholarly purposes. You are not to copy it for public or commercial purposes, to exhibit the document in public, to perform, distribute or otherwise use the document in public. If the document is made available under a Creative Commons Licence you may exercise further usage rights as specified in the licence.



The Role of Environmental Education and Green Supply Chain Practices in Achieving Sustainable Development: Evidence from Indonesia

Rita Parmawati^{1,2,3*}, Fadli Mulyadi^{1,2}, Rosyani⁴, Suaedi⁵, Yunikewaty⁶

¹Department of Socio-Economics, Faculty of Agriculture, Brawijaya University, Malang, Indonesia, ²Study Program of Agribusiness (Off-Main Campus), Brawijaya University, Kediri, Indonesia, ³Postgraduate Program, Brawijaya University, Malang, Indonesia, ⁴Department of Agribusiness, Faculty of Agriculture, University of Jambi, Indonesia, ⁵Cokroaminoto University, Palopo, South Sulawesi, Indonesia, ⁶Faculty of Economics and Business, Palangka Raya University, Indonesia. *Email: rita_parmawati@ub.ac.id

Received: 30 October 2022

Accepted: 08 January 2023

DOI: <https://doi.org/10.32479/ijeeep.14030>

ABSTRACT

Globally, environmental education and green supply chain (GSC) practices are considered essential elements for sustainable development, and this aspect needs new literature and policymakers' attention. Hence, the present article examines the impact of GSC practices on the sustainable development of manufacturing organizations in Indonesia. The article also investigates the moderating role of environmental education among green purchasing, IEM, and sustainable development in manufacturing organizations in Indonesia. The study applies primary data collection technologies such as survey questionnaires to gather primary data from respondents. The study also applies the smart-PLS to test the association among variables. The outcomes revealed that eco-design, green purchasing, and IEM have a positive linkage with sustainable development in manufacturing organizations in Indonesia. The outcomes also exposed the environmental education significantly moderating among green purchasing, IEM, and sustainable development in ABC organizations in Indonesia. The article guides the regulators in developing regulations regarding sustainable development using GSC practices and environmental education.

Keywords: GSC Practices, Eco-design, Green Purchasing, Environmental Education, Sustainable Development

JEL Classifications: H52, I25, Q01, Q56, F64

1. INTRODUCTION

The natural environment in recent years has become a major issue. The increase in global warming has exposed the world's sustainability to extreme danger. The economy of the world has developed over the last few decades. Thus people are ignoring the ecological protection of the environment and focusing more on economic development benefits (Abdul Hamid et al., 2020; Effendi et al., 2021). Environmental issues are becoming intense due to the increase in industrial and human impact on the environment. The situation worsens as natural resources decrease and environmental issues increase (Ali et al., 2022; Ta et al., 2020). Researchers,

scientists, and practitioners are trying to introduce various ways to preserve environmental sustainability (Ainou et al., 2022; Tseng et al., 2019). Environmental concerns and the integration of green practices in supply chain SC are gaining more attention in the literature. This interest can be seen in the efforts by various firms and governments worldwide to eradicate the impact of climate and environmental change.

Companies are now focusing more on reducing environmental impact by introducing environmental concerns in GSC operations (Bai et al., 2022; Tseng et al., 2019). GSC Management assists in coordinating and integrating strategy alignment and various

business processes across the supply chain to satisfy the end customers. Strategic imperatives that need to be integrated include efficiency, customer focus, responsiveness and quality, and environmental sustainability. Introducing environmentally friendly services, processes and products needs undivided endeavor from all the characters of GSC to avert sub-optimization at different levels (Chien et al., 2022b; Vasileiou and Morris, 2006). When a company involves itself in green production or output, it is known as a green business, having an accurate mixture of commitment towards the environment, humanity, profitability, and sustainability (Chien, 2022a; Verma et al., 2018).

However, the addition of “green” in SC assists the relation and influence between the natural environment and the Supply chain. In the current era, multinational companies worldwide are concentrating on GSC due to their strategic benefits and long-lasting impacts. Global competition has elevated firms’ interest in decreasing costs and improving the sustainable environment (Chien et al., 2022c; Jermisittiparsert et al., 2019). According to Srivastava (2007), GSC induces environmental thinking into SC, including designing products, material selection and sourcing, manufacturing, and providing the end product to the customers. The implementation of GSC may generate various environmental benefits, i.e., minimizing the level of carbon emission, increasing the recycled and reused materials, saving energy usage, and decreasing waste production (Chien, 2022d; Balasubramanian and Shukla, 2017). However, cost minimization is the most significant advantage. If the manufacturing sector effectively implements green strategies, then the cost of operational activities will reduce. Therefore, implementing GSC can positively impact a firm’s economic performance by increasing its profits, sales, and market share. To enhance organizational performance, environmental and economic performance, which can give long-term benefits to green practices, should be considered (Haroon et al., 2021; Wiguna et al., 2021). A previous study by Diabat and Govindan (2011) has highlighted that GSC practices consist of recycling, reusing material, green design, minimizing energy consumption, and reverse logistics. While Wu et al. (2011) argued that green practices comprise green innovation, green purchasing, cleaner production, and internal service quality. On the other hand, Zhu et al. (2005) also claimed that green practices involve selling used material and scrap, total quality management, commitment and coordination among senior management, and the environmental auditing process. The lucrative integration of social, environmental, and economic sustainability objectives has foresighted the leading operations and supply chain management (Fahimniam et al., 2015). According to Lee and Ha (2020), a sustainable supply chain can be introduced by managing information, support and operations by focusing on social and environmental problems to enhance the benefits of the entire chain.

Researchers have highlighted different practices creating environmental challenges for the organizational entity and have developed supportive and green practices to eradicate the negative impacts of business activities (Dian et al., 2022; Kamarudin et al., 2021). However, research analyzing the role of GSC practices in developing countries has not been done extensively. There are various green practices, i.e., internal environment management,

green purchase, eco-design, investment recovery, reverse logistics, and cooperation and coordination among SC actors, which are used in GSC but in this study, we are focusing on one of the three practices and their impact on sustainable development of society. There is not much research on these three green practices, i.e., eco-design, green purchasing, and IEM, and their relationship with sustainable development in the Indonesian market (Khattak et al., 2021). To fill this gap, this study provides the holistic framework of GSC practices in the Indonesian market. This involves the impact of GSC practices such as eco-design, green purchasing, and IEM in accomplishing SD. This study also evaluates the moderating impact of environmental education on green purchasing and the internal environment.

The study is structured in following manner. First, in chapter two, the literature review and hypothesis development are discussed. In chapter three, data techniques and other methodologies are defined followed by the discussion and analysis of the results in chapter four. Lastly, the study conclusion is done in chapter five.

2. LITERATURE REVIEW

The article scrutinizes the role of eco-design, green purchasing, and IEM on SD and also explores the environmental education as a moderator in the context of Indonesia. In the current era of the competitive environment, the preservation and preservation of natural resources are becoming important for decision-makers and business operators (Lan et al., 2022; Lin et al., 2022). Jung et al. (2018), has stated that for a brighter future, firms should have a sustainability perspective following SGD as it develops strong relations with stakeholder creating higher productivity of employees and minimizing the cost of conflicts. Feng et al. (2018), have stated that coordination between SC partners (suppliers and customers) and focal firms is essential to integrate GSC practices successfully. Organizations can voluntarily implement GSC practices to enter the market, meet the demands of employees, achieve a competitive edge, and develop a corporate image (Agyabeng-Mensah et al., 2020; Liu et al., 2022a). They were integrating the idea of green in production SC assists in adopting a world view where supply chain and environmental activities are handled carefully to make the world greener. Various firms in emerging Asian economies are moving towards GSC and working hard to achieve the eco-friendly economy vision (Jawaad and Zafar, 2020; Liu et al., 2022b). The GSC concept is a multidisciplinary concern that arises from operating practices of environmental management in the context of SC. Environmental management focuses on how firms minimize the effects of their operations’ negative environment (Eltayeb and Zailani, 2014; Moslehpour et al., 2022a). GSC practices also focus on recycling, reusing, or disposal of goods to avert the impact of damage on the environment. GSC practices propose, execute, and control various practices that help firms be sustainable and socially responsible through environmental protection (Moslehpour et al., 2022b; Santoso et al., 2022). The literature section has embarked on the impact of GSC practices on sustainable development and the role of environmental education as a moderator between green purchasing and IEM.

2.1. Eco-design and Sustainable Development

The eco-design importance was acknowledged when Büyüközkan and Çifçi (2012) analyzed that 80% of environmental impact caused by product can be influenced in the design phase. Eco-design, also known as green design and design for the environment, refers to the product development actions aiming at reducing the environmental impact of the product during its life cycle, i.e., sourcing material, to production and its final distribution, without compromising the criteria of various products such as cost and performance (Johansson, 2002). Eco-design has two main categories: packaging-related design and product-related design. It has been mentioned that the opportunity for cost saving is greater at the initial phase of SC, so the buying firms must look for opportunities to use reused or recycled components. Therefore, the organization needs to ensure that its products' content can be recycled or reused (Laosirihongthong et al., 2013; Moslehpour et al., 2022c). Yung et al. (2012), highlighted that eco-design practice covers the activities from selecting raw materials to the final stage of the product life cycle. Eco-design practices are considered one of the GSC initiatives as they deploy various aspects of the environment into the process of product design, considering the thorough flow of products in SC (Eltayeb and Zailani, 2014; Sadiq et al., 2022a). It has been mentioned earlier that Eco-design is acknowledged as an effective mechanism for SSC activities (Sadiq et al., 2022a; Thamsatitdej et al., 2017). Hence, numerous environmental impacts occurred during the design phase due to various product features. For achieving SSC, the design activity phase having sustainable development concerns is important. Thamsatitdej et al. (2017), have identified five dimensions of eco-design in their research study, such as designing raw materials, clean manufacturing, green packaging, distribution design, design of product deployment, and reverse logistics. The success of eco-design needs internal inter-functional coordination and cooperation of the entire firm, plus external collaboration and coordination with other partners in their SC (Sadiq et al., 2022b; Zhu and Sarkis, 2006). Therefore, eco-design plays a significant role in implementing sustainability practices in the supply chain.

Hypothesis 1: Eco-design and Sustainable development are positively related to each other.

2.2. Green Purchasing and Sustainable Development

For GSC activities, a company should prefer to procure raw materials, which plays an important role in eradicating the environmental footprints (Jermisittiparsert et al., 2019; Sadiq et al., 2022c). Green Procurement or purchasing is considered a significant factor in GSC, which must be eco-friendly. Green Purchasing (GP) is the process of purchasing that tries to ensure that purchased materials or products accommodate the objectives of environmental sustainability determined by purchasing companies, such as promoting recycling, resource reduction, reuse, and decreasing source wastage (Eltayeb and Zailani, 2014; Sadiq et al., 2022d). The firms work closely with their suppliers to introduce environmentally friendly products. Santoso et al. (2022) have highlighted in their study that GP can also enhance the product value alone and also assists firms in improving their environmental image. In addition, GP allows firms to coordinate with suppliers to create SC activities upstream and downstream,

causing efficiency in the firm's operations. GP indicates that rather than using conventional purchasing criteria of quality, cost, and delivery, SC managers or purchasing firms should consider sustainability in their process of purchasing inputs. In the manufacturing industry, strong association with suppliers' aids in the adoption and integration of cutting-edge environmental technologies. Thus suppliers play an important role in enhancing the environmental health of a firm (Jawaad and Zafar, 2020; Tan et al., 2021). However, choosing the right and suitable supplier has an important impact on an organization's environmental goals. For improving environmental performance, selecting the right supplier is not enough (Cankaya and Sezen, 2018; Zhao et al., 2021). Once the right supplier has been chosen, the supply process should be managed through a collaborative and strategic perspective with the suppliers. Moreover, it is also crucial to analyze whether either supplier is meeting the organization's criteria while managing and selecting the supplier (Paulraj, 2011; Zhao et al., 2022). Indicators that should be considered while green purchasing are: procuring environmentally friendly products, giving priority should be given to those suppliers who have a proper environmental management system, suppliers should have certification of ISO 14001, and prioritize recyclable (Santoso et al., 2022; Shibli et al., 2021). Hence green purchasing is used as a valuable tool to eradicate environmental damage, integrating clean production techniques and enhancing the sustainable development of the supply chain.

Hypothesis 2: Green Purchasing and Sustainable development are positively related to each other.

2.3. IEM and Sustainable Development

An internal environment management system IEM considers the personnel who act as aids and personnel support in an innovative way, such as through new activities, programs, and introducing innovative and latest technologies (Jawaad and Zafar, 2020; Ojogiwa, 2021). Jermisittiparsert et al. (2019), stated that IEM indicates firms' environmental protection policies and targets to check the environment's safety. Many organizations have actively integrated the GSC practices of IEM. Zhu et al. (2010), have highlighted various perspectives of IEM, such as the senior manager's commitment regarding GSC, the mid-level manager's support, and auditing management and environmental compliance. IEM practices ensure the support for the practices regarding environment management from each managerial manager. Environmental success can only be gained if top management is committed and fully dedicated to ensuring and regulating environmental issues (Jawaad and Zafar, 2020; Wirsbinna and Grega, 2021). The cooperation and coordination between various departments related to building a system and environmental improvements can also be achieved through IEM. Liu et al. (2012), also claimed in their study that top management support is important in implementing and introducing innovative ideas, especially concerned with environmental management. GSC practices need coordination; for example, producing new products regulated with a green concept would demand customer collaboration for integrating their requirements while the product is in the design process. IEM requires a huge deal of coordination. Just In Time (JIT) and Total Quality Management (TQM) are considered the internal factors of the environment

and are significantly linked with GSC practices and help in advancing the green practices of firms (Jermisittiparsert et al., 2019; Jermisittiparsert, 2021). Sustainable SC requires awareness about green practices for their environmentally friendly function. Hence internal environment management plays a crucial role in achieving sustainable development goals.

Hypothesis 3: IEM and Sustainable Development are positively related to each other.

2.4. Moderating Role of Environmental Education

Environmental Education is considered one of the significant tools is paving the way for introducing a sustainable society. Previous studies have highlighted the importance of environmental education concerning green practices for the success of firms (Cankaya and Sezen, 2018). In this section, we will study the moderator role of environmental education between green purchasing and IEM. It has been mentioned that two significant purposes have been served through environmental education (Hartani et al., 2021; Sammalisto and Brorson, 2008). First is to guide the environmental policies of the firms to personnel, and second is to modify the individual behaviors to develop responsible and permanent relations with the environment. Integrating development and environmental education into society has become essential for green practices. While purchasing, firms should have an idea that it should not negatively affect the environment. So before purchasing, they must have an environmental education regarding green purchasing, and organizations should consider recycling or reusing goods. All the members of SC should participate and take responsibility through their efforts to meet green practices to achieve long-term benefits and profits (Jermisittiparsert et al., 2019). Therefore, environmental education act as a moderator between green purchasing and internal environment education. GSC practices derived advantages from environmental education because of skill development tactics, employee involvement, team building, and team effort to share and communicate inclusive knowledge. These practices are decentralized and based on difficult skills to duplicate or copy (Suryanto et al., 2018). Thus, when organizations on the internal level, have the awareness or knowledge of sustainability, only then will they be able to implement green practices in their SC activities, such as green purchasing or green procurement. Therefore, to be aware of green purchasing and its criteria, the IEM firm needs to have environmental information.

Hypothesis 4: Environmental education moderates the relationship of green purchasing with sustainable development.

Hypothesis 5: Environmental education moderates the relationship of IEM with sustainable development.

3. METHODOLOGY

The paper evaluates eco-design, green purchasing, and IEM and their effectiveness on SD and also investigates environmental education as a moderator in Indonesian context. The study applies primary data collection technologies to collect first hand data from respondents. The study adopted the items from prior studies. These items are extracted from past studies such as SD has five items taken from Jabbour et al. (2020), environmental education

measured with five items taken from Boca and Saraçlı (2019), eco-design has three items taken from Green, Inman, Sower, and Zelbst (2018), green purchasing has six items extracted from Green, Zelbst, Meacham, and Bhadauria (2012) and IEM has seven items, adopted from Green et al. (2018). Table 1 provides the detail of measurement constructs.

The study selected the employees of manufacturing organization as the respondents. These respondents have been selected using purposive sampling because the purpose of the study is to collect data from employees who have enough awareness of the environment. The survey was sent using personal visits. A total of 534 surveys were distributed but received only 292 surveys representing around 54.68 percent response rate. Moreover, the study also applies the smart-PLS to test the association among variables. It is a useful tool for primary data analysis because it evaluates both small and large data sets effectively (Hair et al., 2017). In addition, the study used three dimensions of GSC practices as independent variables such as eco-design (ED), green purchasing (GP), and IEM. Moreover, the study used environmental education (EE) as the moderator and sustainable development (SD) as the dependent variable. These variables are presented in Figure 1.

4. RESEARCH FINDINGS

The outcomes indicated that Alpha and composite reliability values are > 0.7 . These values reported valid convergent validity. In addition, the outcomes also indicated that factor loadings and average variance extracted values are > 0.5 . These values reported valid convergent validity (Table 2).

The outcomes indicated that the figures indicated the connection with the construct itself are larger than the figures that showcase the connection with other constructs. Hence, the values indicate valid discriminant validity (Table 3).

The outcomes indicated that the figures indicated the connection with the construct itself are larger than the values which indicates the connection with other constructs (Table 4). This ensures valid measurement.

The outcomes show the discriminant validity that shows the correlation among variables. The outcomes indicated that the figures of the Heterotrait Monotrait (HTMT) ratio are lower than 0.85. These values reported valid discriminant validity. These

Figure 1: Theoretical model

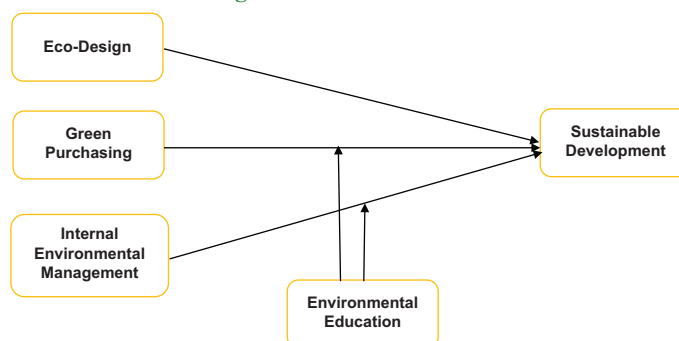


Table 1: Variables and measurements

Items		Sources
Sustainable Development		
SD1	My firm reduced emissions of polluting gases.	(Jabbour et al., 2020)
SD2	My organization reduced waste generation.	
SD3	My firm reduced hazardous materials consumption.	
SD4	My firm decreased environmental accident frequency.	
SD5	My organization increased natural resources' efficient use.	
Environmental Education		
EE1	My firm educates me about the air pollution effects on the environment and people.	(Boca and Saraçlı, 2019)
EE2	My firm also educates me about the air pollution effects on employees.	
EE3	My firm educates me about the factory wastes cause environmental pollution.	
EE4	My firm worries about environmental pollution.	
EE5	I am afraid of environmental pollution.	
Eco-design		
ED1	My firm developed the product's design that reduced energy and material consumption.	(Green et al., 2018)
ED2	My firm developed the products' design for the recovery of material.	
ED3	My firm developed the product's design that avoids using hazardous products.	
Green Purchasing		
GP1	My firm used the eco-labeling of products.	(Green et al., 2012)
GP2	My organization always cooperates with suppliers for environmental management.	
GP3	My firm conducted an environmental audit of suppliers regularly.	
GP4	My firm always selects suppliers who have ISO 14000 certification.	
GP5	My firm always evaluates environmentally friendly practices.	
GP6	My firm always required environmentally friendly features in purchased items.	
Internal Environmental Management		
IEM1	Senior managers are committed to GSCM.	(Green et al., 2018)
IEM2	Mid-level managers support the implementation process of GSCM.	
IEM3	My firm developed cross-functional cooperation for the improvement of the environment.	
IEM4	My firm strives for quality environmental management.	
IEM5	My organization organized environmental auditing programs.	
IEM6	My firm gets the ISO 14001 certification.	
IEM7	My organization implements environmental management systems.	

Table 2: Convergent validity

Variables	Items	Loadings	Alpha	CR	AVE
Eco-design	ED1	0.815	0.899	0.939	0.837
	ED2	0.961			
	ED3	0.961			
Environmental Education	EE1	0.853	0.917	0.938	0.751
	EE2	0.881			
	EE3	0.877			
	EE4	0.823			
	EE5	0.897			
Green Purchasing	GP1	0.943	0.97	0.976	0.87
	GP2	0.92			
	GP3	0.952			
	GP4	0.927			
	GP5	0.904			
	GP6	0.949			
Internal Environmental Management	IEM1	0.84	0.924	0.939	0.688
	IEM2	0.892			
	IEM3	0.799			
	IEM4	0.803			
	IEM5	0.803			
	IEM6	0.766			
	IEM7	0.894			
Sustainable Development	SD1	0.868	0.87	0.906	0.659
	SD2	0.718			
	SD3	0.856			
	SD4	0.785			
	SD5	0.824			

Table 3: Fornell larcker

	ED	EE	GP	IEM	SD
ED	0.915				
EE	0.394	0.867			
GP	0.490	0.415	0.933		
IEM	0.426	0.427	0.467	0.829	
SD	0.458	0.369	0.421	0.460	0.812

values are given in Table 5. Measurement model assessment results are presented in Figure 2.

The article examines the impact of eco-design, green purchasing, and IEM on SD and also expose environmental education as a moderator on the relationship among green purchasing, IEM, and sustainable development in manufacturing organizations in Indonesia. The outcomes revealed that eco-design, green purchasing, and IEM have a positive linkage with sustainable development in ABC organizations in Indonesia, hence support H1, H2 and H3. Moreover, findings also claim that the environmental education significantly moderates the relation of green purchasing, IEM with sustainable development in ABC organizations in Indonesia, hence support H4 and H5 (Table 6). Structural model assessment results are presented in Figure 3.

Finally, the outcomes also exposed the environmental education significantly moderating among green purchasing, IEM, and sustainable development in ABC organizations in Indonesia and accept H4 and H5. These values are given in Figure 4.

Figure 2: Measurement model assessment

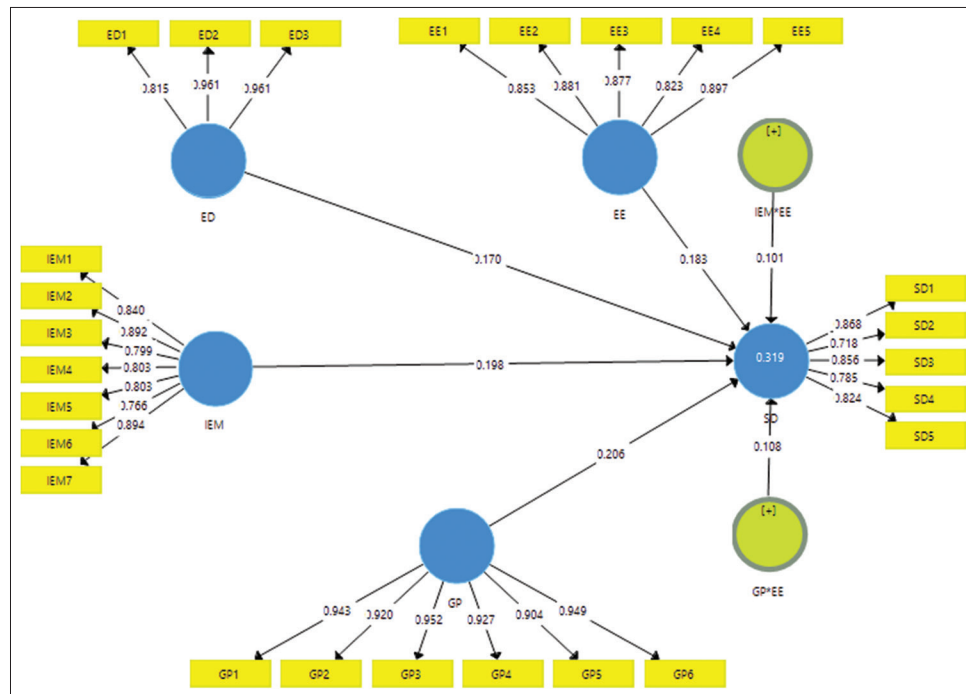


Figure 3: Structural model assessment

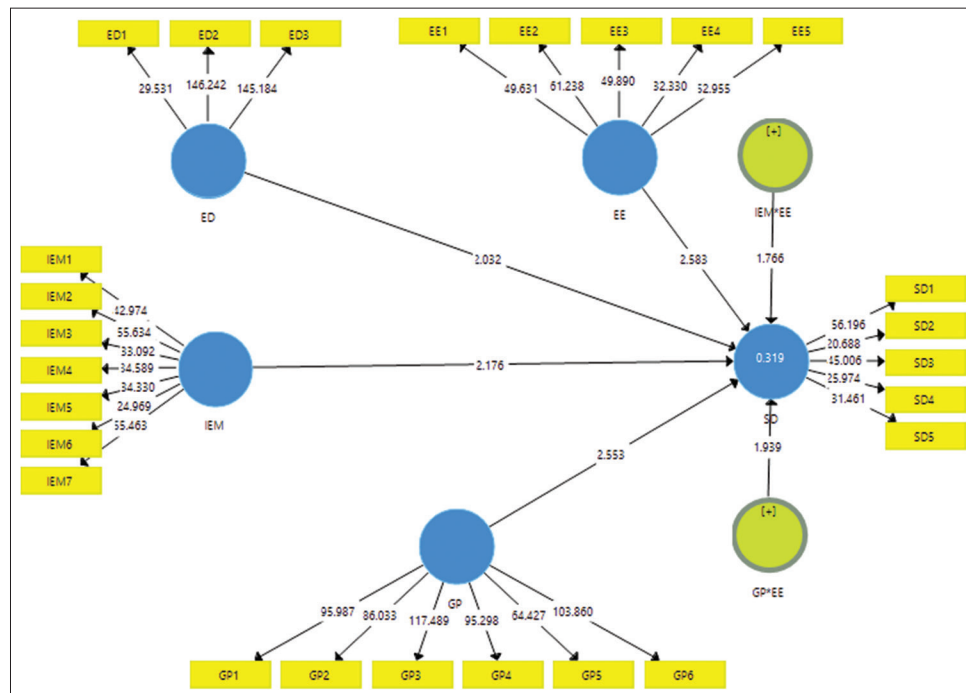


Figure 4: Moderation analysis

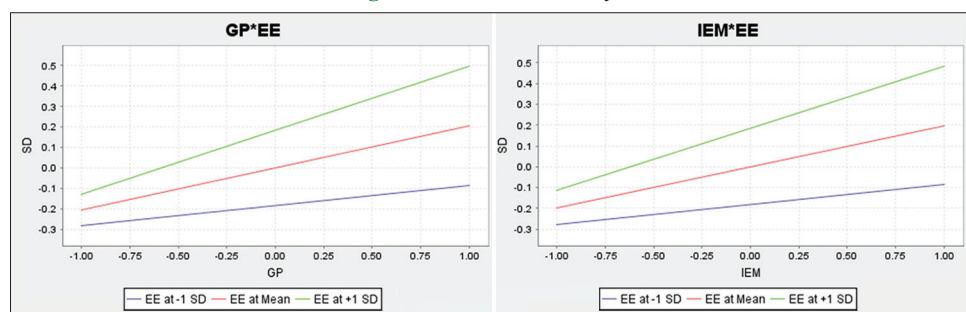


Table 4: Cross-loadings

	ED	EE	GP	IEM	SD
ED1	0.815	0.327	0.459	0.767	0.400
ED2	0.961	0.374	0.442	0.749	0.430
ED3	0.961	0.377	0.444	0.749	0.426
EE1	0.314	0.853	0.355	0.325	0.334
EE2	0.357	0.881	0.354	0.389	0.339
EE3	0.324	0.877	0.348	0.355	0.330
EE4	0.373	0.823	0.378	0.398	0.289
EE5	0.342	0.897	0.368	0.391	0.304
GP1	0.456	0.387	0.943	0.433	0.369
GP2	0.448	0.414	0.920	0.439	0.388
GP3	0.462	0.384	0.952	0.443	0.374
GP4	0.459	0.400	0.927	0.431	0.410
GP5	0.456	0.356	0.904	0.426	0.430
GP6	0.460	0.381	0.949	0.438	0.373
IEM1	0.749	0.346	0.405	0.840	0.441
IEM2	0.672	0.374	0.353	0.892	0.365
IEM3	0.650	0.353	0.327	0.799	0.278
IEM4	0.708	0.351	0.455	0.803	0.433
IEM5	0.678	0.353	0.391	0.803	0.354
IEM6	0.630	0.332	0.390	0.766	0.386
IEM7	0.676	0.373	0.354	0.894	0.363
SD1	0.416	0.308	0.339	0.413	0.868
SD2	0.244	0.213	0.328	0.246	0.718
SD3	0.397	0.306	0.397	0.425	0.856
SD4	0.370	0.333	0.316	0.358	0.785
SD5	0.406	0.326	0.329	0.397	0.824

Table 5: Heterotrait Monotrait ratio

	ED	EE	GP	IEM	SD
ED					
EE	0.435				
GP	0.526	0.441			
IEM	0.503	0.466	0.487		
SD	0.511	0.408	0.457	0.496	

Table 6: Path analysis

Relationships	Beta	Standard deviation	T statistics	P values
ED -> SD	0.170	0.084	2.032	0.022
EE -> SD	0.183	0.071	2.583	0.006
GP -> SD	0.206	0.081	2.553	0.006
GP*EE -> SD	0.108	0.056	1.939	0.028
IEM -> SD	0.198	0.091	2.176	0.016
IEM*EE -> SD	0.101	0.057	1.766	0.040

5. DISCUSSION

The article examines the direct impact of eco-design, green purchasing, and IEM on SD and also investigates environmental education as a moderator on outlined relationship in Indonesian context. Findings exposed that eco-design and sustainable development are positively related. Results are supported by Monteiro et al. (2019) that articulates that when the firms adopt a policy of eco-designing, their intention is to use clean, easy-to-use, and recycled material, apply production processes that may not damage products' quality, and avoid waste emissions after the production level. This not only provides eco-friendly products but creates an eco-friendly context in the organization. Thus, it gives rise to sustainable development. These results are also in line with

the study of Perpignan et al. (2020). The previous study posits that in a supply chain, organizations are interlinked. One's strategies affect those of others. If one firm implements eco-designing, it assures sustainable development of all firms across the chain.

Findings also exposed the positive role of green purchasing on SD. Findings are consistent with Zhang and Dong (2020), which highlights that green purchasing reduces solid waste generation, greenhouse gas emissions, and energy use. Reducing expenses, enhancing the company's reputation, and enhancing staff wellness, can also increase an organization's bottom line. Hence, it is possible to achieve sustainable development. These results are also in line with the study of Shao and Ünal (2019). According to this previous study, in the economy where green purchasing is being encouraged, the resources and environment can be preserved in order to sustain economic development.

The results revealed that IEM has a positive association with sustainable development. These results are in line with the study of Ikram et al. (2019), which posits that when the firms in a chain internally regulate their activities to have eco-friendly outcomes, it is more likely for them to follow eco-friendly principles from chain management. The improvement in internal and external environmental management reduces pressure on the natural environment and preserves resources for SD. Findings are in line with Fatimah et al. (2020) that highlights that the effectiveness of IEM assures environmental preservation for future use. Hence, it enables the economy to have SD.

Results showcase that environmental education as a moderator plays significant role between green purchasing and SD. Findings show consistency with Cillo et al. (2019), that posits that environmental education enables organizational personnel to recognize green products and undertake green purchasing. So, environmental education develops awareness of sustainable development and, with green purchasing, helps achieve it. These results are also in line with the study of Kopnina (2019), which indicates that environmental education develops the capability for green purchasing and thereby, assure the achievement of sustainable development.

The results showed that environmental education as a moderator plays significant role between IEM and Sd. Results are in line with Agbedahin (2019), indicating that when administrators have thorough environmental education, they can implement IEM effectively and achieve SD. So, it strengthens the association between IEM and SD. Findings are consistent with Bascopé et al. (2019) that indicates that environmental education improves IEM and SD. So, environmental education improves the relationship between IEM and SD.

6. CONCLUSION

The present study objective was to examine the influences of GSC practices like eco-design, green purchasing, and IEM on sustainable development. It was also to analyze the role of environmental education between green purchasing and IEM and SD. The researchers acquired empirical data about GSC practices like

eco-design, green purchasing, IEM, environmental education, and sustainable development from Indonesia. The results revealed that there is a positive association between GSC practices like eco-design, green purchasing, IEM, and SD. Findings indicated that the struggle for eco-designing minimizes environmental pollution because of eco-friendly production processes. It leads to sustainable development. The results also showed that the eco-purchasing reduces the environmental emissions from different business departments. So, with environmental protection, sustainable development is possible. The results also showed that if IEM is effective, it assures environmental preservation making the economy have sustainable development. The study also concluded that environmental education is a significant moderator that makes the outlined relation stronger in positive manner. Therefore, it accelerates progress to sustainable development.

6.1. Implications

The present study has many empirical implications as well. It provides a guideline on how to achieve sustainable development. The study guides that GSC management must make the firms follow eco-designing in order to attain sustainable development. The study also guides that GSC management must ensure green purchasing across the chain in order to ensure sustainable development. The article guides the regulators in developing regulations regarding sustainable development using GSC practices and environmental education. The study provides a guideline that the firms within the chain must implement IEM so that SD can be achieved. The study also conveys that government must encourage environmental education among the public, and the firms should also ensure environmental education for the employees. This would be helpful to implement GSC practices like green purchasing and IEM and achieve SD.

6.2. Limitations

The current also has some limitations. These limitations are likely to be overcome in future work if authors show extra effort. The study examines only the influences of GSC practices, including eco-design, green purchasing, and IEM, on sustainable development. The factors such as human resource management, corporate social responsibility, green investment, etc., can play a critical role in achieving sustainable development. So, it is up to researchers.

they must also analyze these factors for the correct evaluation of sustainable development for a country. The results of the previous are extracted utilizing the data from a developing country Indonesia. So, the study may not be valid in other countries. In order to generalize the research, authors conduct it in both developed and developing countries.

REFERENCES

Abdul Hamid, B., Azmi, W., Ali, M. (2020), Bank risk and financial development: Evidence from dual banking countries. *Emerging Markets Finance and Trade*, 56(2), 286-304.

Agbedahin, A.V. (2019), Sustainable development, education for sustainable development, and the 2030 agenda for sustainable development: Emergence, efficacy, eminence, and future. *Sustainable*

Development, 27(4), 669-680.

Agyabeng-Mensah, Y., Ahenkorah, E., Afum, E., Agyemang, A.N., Agnigbe, C., Rogers, F. (2020), Examining the influence of internal green supply chain practices, green human resource management and supply chain environmental cooperation on firm performance. *Supply chain management: An International Journal*, 585, 599-614.

Ainou, F.Z., Ali, M., Sadiq, M. (2022), Green energy security assessment in Morocco: green finance as a step toward sustainable energy transition. *Environmental Science and Pollution Research*, <https://doi.org/10.1007/s11356-022-19153-7>

Ali, M., Ibrahim, M.H., Shah, M.E. (2022), Impact of non-intermediation activities of banks on economic growth and volatility: An evidence from OIC. *The Singapore Economic Review*, 67(1), 333-348.

Bai, X., Wang, K.T., Tran, T.K., Sadiq, M., Trung, L.M., Khudoykulov, K. (2022), Measuring China's green economic recovery and energy environment sustainability: Econometric analysis of sustainable development goals. *Economic Analysis and Policy*, 75, 768-779.

Balasubramanian, S., Shukla, V. (2017), Green supply chain management: An empirical investigation on the construction sector. *Supply chain management: An International Journal*, 5, 9-14.

Bascopé, M., Perasso, P., Reiss, K. (2019), Systematic review of education for sustainable development at an early stage: Cornerstones and pedagogical approaches for teacher professional development. *Sustainability*, 11(3), 719-738.

Boca, G.D., Saraçlı, S. (2019), Environmental education and student's perception, for sustainability. *Sustainability*, 11(6), 1-18.

Büyükoğkan, G., Çifçi, G. (2012), Evaluation of the green supply chain management practices: A fuzzy ANP approach. *Production Planning and Control*, 23(6), 405-418.

Cankaya, S.Y., Sezen, B. (2018), Effects of green supply chain management practices on sustainability performance. *Journal of Manufacturing Technology Management*, 8, 99-114.

Chien, F. (2022a), How renewable energy and non-renewable energy affect environmental excellence in N-11 economies? *Renewable Energy*, 196, 526-534.

Chien, F. (2022d), The mediating role of energy efficiency on the relationship between sharing economy benefits and sustainable development goals (Case Of China). *Journal of Innovation and Knowledge*, 78, 100270.

Chien, F., Chau, K.Y., Sadiq, M., Hsu, C.C. (2022c), The impact of economic and non-economic determinants on the natural resources commodity prices volatility in China. *Resources Policy*, 78, 102863.

Chien, F., Hsu, C.C., Sibghatullah, A., Hieu, V.M., Phan, T.T.H., Tien, N.H. (2021), The role of technological innovation and cleaner energy towards the environment in ASEAN countries: Proposing a policy for sustainable development goals. *Economic Research-Ekonomska Istraživanja*, 2016463. <https://doi.org/10.1080/1331677X.2021.2016463>

Chien, F., Zhang, Y., Sharif, A., Sadiq, M., Hieu, M.V. (2022b), Does air pollution affect the tourism industry in the USA? Evidence from the quantile autoregressive distributed lagged approach. *Tourism Economics*, <https://doi.org/10.1177/13548166221097021>

Cillo, V., Petruzzelli, A.M., Ardito, L., Del Giudice, M. (2019), Understanding sustainable innovation: A systematic literature review. *Corporate Social Responsibility and Environmental Management*, 26(5), 1012-1025.

Diabat, A., Govindan, K. (2011), An analysis of the drivers affecting the implementation of green supply chain management. *Resources, Conservation and Recycling*, 55(6), 659-667.

Dian, W., Pambudi, W., Leonardus, S., Sukrisno, S., Kundori, K. (2022), The mediating role of environmental sustainability between green human resources management, green supply chain, and green business: A conceptual model. *Uncertain Supply Chain Management*,

- 10(3), 933-946.
- Effendi, M.I., Widjanarko, H., Sugandini, D. (2021), Green supply chain integration and technology innovation performance in SMEs: A case study in Indonesia. *The Journal of Asian Finance, Economics and Business*, 8(4), 909-916.
- Eltayeb, T., Zailani, S. (2014), Going green through green supply chain initiatives toward environmental sustainability. *Operations and Supply Chain Management: An International Journal*, 2(2), 93-110.
- Fahimnia, B., Sarkis, J., Davarzani, H. (2015), Green supply chain management: A review and bibliometric analysis. *International Journal Production Economics*, 162, 101-114.
- Fatimah, Y.A., Govindan, K., Murniningsih, R., Setiawan, A. (2020), Industry 4.0 based sustainable circular economy approach for smart waste management system to achieve sustainable development goals: A case study of Indonesia. *Journal of Cleaner Production*, 269, 1222-1247.
- Feng, M., Yu, W., Wang, X., Wong, C. Y., Xu, M., Xiao, Z. (2018), Green supply chain management and financial performance: The mediating roles of operational and environmental performance. *Business Strategy and the Environment*, 27(7), 811-824.
- Green, K.W., Inman, R.A., Sower, V.E., Zelbst, P.J. (2018), Impact of JIT, TQM and green supply chain practices on environmental sustainability. *Journal of Manufacturing Technology Management*, 30(1), 26-47.
- Green, K.W., Zelbst, P.J., Meacham, J., Bhaduria, V.S. (2012), Green supply chain management practices: Impact on performance. *Supply chain management: An International Journal*, 17(3), 290-305.
- Hair, J.F., Hult, G.T.M., Ringle, C.M., Sarstedt, M., Thiele, K.O. (2017), Mirror, mirror on the wall: A comparative evaluation of composite-based structural equation modeling methods. *Journal of the Academy of Marketing Science*, 45(5), 616-632.
- Harooun, O., Ali, M., Khan, A., Khattak, M.A., Rizvi, S.A.R. (2021), Financial market risks during the COVID-19 Pandemic. *Emerging Markets Finance and Trade*, 57(8), 2407-2414.
- Hartani, N.H., Haron, N., Tajuddin, N.I.I. (2021), The impact of strategic alignment on the sustainable competitive advantages: Mediating role of it implementation success and it managerial resource. *International Journal of eBusiness and eGovernment Studies*, 13(1), 78-96.
- Ikram, M., Zhou, P., Shah, S., Liu, G. (2019), Do environmental management systems help improve corporate sustainable development? Evidence from manufacturing companies in Pakistan. *Journal of Cleaner Production*, 226, 628-641.
- Jabbour, C.J.C., Seuring, S., de Sousa Jabbour, A.B.L., Jugend, D., Fiorini, P.D.C., Latan, H., Izeppi, W.C. (2020), Stakeholders, innovative business models for the circular economy and sustainable performance of firms in an emerging economy facing institutional voids. *Journal of Environmental Management*, 264, 110416.
- Jawaad, M., Zafar, S. (2020), Improving sustainable development and firm performance in emerging economies by implementing green supply chain activities. *Sustainable Development*, 28(1), 25-38.
- Jermisittiparsert, K. (2021), Linkage between energy consumption, natural environment pollution, and public health dynamics in ASEAN. *International Journal of Economics and Finance Studies*, 13(2), 1-21.
- Jermisittiparsert, K., Siriattakul, P., Sangperm, N. (2019), Predictors of environmental performance: Mediating role of green supply chain management practices. *International Journal of Supply Chain Management*, 8(3), 877-888.
- Jermisittiparsert, K., Siriattakul, P., Wattanapongphasuk, S. (2019), Determining the environmental performance of Indonesian SMEs influence by green supply chain practices with moderating role of green HR practices. *International Journal of Supply Chain Management*, 8(3), 59-70.
- Johansson, G. (2002), Success factors for integration of ecodesign in product development: A review of state of the art. *Environmental Management and Health*, 2, 9-21.
- Jung, S., Nam, C., Yang, D.H., Kim, S. (2018), Does corporate sustainability performance increase corporate financial performance? Focusing on the information and communication technology industry in Korea. *Sustainable Development*, 26(3), 243-254.
- Kamarudin, F., Anwar, N.A.M., Chien, F., Sadiq, M. (2021), Efficiency of microfinance institutions and economic freedom nexus: Empirical evidence from four selected ASIAN countries. *Transformations in Business and Economics*, 20(2b), 845-868.
- Khattak, M.A., Ali, M., Rizvi, S.A.R. (2021), Predicting the European stock market during COVID-19: A machine learning approach. *MethodsX*, 8, 101198.
- Kopnina, H. (2019), Green-washing or best case practices? Using circular economy and cradle to cradle case studies in business education. *Journal of Cleaner Production*, 219, 613-621.
- Lan, J., Khan, S.U., Sadiq, M., Chien, F., Baloch, Z.A. (2022), Evaluating energy poverty and its effects using multi-dimensional based DEA-like mathematical composite indicator approach: Findings from Asia. *Energy Policy*, 165, 112933.
- Laosirihongthong, T., Adebajo, D., Tan, K.C. (2013), Green supply chain management practices and performance. *Industrial Management and Data Systems*, 1, 59-65.
- Lee, C., Ha, B.C. (2020), The impact of interactional justice and supply-chain collaboration on sustainable SCM performance: The case of multinational pharmaceutical firms. *The Journal of Asian Finance, Economics and Business*, 7(2), 237-247.
- Lin, C.Y., Chau, K.Y., Tran, T.K., Sadiq, M., Van, L., Phan, T.T.H. (2022), Development of renewable energy resources by green finance, volatility and risk: Empirical evidence from China. *Renewable Energy*, 201, 821-831.
- Liu, X., Yang, J., Qu, S., Wang, L., Shishime, T., Bao, C. (2012), Sustainable production: practices and determinant factors of green supply chain management of Chinese companies. *Business Strategy and the Environment*, 21(1), 1-16.
- Liu, Z., Lan, J., Chien, F., Sadiq, M., Nawaz, M.A. (2022b), Role of tourism development in environmental degradation: A step towards emission reduction. *Journal of Environmental Management*, 303, 114078.
- Liu, Z., Yin, T., Surya Putra, A.R., Sadiq, M. (2022a), Public spending as a new determinate of sustainable development goal and green economic recovery: Policy perspective analysis in the Post-Covid ERA. *Climate Change Economics*, 13, 2240007.
- Monteiro, J., Silva, F., Ramos, S., Campilho, R., Fonseca, A. (2019), Eco-design and sustainability in packaging: A survey. *Procedia Manufacturing*, 38, 1741-1749.
- Moslehpour, M., Chau, K.Y., Du, L., Qiu, R., Lin, C.Y., Batbayar, B. (2022c), Predictors of green purchase intention toward eco-innovation and green products: Evidence from Taiwan. *Economic Research-Ekonomska Istraživanja*, 1-22. <https://doi.org/10.1080/1331677X.2022.2121934>
- Moslehpour, M., Chau, K.Y., Tu, Y.T., Nguyen, K.L., Barry, M., Reddy, K.D. (2022b), Impact of corporate sustainable practices, government initiative, technology usage, and organizational culture on automobile industry sustainable performance. *Environmental Science and Pollution Research*, 29(55), 83907-83920.
- Moslehpour, M., Shalehah, A., Wong, W.K., Ismail, T., Altantsetseg, P., Tsevegjav, M. (2022a), Economic and tourism growth impact on the renewable energy production in Vietnam. *Environmental Science and Pollution Research*, 29(53), 81006-81020.
- Ojogiwa, O.T. (2021), The crux of strategic leadership for a transformed public sector management in Nigeria. *International Journal of Business and Management Studies*, 13(1), 83-96.
- Paulraj, A. (2011), Understanding the relationships between internal

- resources and capabilities, sustainable supply management and organizational sustainability. *Journal of Supply Chain Management*, 47(1), 19-37.
- Perpignan, C., Baouch, Y., Robin, V., Eynard, B. (2020), Engineering education perspective for sustainable development: A maturity assessment of cross-disciplinary and advanced technical skills in eco-design. *Procedia CIRP*, 90, 748-753.
- Sadiq, M., Amayri, M.A., Paramaiah, C., Mai, N.H., Ngo, T.Q., Phan, T.T.H. (2022b), How green finance and financial development promote green economic growth: Deployment of clean energy sources in South Asia. *Environmental Science and Pollution Research*, 29, 65521-65534.
- Sadiq, M., Lin, C.Y., Wang, K.T., Trung, L.M., Duong, K.D., Ngo, T.Q. (2022d), Commodity dynamism in the COVID-19 crisis: Are gold, oil, and stock commodity prices, symmetrical? *Resources Policy*, 79, 103033.
- Sadiq, M., Ngo, T.Q., Pantamee, A.A., Khudoykulov, K., Ngan, T.T., Tan, L.L. (2022a), The role of environmental social and governance in achieving sustainable development goals: Evidence from ASEAN countries. *Economic Research-Ekonomska Istraživanja*, 36, 2072357.
- Sadiq, M., Ou, J.P., Duong, K.D., Van, L., Ngo, T.Q., Bui, T.X. (2022c), The influence of economic factors on the sustainable energy consumption: Evidence from China. *Economic Research-Ekonomska Istraživanja*, 2093244. <https://doi.org/10.1080/1331677X.2022.2093244>
- Sammalisto, K., Brorson, T. (2008), Training and communication in the implementation of environmental management systems (ISO 14001): A case study at the University of Gävle, Sweden. *Journal of Cleaner Production*, 16(3), 299-309.
- Santoso, R.W., Siagian, H., Tarigan, Z.J.H., Jie, F. (2022), Assessing the benefit of adopting ERP technology and practicing green supply chain management toward operational performance: An evidence from Indonesia. *Sustainability*, 14(9), 4944-4955.
- Shao, J., Ünal, E. (2019), What do consumers value more in green purchasing? Assessing the sustainability practices from demand side of business. *Journal of Cleaner Production*, 209, 1473-1483.
- Shibli, R., Saifan, S., Ab Yajid, M.S., Khatibi, A. (2021), Mediating role of entrepreneurial marketing between green marketing and green management in predicting sustainable performance in Malaysia's organic agriculture sector. *AgBioForum*, 23(2), 37-49.
- Srivastava, S.K. (2007), Green supply-chain management: A state-of-the-art literature review. *International Journal of Management Reviews*, 9(1), 53-80.
- Suryanto, T., Haseeb, M., Hartani, N.H. (2018), The correlates of developing green supply chain management practices: Firms level analysis in Malaysia. *International Journal of Supply Chain Management*, 7(5), 316-321.
- Ta, V.L., Bui, H.N., Canh, C.D., Dang, T.D., Do, A.D. (2020), Green supply chain management practice of FDI companies in Vietnam. *The Journal of Asian Finance, Economics and Business*, 7(10), 1025-1034.
- Tan, L.P., Sadiq, M., Aldeehani, T.M., Ehsanullah, S., Mutira, P., Vu, H.M. (2022), How COVID-19 induced panic on stock price and green finance markets: Global economic recovery nexus from volatility dynamics. *Environmental Science and Pollution Research*, 29(18), 26322-26335.
- Thamsatitdej, P., Boon-Itt, S., Samaranayake, P., Wannakarn, M., Laosirihongthong, T. (2017), Eco-design practices towards sustainable supply chain management: Interpretive structural modelling (ISM) approach. *International Journal of Sustainable Engineering*, 10(6), 326-337.
- Tseng, M.L., Islam, M.S., Karia, N., Fauzi, F.A., Afrin, S. (2019), A literature review on green supply chain management: Trends and future challenges. *Resources, Conservation and Recycling*, 141, 145-162.
- Vasileiou, K., Morris, J. (2006), The sustainability of the supply chain for fresh potatoes in Britain. *Supply chain management: An International Journal*, 5, 5-14.
- Verma, D., Dixit, R.V., Singh, K. (2018), Green supply chain management: A necessity for sustainable development. *The IUP Journal of Supply Chain Management*, 15(1), 40-58.
- Wiguna, I.P.A., Rachmawati, F., Rohman, M.A., Setyaning, L.B.T. (2021), A framework for green supply chain management in construction sector: A case study in Indonesia. *Journal of Industrial Engineering and Management*, 14(4), 788-807.
- Wirsinna, A., Grega, L. (2021), Assessment of economic benefits of smart city initiatives. *Cuadernos de Economía*, 44(126), 45-56.
- Wu, K.J., Tseng, M.L., Vy, T. (2011), Evaluation the drivers of green supply chain management practices in uncertainty. *Procedia-Social and Behavioral Sciences*, 25, 384-397.
- Yung, W.K., Chan, H., Wong, D.W., So, J.H., Choi, A.C., Yue, T.M. (2012), Eco-redesign of a personal electronic product subject to the energy-using product directive. *International Journal of Production Research*, 50(5), 1411-1423.
- Zhang, X., Dong, F. (2020), Why do consumers make green purchase decisions? Insights from a systematic review. *International Journal of Environmental Research and Public Health*, 17(18), 6607-6618.
- Zhao, L., Chau, K.Y., Tran, T.K., Sadiq, M., Xuyen, N.T.M., Phan, T.T.H. (2022), Enhancing green economic recovery through green bonds financing and energy efficiency investments. *Economic Analysis and Policy*, 76, 488-501.
- Zhao, L., Zhang, Y., Sadiq, M., Hieu, V.M., Ngo, T.Q. (2021), Testing green fiscal policies for green investment, innovation and green productivity amid the COVID-19 era. *Economic Change and Restructuring*, <https://doi.org/10.1007/s10644-021-09367-z>
- Zhu, Q., Geng, Y., Fujita, T., Hashimoto, S. (2010), Green supply chain management in leading manufacturers: Case studies in Japanese large companies. *Management Research Review*, 33(4), 380-392.
- Zhu, Q., Sarkis, J. (2006), An inter-sectoral comparison of green supply chain management in China: Drivers and practices. *Journal of Cleaner Production*, 14(5), 472-486.
- Zhu, Q., Sarkis, J., Geng, Y. (2005), Green supply chain management in China: Pressures, practices and performance. *International Journal of Operations and Production Management*, 3, 5-11.