

Greening the Sugar Industry: Practices, Insights & Environmental Framework From the Sugarbowl of the Philippines

Erika S. Nicolas
University of St. La Salle

Eric Arthur N. Dio
University of St. La Salle

This study examines the environmental management practices of sugar mills in the Philippines, assessing current strategies in pollution control, waste management, and energy efficiency. Through surveys and focus group discussion, the research explores how selected mills implement green practices and adopt cleaner technologies. Results show varying levels of environmental commitment, with some mills demonstrating innovation in waste management and resource conservation. The study identifies challenges in policy support and technological access, offering a framework to enhance sustainability across the industry. These findings contribute to ongoing efforts to green the sugar industry and promote ecological modernization in agro-industrial sectors.

Keywords: sugar industry, sustainability, environmental strategies, Philippines, ecological modernization

INTRODUCTION

The rapid industrialization, urbanization, and population growth have placed immense pressure on the planet's natural resources and ecosystems (Munir & Ameer, 2020; Shao, 2020; Dong, 2019; Jiefang, 2019). Concerns such as deforestation, climate change, pollution, and loss of biodiversity have reached critical levels (United Nations-World Meteorological Organization, 2022), necessitating a comprehensive and integrated approach to environmental management. Though having spurred economic growth, manufacturing industries have been known contributors to environmental degradation (Ososanmi et al., 2022; Khan et al., 2020) and pollution (Evangelista & Durst, 2015). Manrique & Marti-Ballester (2017) explain that businesses need to understand their environmental responsibilities and sustainably create values. Businesses are expected not only to act socially responsibly (Benavides-Velasco et al., 2014) but also to take their environmental responsibilities seriously and contribute to the communities in which they conduct business (Juholin, 2004). Furthermore, they must operate in a manner that lessens the adverse effects of their operation (De Grosbois, 2012). This heightened emphasis on responsible and sustainable manufacturing practices matches the 17 UN Sustainable Development Goals (SDGs). SDG 12, in particular, presents a comprehensive framework for manufacturing companies to address sustainable consumption and production.

Moreover, manufacturing companies are considering the circular economy approach to trim operational waste. In applying the Circular Economy approach, the extraction of natural resources is minimized while

waste prevention is maximized; it optimizes the environmental, social, and economic values of materials, products, and components throughout their lifecycle (Velenturf & Purnell, 2021). Hence, integrating SDG into the company's operations while adopting the Circular Economy (CE) principles can accelerate their transition towards a sustainable future.

Amidst these escalating environmental challenges and the urgent need for sustainability, developing and implementing effective environmental management practices (EMPs) have become crucial. EMPs are actions and decisions to reduce negative environmental consequences by developing and implementing new or improved goods, processes, organizational routines, and management systems (González-Benito et al., 2005 in Latip, 2022). EMP is the level of resources invested in activities and know-how development that reduces pollution at the source (Hajmohammad et al., 2013).

One country that is most vulnerable to the adverse effects of this environmental infamy is the Philippines. According to the Climate Change Commission (CCC) of the Philippines, the country is the third most vulnerable country to climate change, with impacts including annual losses in GDP, droughts, threats to biodiversity and food security, sea level rise, public health risks, endangerment of vulnerable groups, and even workplace productivity among others. Unfortunately, despite this status, the country ranked 158th out of 180 countries in the 2022 Environmental Performance Index (Wolf et al., 2022). The report added that the country's environmental rating has significantly decreased by 7.50% compared to its performance a decade ago. The EPI includes air quality, waste management, and sanitation criteria. The current situation may partly be attributed to the actions or inactions of businesses towards the environment. However, this cannot be validated or invalidated due to the scarcity of information at the local level.

This holds true for the Province of Negros Occidental, the locale of this study. Being the top manufacturer of the country's sugar produce, the province is known as the sugar capital of the country and is dubbed as the Sugarbowl of the Philippines. Being a home to nine sugar manufacturing firms, there needs to be more information about the environmental management practices of its sugar industry. As previously emphasized, manufacturing firms play a pivotal role in uplifting a country's environmental performance. EMPs can improve a company's environmental performance (Latip et al., 2022, Bengtsson, 2008; Jackson & Apostolakou, 2010), which could create a ripple effect to the nation's EPI. However, there is a dearth of research on the environmental management practices of industries in the Philippines particularly in sugar production. Thus, this study aims to address this critical and crucial knowledge gap. By focusing on the EMPs of firms in their primary and support activities, the study may further enlighten external and internal stakeholders. It can contribute vital information to their policymaking, development planning, and investment decision-making.

METHODS

Research Design

This study employed a descriptive research design to examine the environmental management practices of nine sugar manufacturing firms. Using the value chain model, we assessed the extent of environmental management practices implemented by the participating companies in both the primary and support activities identified in the value chain model. The primary activities included inbound logistics, operations, outbound logistics, marketing and sales, and services. The support activities, on the other hand, comprised procurement, technology development, human resource management, and firm infrastructure.

According to Groves et al. (2012), descriptive studies look at a population's characteristics, identify problems within a unit, an organization, or a population, or look at variations in characteristics or practices between institutions or even countries. Additionally, the researcher describes the variables but does not manipulate any variables. Descriptive research design utilizes observational or survey data collection techniques. In this study, we used a survey questionnaire to determine and describe the profile of the company participants and their extent of implementation of environmental management practices in the primary and support activities in the organization. This data gives valuable insights as to whether companies in different manufacturing industries have the exact extent of implementation or not as to their

environmental management practices. The company initiatives and the benefits and challenges were also identified to provide information about the existing situation of the company participants.

Participants

Total enumeration was used in the conduct of study with the participation of the nine sugar manufacturing firms. The study's first phase involved a survey by the Pollution Control Officers (PCOs) of the nine firms. The PCOs were appropriate as participants of this study as they are technically competent in environmental management and pollution control and are officially accredited by the Environmental Management Bureau of the Department of Environment and Natural Resources (EMB-DENR) to perform a broad spectrum of tasks ranging from waste management and pollution monitoring to ensuring regulatory compliance and stakeholder engagement. The study's second phase involved a Focus Group Discussion (FGD) participated by ten managers and supervisors in various manufacturing firms that are not PCOs. The FGD comprises one environmental manager, one logistics manager, one operations manager, one quality assurance officer, two chemical engineers, one marketing manager, one sales executive, one human resource officer, and one store supervisor. During the framework presentation before finalization, the PCOs and members of the FGD were again invited as well other stakeholders from the business and academic community. A total of around ten people joined in the presentation/discussion.

Instrument

In order to achieve the objectives of this study, a researcher-made questionnaire and an interview guide were used as instruments for data gathering. The first instrument is a survey instrument for obtaining consistent and reliable participant data. This was validated by five-panel experts using Good and Scates resulting in an average validity score of 4.15.

Similarly, to guarantee that the results collected from the survey prove reliable, the rated survey forms were pretested to twenty participants from smaller manufacturing companies that are not on the list of EMB-Negros Occidental. This was disseminated through online methods and personal delivery. The reliability test using Cronbach's Alpha was used to determine the constructs' internal consistency. Cronbach's Alpha garnered a score of 0.984 for blocks 2 and 3 and a score of 0.855 for blocks 4 and 5. All the scales presented acceptable reliability levels (Nunnally & Bernstein, 1994).

The second instrument is an interview guide. An interview guide outlines the key topics and questions that was used during the Focus Group Discussion (FGD). This allows participants to present their view or 'tell their story' (Conrad et al., 2001). This helps us to obtain narrative or textual data in the participants' own words. The interview guide in this study consists of seven areas that were used to initiate discussion. These areas are as follows: general concern about awareness of environmental management practices, resource conservation, no resource conservation practices, pollution prevention, solid waste management, health and safety and environmental policy. The key topics were based on the specific objectives of the study.

Data Analysis

Frequency count and percentage were used on the company profile of the participants such as form of business organization, years in operation, employee size, and location. Mean and standard deviation were employed to determine the extent of compliance of company participants with the primary and support activities of environmental management practices.

Ethical Considerations

The participants were made aware that their identities and answers would remain confidential to ensure that the study was conducted as thoroughly and ethically as possible. A letter was made to seek approval from the management of the company members. This is for the purpose of formality and informed consent. We waited for the confirmation of the participants before conducting a survey. The participants were not forced to answer the questionnaire rather it was voluntary. Moreover, participants' rights to withdraw from the study at any stage if they wish to do so was acknowledged and respected. The use of offensive,

discriminatory, or other unacceptable language was avoided in formulating the questions. It is also fitting to acknowledge the works of other authors used in any part of the thesis observed in this study. The highest level of objectivity was maintained in discussions and analyses throughout the research.

RESULTS AND DISCUSSION

The sugar industry plays a pivotal role in the socio-economic development of many nations, as it addresses one of the basic necessities of human survival (Ranjan et al., 2021). The sugar sector has long been a cornerstone of agricultural and economic activity in the Philippines. Notably, 54% of the agricultural land in Negros Occidental is devoted to sugarcane cultivation, underscoring the industry's critical contribution to the region's livelihood and development (Philippine Statistics Authority, 2023).

Despite its economic importance, the sugar industry is also recognized as one of the major consumers and polluters of freshwater resources. Sugar mills generate approximately 1,000 liters of wastewater for every ton of sugarcane processed (Sahu & Chaudhari, 2015; Asaithambi & Matheswaran, 2016). As with many other industrial sectors, sugar and sugar-bioprocess companies face mounting sustainability challenges. These include unstable profits, global sugar surpluses, and increasing pressure to adopt renewable raw materials, reduce greenhouse gas emissions, and respond to consumer demand for environmentally responsible products (Solomon et al., 2019). Water and energy-intensive production processes further intensify the need for transformation.

In light of these challenges, the following tables presents the extent of implementation of environmental management practices by the Philippine sugar industry, analyzed through key activities across the value chain.

Extent of Implementation in Inbound Logistics

Table 1 shows that in terms of Inbound Logistics in the sugar industry, Certification reveals Great extent of Implementation with a Mean score of 5.25 SD ± 0.79 . The Province of Negros is the country's biggest sugar producer, generating around 50.70% of the total production (PSA, 2023). As such, industrial users, and national and multi-national food manufacturers are among their clients. These clients require stringent pre-requisites in supplier selection, including certification in certain standards such as the International Organization for Standardization (ISO) and Occupational Safety and Health (OSH). Furthermore, government agencies such as the EMB and the Department of Labor (DOLE) require these firms to comply with the Environmental Implementation Certificate (ECC) for the former and the Philippine Occupational Health Standards for the latter. EMB has an adjudication authority while DOLE is equipped with the police power to ensure their respective mandate is implemented effectively. Certification can provide firms immense opportunity versus competition since this would create entry barriers since buyers prefer certified firms and government regulators limit non-certified firms to operate. This is in consonance to the study of Jell-Ojobor and Raha (2022) which cited Porter and Kramer (2006) that indeed having a certification can provide an opportunity for competitive advantage and depicts an earth amicable business (Marfini & Muposhi, 2017 in Ariyanti, 2018). However, firms should not be complacent and must continue improving their system. In 2008, Carter and Rogers developed a Sustainable Supply Chain Management (SSCM) Framework, part of the study revealed the importance of examining inbound logistics activities such packaging, disposal, warehouse safety emission, energy use and hazardous materials in identifying environmental and social initiatives with the most environmental and social impact. As shared by companies A9 and A1 during the FGD, their companies also select their suppliers with certification from approved body of standards locally and globally. As a result, the participants have been able to apply the certification requirements to their work effectively.

Meanwhile, Packaging garnered the lowest Mean score of 3.44 SD ± 1.25 , indicating a small extent of Implementation. The result of the study contrast the work of Guillard et al. (2018) which emphasized the importance of packaging in developing sustainable product particularly food. However, the data of the study may suggest that although the participants only implemented environmentally friendly packaging and reduced packaging materials to a small extent, they still met the requirements of the regulatory agencies. In

the Philippines, the Philippine National Standard for the Specification of Raw Cane Sugar (PNS/BAFPS 81:2010) states that raw cane sugar as produced for direct consumption shall be packed in new, clean sound polypropylene (PP) bags lined with polyethylene film, or equivalent packaging or bulk containers. Company A7 confirms this usage and refers it to a sack bag. These sack bags or PP bags are made from a durable plastic type that can be reused multiple times. They are also recyclable, so they can be broken down and used to make new products. However, if PP bags are not reused or recycled, they can end up in landfills, where they can take hundreds of years to decompose. Additionally, the production of PP bags requires the use of fossil fuels, which can contribute to air pollution. Company A1, A5, A9 mentioned that they are continually improving their way of packaging to ensure that the locally produced sugars meet current international standards for safety and quality. Thus, it can be surmised that this area would eventually be another room for improvement.

The overall Mean score is **4.16** $SD \pm 1.01$ which indicates a Moderate extent. This implies that the sugar industry presents a high level of Implementation with environmental management practices in inbound logistics, particularly in acquiring certifications and adhering to regulatory requirements. However, they should also review their packaging practices to minimize environmental impact and align with emerging sustainability standards.

TABLE 1
EXTENT OF IMPLEMENTATION IN INBOUND LOGISTICS

Practices	Mean	$\pm$ SD	Extent
Certification	5.25	0.79	Great
Transporting	4.38	1.21	Moderate
Reusing	3.89	1.27	Moderate
Recycling	3.81	1.67	Moderate
Packaging	3.44	1.25	Small
Overall Mean	4.16	1.01	Moderate

Extent of Implementation in Operations

Table 2 shows the Mean score for extent of Implementation in Operations. Certification garnered the highest in the sugar industry with **5.56** $SD \pm 0.87$. This indicates that most companies in the sugar industry have a great extent of Implementation with operation certification requirements, with a few companies having slightly lower or higher scores. It can be implied that companies in this industry are meeting or exceeding the majority of the requirements for certification. Aside from the certifications required by the Philippine government such as Environmental Implementation Certificate (ECC), Certificate of Non-Coverage (CNC), Certificate of Product Registration (CPR), Occupational Safety and Health Administration (OSHA), Philippine Standard (PS) Quality and/or Safety Mark, Hazard Analysis and Critical Control Points (HACCP) and Good Manufacturing Practices (GMP), there are a number of other certifications that the participants was able to obtain that may have demonstrated their company's commitment to quality, safety, and environmental sustainability. Companies A1, A5, A6, and A9 mention that these certifications are ISO (International organization for Standardization) and Halal Certificates. Most common ISO certifications are ISO 9001:2015 (Quality Management System) and ISO 14001:2015 (Environmental Management System). According to Younis et al. (2020), firms with an EMS such as ISO 14001 are in a better position to achieve higher performance improvements than non-EMS-certified firms.

Additionally, Fadly (2020) reveals that certification leads to resource savings reflected by less use of electricity, fuel, and water for each unit of output. This is likely because EMS certification requires companies to identify and assess their environmental impacts and implement measures to reduce them. These measures can include using more efficient equipment, improving energy and water conservation practices, and reducing waste. Some of the participants are also Halal certified because they wanted to cater

to the Muslim consumers which require that the processing of products and services should meet the requirements of Islamic law. In addition to the reason mentioned earlier, a study by Ab Talib (2017) found that Halal Food Safety Certification (HFSC) can also provide financial, operational, production, and human resource benefits. For example, Karaman et al. (2012), Escanciano and Santos-Vijande (2014) demonstrated that aside from reducing the rate of mistakes and production defects, several studies revealed that improving product quality and safety are also among the benefits of implementing HFSC. Hence, environmental benefits are also likely to follow when quality and safety are into play. This is because Halal Food Safety Certification (HFSC) requires companies to implement practices that reduce waste, conserve resources, and protect the environment.

On the other hand, the Mean score for Awareness on Green Operations is $3.14 \text{ SD} \pm 0.94$, the lowest among others. This suggests that participants may have been implementing green campaigns but most of them are not aware about how the company records and reports greenhouse data or even knows that the company can avail of loans for green businesses. These loans can be used to finance green initiatives, such as energy efficiency upgrades or the purchase of renewable energy equipment. In the Philippines, commercial banks as well government-owned banks offer loans to help businesses finance green projects. These programs can provide grants, tax breaks, or other forms of financial assistance. This is an area that could be improved upon in order to make the environmental management system more effective.

The overall Mean score is $4.33 \text{ SD} \pm 0.73$, indicating a Moderate extent. Dornfeld et al. (2021) which studied Brazilian sugar mills environmental strategies exhibited higher implementation of environmental practices which negated the results of this study. However, the sugar industry is strongly dedicated to environmental management practices in inbound logistics, particularly in acquiring certifications. Companies widely adhere to regulatory requirements and pursue additional certifications like ISO and Halal, reflecting their dedication to quality, safety, and sustainability.

TABLE 2
EXTENT OF IMPLEMENTATION IN OPERATIONS

Practices	Mean	$\pm \text{SD}$	Extent
Certification	5.56	0.87	Very Great
Plant Operations	4.85	0.72	Great
Waste Management	4.36	0.98	Moderate
Collaboration	4.06	1.07	Moderate
Reusing and Recycling	4.04	1.86	Moderate
Awareness	3.14	0.94	Small
Overall Mean	4.33	0.73	Moderate

Extent of Implementation in Outbound Logistics

Table 3 shows the highest Mean score is Disposal, with a score of $5.56 \text{ SD} \pm 0.72$. This implies that companies in the sugar industry generally comply with the requirements for disposal of their wastes in the context of outbound logistics. According to Yadav et al. (2021), wastewater emitting from sugar industry has enormous effects on the ecosystem and environment. This is why the DENR is closely and strictly monitoring how they disposed of their waste as it can negatively impact the environment and threaten public health. However, the availability of new, more efficient methods and sustainable wastewater treatment technologies has become more affordable, approved, accepted, and understood. Companies can prevent accidents and reduce waste by keeping their facilities clean and well-maintained. In the FGD, two agreed that all waste management starts with an implementation of good housekeeping so as to minimize the leaks during the production process. Company A5 mentioned that their company invested in wastewater treatments in its various facilities nationwide. It was reported in their annual reports for investor relations that the company spent around P333 million as of 2007. Another participant added that they too have a

waste water treatment plan in place. He further mentioned in the FGD that the mudpress, which is also considered waste, are collected by an external party who uses it as an organic fertilizer.

The lowest Mean score of 3.93 SD±1.35 is Packaging implementation in outbound logistics. This indicates that there is a moderate extent of implementation. Having the same results as with the inbound logistics, it confirms that the participants in this industry are just compliant with the minimum requirement of the regulatory agencies and do not prioritize a more environment –friendly material for packaging. The reason may be is the cost of changing packaging might be too high.

The overall Mean score of the sugar industry is 4.55 SD ± 0.73, indicating a Great extent. This infer that company participants are taking measures to reduce the environmental impact of their waste disposal practices. This result agrees with the findings of Yadav et al. (2021), who found that the availability of new, more efficient, and sustainable wastewater treatment technologies has led to improved Implementation with disposal regulations.

TABLE 3
EXTENT OF IMPLEMENTATION IN OUTBOUND LOGISTICS

Practices	Mean	± SD	Extent
Disposal	5.56	0.72	Great
Waste minimization	4.39	1.11	Moderate
Transportation	4.33	1.76	Moderate
Packaging	3.93	1.35	Moderate
Overall Mean	4.55	0.73	Great

Extent of Implementation in Marketing and Sales

Table 4 shows that in terms of Implementation in Marketing and Sales activities in the sugar industry, Green features had the highest Mean score of 4.52 SD ± 0.77, which indicates to a Great extent. This implies that the participants have generally complied with EMPs focused on sustainability and consumption and using bio-degradable features for their products. The information shared by A1 during FGD was that their company is studying the use of bio-degradable plastics in their packaging as one of their eco-marketing activities and as part of their corporate social responsibility. However, due to the cost of biodegradable plastics, most consumers stopped from patronizing them (Yaguchi et al., 2020). Another issue Kabir et al., (2020) raises is the adoption and how it can be handled globally because it seems that most people don't know enough about biodegradable plastics' utility and protection. Despite the fact that some biodegradable plastics have demonstrated excellent physiochemical, mechanical, and degradable properties in various industrial use, it is widely acknowledged that biodegradable plastics are not yet a viable replacement for synthetics plastics (Rujnić-Sokele & Pilipović, 2017).

Meanwhile, the lowest Mean score of 3.58 SD ± 1.59 is Vehicle Management, which indicates a Moderate extent. This suggest that participants in this industry is compliant in most areas, but not in all areas in Marketing and Sales. For instance, Company A1 said that their company is also considering fuel efficient vehicles but their primary consideration is the cost of the vehicles. Most of their vehicles use diesel fuel that has internal combustion engines which, according to Gritsenko et al., (2021), is the main source of air pollution. However, Company A9 added that they also make it to a point that all trips are scheduled based on routes that could minimize their fuel consumption. One specific example is scheduling their trip during off-peak hours or combining their trips into one if they need to go to different locations with the same direction. Company A5 also contributed that if they need to attend seminars in other cities, and if only one or two of them are participants, they just ride a bus to get there. This is because it is more environment-friendly, cost-effective, and time-efficient than using the company-issued car for just the two. The overall Mean score of the Implementation in Marketing and Sales by the sugar industry is 3.97 SD ± 0.79, indicating a Moderate extent. This implies that the company participants are committed to complying with

sustainability standards. However, further efforts and improvements in activities such as vehicle management, CSR, recycling and minimizing the use of paper.

TABLE 4
EXTENT OF IMPLEMENTATION IN MARKETING AND SALES

Practices	Mean	± SD	Extent
Green features	4.52	0.77	Great
Minimize paper	4.39	0.73	Moderate
Recycling	3.74	1.74	Moderate
CSR	3.61	1.31	Moderate
Vehicle Management	3.58	1.59	Moderate
Overall Mean	3.97	0.79	Moderate

Extent of Implementation in Service

Table 5 demonstrates that in terms of service activities in the sugar industry, maintenance service has the highest Mean score of 5.67, SD $\pm$ 0.50, which indicates Very Great extent. This infers that the participants complied with frequent scheduled maintenance which is essential for ensuring the safety and efficiency of sugar production facilities. This may also suggest that the company participants are aware of the importance of preventive maintenance to ensure their facilities are properly maintained. Holgado, Macchi, and Evans (2020) investigated the links of maintenance function with product competitiveness and energy management activities and confirmed environmental benefits from keeping machineries in good working conditions. During the focus group discussion, Company A1, A5 and A9 stated that they are highly meticulous in scheduling preventive maintenance, particularly for the equipment and machinery, as well as the vehicles used in production and sales, respectively. Thus, this shows that company participants adhere to regular scheduled maintenance routines to ensure safety and efficiency. The impact of this activity may be beneficial to the environment since it could minimize waste by fewer breakdowns and replacements. This can also prevent leakage and emission and optimization of energy. However, having frequent maintenance means using more materials such as lubricants, filters and cleaning agents which could contribute to resource depletion and potential pollution if not disposed of correctly. Liyanage (2007) pointed out that sustainability improvements emerge from close cooperation between maintenance and other manufacturing operations. Hence, it is crucial to manage downsides by balancing proactive approach to responsible resource management.

On the other hand, Recycle and reuse has the lowest Mean score of 2.67 SD $\pm$ 1.33, which indicates a small extent. This insinuates that the participants comply with a small extent in terms of recycling materials for customers' use, eliminating plastic bags, and collecting packages from customers to recycle them. Sugar centrals deal more with bulk materials, which means that they are often not able to recycle them. This is because bulk materials are often difficult to separate and process and can be contaminated with other materials. Although some sugar centrals, like A6, still favor plastic packaging to sell their products in the retail market, perhaps due to (Zhuo et al., 2023) perceived convenience in people's lives.

The overall Mean score is 3.84 SD $\pm$ 0.97 which indicates a small extent. In the study of Viana and Perez (2013) among Brazil's sugar industry millers, their result rendered high practice in reuse, recycling and waste management which negated the results of this study. This may suggest a commendable Implementation with maintenance practices of the company participants, particularly in scheduling preventive maintenance for equipment, machinery, and vehicles. This commitment ensures safety and operational efficiency while minimizing waste, reducing carbon emission, preventing leaks, and optimizing energy consumption.

TABLE 5
EXTENT OF IMPLEMENTATION IN SERVICE

Practices	Mean	± SD	Extent
Maintenance service	5.67	0.50	Very Great
Customer focused	5.56	0.40	Very Great
Minimize the use of paper	4.89	1.90	Great
Environmental standards	4.19	1.17	Moderate
E-services	3.96	1.84	Moderate
Minimize waste	3.94	2.09	Moderate
Product safety	3.67	2.09	Moderate
Recycle and Reuse	2.67	1.33	Small
Overall Mean	3.84	0.97	Moderate

Extent of Implementation in Human Resource Management

Table 6 presents that in terms of Human Resource Management in the sugar industry, Green Awareness tops the lists with a Mean score of 4.81 SD $\pm$ 1.00 which indicates a Great extent. This implies that the industry has placed a considerable attention on promoting environmental consciousness and sustainability awareness among its human resource. A popular explanation of Amrutha and Geetha (2020) is that GHRM practices attract top green talents or create green talents through environmental protection related training and development that leads to the employee level outcomes of satisfaction, commitment and intention to stay. Acquisition of green talent becomes more meaningful when followed by green training for environmental protection activities to develop and retain top green talents and overcome the challenges (Raut et al., 2020) across the expanse of the global marketplace. The representatives of the sugar companies during the FGD reported that the trainings provided by the top management are designed to increase the awareness of their employees in the areas of environmental issues, green Implementation, health concern and safety. For instance, A9 discussed environmental awareness for their employees (planting over 6,000 seedlings through simultaneous tree-planting activities across 25 areas) in partnership with the local government unit. A5 added that they regularly conduct awareness training and occupational health and safety for employees. Moreover, A1 revealed that they host events promoting green activities and awareness, including competitions among employees focused on environmental sustainability, public speech and cleaning up the surroundings. This practice of greening the traditional human resource practices would add value to the sweltering field of sustainable development (Haddock-Millar & O'Donohue, 2016; Bombiak and Marciniuk-Kluska, 2018) and contributes social benefits to the society and stakeholders Amrutha and Geetha (2020). It is also worth mentioning that A1, A5 and A9 concurred during the FGD that although their respective employers encouraged employees and made aware of environmental practices in the organization through environmental training program, some employees have difficulty to adapt which is attributed to ingrained habits or practices that they may have developed over time. The participant A5 pointed out that some employees may follow the environmental policies particularly waste segregation but a reluctance is evident on their faces. For some of them, it is a burdensome because they do not practice it outside the facility or in their household. According to a discussion by Kasser (2002) as cited in Graves and Sarkis (2018), individual's values are their fundamental beliefs about desirable behaviors or end-states. Values drive attitudes, emotions, and behaviors, and typically endure across time and situations. They play a critical role in environmental behaviour (Steg et al., 2014; van den Broek et al., 2017).

On the other hand, Green rewards has the lowest Mean score of 4.03 SD $\pm$ 1.42, indicating a Moderate extent. Many of the participants revealed that companies solicit ideas about how to carry out the environmental practices but have not integrated a reward system through their performance evaluation. A previous study conducted by Masri and Jaaron (2017) claimed that "green reward and compensation" are not extensively used within manufacturing organizations to encourage pro-environmental behavior of

employees. However, Paillé and Valéau (2023) argued that employee environmental performance is impacted by green reward practices when organizations support them. This could mean that manufacturing companies can harness the potential of green rewards to encourage employees towards environmental stewardship only when top management supports them.

The overall Mean score is 4.52 SD $\pm$ 0.80 which indicates Great extent. Viana and Perez (2013) confirms this result in their study, indicating high environmental management practice in human resource. This suggests that despite facing employee behavioral challenges, the industry have been able to implement its environmental management practices. This is consistent with the study conducted by Zhenjing et al., (2022). It posits that a favorable work environment had the power to improve employee performance. Likewise, a favorable work environment also improved the employee commitment level and achievement-striving ability significantly. As long as the company participants maintained its current programs and trainings, this would foster teamwork and collaboration that may eventually improve its existing state.

TABLE 6
EXTENT OF IMPLEMENTATION IN HUMAN RESOURCE MANAGEMENT

Practices	Mean	$\pm$ SD	Extent
Green Awareness	4.81	1.00	Great
Green habits and regulations	4.69	1.26	Great
Employee participation	4.61	0.74	Great
Job Specification	4.49	0.66	Moderate
Green rewards	4.03	1.42	Moderate
Overall Mean	4.52	0.80	Great

Extent of Implementation in Procurement

Table 7 shows that in terms of Procurement in sugar industry, Supplier Certification reveals Moderate extent of implementation with a Mean score of **4.50** SD $\pm$ **0.68**. This suggests that suppliers have generally adhere to the standards and requirements set forth by the participants. However, it is to be noted that the certifications possessed by their suppliers are for government Implementation purposes only which most of the times, they comply with the minimum requirement. Additional certifications that the suppliers can obtain are the ISO 14001 or ISO 9001. These certificates may serve as valuable credentials for suppliers to exhibit their commitment to environmentally responsible practices. Fortuński (2008) highlights the adoption of international standards particularly the ISO 14001 to support sustainable development by driving improvements in environmental management practices. This was confirmed by the study of Frondel et al. (2018) which concluded that the pure implementation of an EMS without any certification does not enhance facilities' financial performance. However, the contention of some researchers that while there is empirical evidence that both EMS adoption and certification can improve environmental performance (Arimura et al., 2008) and can also encourage environmental innovation (Horbach, 2008), its impact on business performance is less established and requires further investigation. During the FGD, A1 and A5 have greatly emphasized these certifications and that going beyond the Implementation aspect would make a huge positive impact to the environment, likewise, the overall company performance. Hence, while working towards being certified in this kind of standards organizations that is accepted globally to be effective and has greatly improved thousands of manufacturing companies, they must carefully choose the certifications that would positively impact their business performance.

In the same table, Procurement procedures garnered a Mean score of 4.15 SD $\pm$ **1.30** indicating a Moderate implementation extent. This implies that the implementation is up to a certain satisfactory degree. Globally, companies are transitioning from traditional paper-based procurement to paperless e-procurement system to reduce paper and paper waste and increase efficiency. This practice aligns with the findings of Yang et al. (2015) who suggest that environmental management practices are positively related to technological innovation performance. Despite the shift to electronic data interchange, companies in the

Philippines specifically in Negros Occidental Province are facing challenges in adapting to these technologies. While these companies want to be at par with other countries in terms of technology, the lack of infrastructure by telecommunication companies to have these services available is a major obstacle. Consequently, according to A1, this situation hurls them back in the traditional paper-based approach. The structure of operation and technology opted by the suppliers needs managerial interception for a better degree of control. This will help them select and improve their supplier's technologies and alternates for an enhanced green performance (Ali et al., 2019).

The overall Mean score of Procurement in sugar industry is $4.33 \text{ SD} \pm 0.90$ which indicates a Moderate extent. This implies that the company participants need to work towards improving its supplier relationship as well as overcoming the limitation on infrastructure to implement electronic procurement effectively. Bienhaus and Haddud (2018) found in their study that digital procurement empowers businesses through enhanced daily operations, solves complex decision-making, and optimizes organization efficiency. Hence, this may elevate their procurement into a strategic level.

TABLE 7
EXTENT OF IMPLEMENTATION IN PROCUREMENT

Practices	Mean	$\pm \text{SD}$	Extent
Supplier Certification	4.50	0.68	Great
Procurement Procedures	4.15	1.30	Moderate
Overall Mean	4.33	0.90	Moderate

Extent of Implementation in Technology Development

Table 8 shows that regarding Technology Development in the sugar industry, Information Technology garnered the highest Mean score of $4.86 \text{ SD} \pm 1.38$ which indicates to a Great extent. These results evinced that information technology is a valuable tool for the sugar industry. It has most likely improved their efficiency, productivity, and quality in various operations. In response to the expected changes, companies are actively seeking ways to apply innovative technologies to secure long-term competitiveness and enable them to adapt to the evolving environmental conditions including shortening product lifecycles, increasing diversity and changing consumer expectations (Bauer & Gegenhuber, 2015; Lasi et al., 2014). According to A1, their company has been procuring certain technologies that could deliberately shorten and speed up their business processes. However, it is also obvious that their company is prioritizing certain technologies given the high cost involved.

Meanwhile, Water saving has the lowest Mean score of $2.56 \text{ SD} \pm 2.24$ which means to a Small extent. In this study, water saving referred to redesigning or improving water taps and shower heads. The participants scored this activity the lowest. Given that all facilities have been in existence between 52 to 103 years, some possible reasons that may have arisen are the management may have considered improving water-saving fixtures as having insignificant impact to the environment, it may require extra effort and eventually becomes a disruption to their daily routine and cost concerns might also be one of the reasons.

The Overall Mean score of $4.12 \text{ SD} \pm 1.06$ suggests that the sugar centrals are implementing Technology Development moderately. This could mean that the sugar centrals are open to adopting new technologies, however, as emphasized in the study of Xiao et al. (2024) total transformation may be hindered by limited financial resources, the unavailability of technical support and the management's perception about adopting new technologies.

TABLE 8
EXTENT OF IMPLEMENTATION IN TECHNOLOGY DEVELOPMENT

Practices	Mean	± SD	Extent
Information technology	4.86	1.38	Great
Energy efficient	4.78	0.76	Great
Waste management	4.41	1.51	Moderate
Implementation	4.19	1.24	Moderate
Alternative source	4.03	0.90	Moderate
Knowledge sharing	4.00	1.65	Moderate
Water saving	2.56	2.24	Small
Overall Mean	4.12	1.06	Moderate

Extent of Implementation in Firm Infrastructure

Table 9 shows that in terms of firm infrastructure in the Sugar industry, Waste management received the highest Mean score of 4.96 SD $\pm$ 0.67 which indicates that the extent of implementation is Great. This suggests that the participants viewed that the companies' practices such as converting wet waste into fertilizer, travelling less, refurbishing old furniture instead of throwing them away, usage of software or system that support manufacturing line, and reduction of hazardous emission can minimize waste production and create efficiency advantage. By reducing waste through conversion to fertilizer means lesser amount of disposal to landfills. This practice may not only reduce cost but creates positive environmental impact all throughout the process from pick-up to drop-off. Refurbishing old furniture extends the lifespan of the furniture. Thereby, contributing to lesser use of materials and the emission of machines that are used to manufacture it. In the study conducted by Malokani et al. (2023), they discover that minimization of waste and emissions, reduction of resource use and green employee behavior in encouraging environmental protection have a positive and significant impact on environmental strategy, implying that they can be valuable tools for promoting sustainable practices in the manufacturing sector. Companies reduce their reliance on paper for communication, documentation, and other purposes as they choose to adapt the usage of software or online system. By using video conferencing or other online methods, it reduced their travel time and cost, contributing to lesser use of fuel and paper. While the latter may require electricity, it is the more sustainable way. According to A1, their company is gradually adopting to these types of systems. However, as pointed out by A5, it would take time to fully implement the systems mentioned above due to internal factors such as lower salaries versus acquiring smart equipment, lack of sufficient information by the top management to knowledge transfer and external factors such as unavailability of internet infrastructure and skilled technicians to repair software systems of machineries. Prior research conducted by Haddara and Elragal (2015) reported that transitioning to this kind of environmental practices would require significant changes to existing business process re-engineering, employee mindset, and massive training and reallocation to the current workforce. Another challenge is employee resistance to change, which often blocks the implementation of automation projects. Hence, providing adequate training and fostering a culture of environmental awareness among employees can help this industry navigate effectively to reach its sustainability goals.

On the other hand, Energy saving has the lowest Mean score of 4.09 SD $\pm$ 1.01, revealing a Moderate extent. This implies that while some of these energy saving practices are implemented to moderate extent, some practices like green data center and centralized AC which have been specifically mentioned during the FGD are not being practiced by most of them due to initial high cost of investment. Carlander and Thollander (2023) revealed that the most prominent barriers to implementation of energy-efficient technologies were inertia, risk, access to capital and lack of knowledge. Despite having to produce their own electricity through biomass, company participants are still adamant due to potential risks.

The overall Mean score of 4.48 **SD $\pm$ 0.84** which indicates Moderate extent. This suggests that in terms of firm infrastructure, the sugar industry takes into account to incorporate environmental considerations

and there are still opportunities available to pursue. According to Liu et al. (2022), the practice of environmental management in the firm infrastructure has yielded a positive outcome in terms of energy conservation and the mitigation of CO2 emissions. Hence, it aligns with the objectives of cost efficiency and project sustainability associated with environmental performance.

TABLE 9
EXTENT OF IMPLEMENTATION IN FIRM INFRASTRUCTURE

Practices	Mean	± SD	Extent
Waste management	4.96	0.67	Great
Design consideration	4.67	1.58	Great
Certification and Policies	4.50	1.52	Great
Recycling	4.50	1.08	Great
Space utilization	4.14	0.78	Moderate
Energy saving	4.09	1.01	Moderate
Overall Mean	4.48	0.84	Moderate

Perceived Benefits in Implementing EMP

In the ever-changing business climate, implementing environmental management practices has progressed from being an optional choice to becoming an essential strategic and sustainability requirement. The escalating global environmental risks have amplified the strategic significance of integrating environmental management techniques into the operations of every business (Haque and Ntim, 2018). Companies that adopt and execute strong environmental management strategies have numerous advantages that go beyond simply meeting regulatory requirements. They may vary per country and industry depending on the ecosystems being safeguarded. Prioritizing environmental responsibility becomes fundamental for achieving success by integrating profitable strategies with environmentally sustainable practices. This will lead to the establishment of a resilient and peaceful cohabitation between commerce and nature. As shown in Table 10, the top benefits in adopting environmental practices are more appealing to clients, customers and employees, improves business sustainability, attract new customers, and tax incentives.

It can be observed that the top benefits identified by the participants are financial in nature. This is in agreement with the study of Abuzeinab (2018), which recognizes financial benefits aside from long-term viability, credibility or reputation benefits for enterprises that are into green business. Companies that embrace proactive environmental strategies may experience enhanced market legitimacy and social approbation, resulting in increased sales and higher prices (Molina-Azorin, 2015). However, some studies imply that firms would gain financial benefits in the long-term rather than in the short-term when adopting environmental management practices. According to Dahlmann et al. (2019), a corporation's performance can be improved over time by strengthening its relationships with influential stakeholders and acquiring competitive advantages, such as access to critical resources, through its long-term goal of reducing carbon emissions. Also, in the work of Li et al. (2017), the influence of environmental management practices on financial performance is not immediate. They suggest that for firms to maintain a competitive edge and ensure survival, they would need to integrate green initiatives and policies into their long-term strategies. These could be attributed to the fact that environmental management practices would require adoption of long-term programs and policies and would demand capital expenditures such as big item purchases like pollution control and waste management systems.

TABLE 10
PERCEIVED BENEFITS IN IMPLEMENTING EMP

Benefit	f	Percent
More appealing to clients, customers and employees	8	88.9
Improves business sustainability	8	88.9
Attract new customers	7	77.8
Improve technical decisions	7	77.8
Tax Incentives	6	66.7
Boost workforce morale	6	66.7
Earn greater trust and loyalty from consumers	6	66.7
Government subsidy benefits	6	66.7
Promote additional innovations	5	55.6
Positive societal Impact	4	44.4
Enhance training programs	4	44.4
Reduce inefficiencies created by employees or contractors	2	22.2
Helps reduce the impact on the environment and preserves natural resources	1	11.1

Perceived Challenges in Implementing EMP

The pressure to adopt environmental management practices among business firms is mounting. However, they face many challenges, from navigating complex regulations, integrating eco-friendly initiatives in operations and strategies, and overcoming implementation costs. For the participants, as shown in Table 11, the top 2 biggest challenge perceived by the participants are unclear leadership strategy and goals towards environmental issues and quality of consultants. No current study presented similar obstacle. Although other studies indicated implementation challenges, their issue differs from that of the participants. For example, in the study of Waxin, et al. (2019) in the implementation of EMS among firms in Arab countries, one their concern is the lack of regulation. They have also identified the following challenges: lack of qualified human resources, practical challenges associated with implementation, a lack of regulations, a lack of support from management, and high costs. Massoud et al. (2015), in their study also identified contrasting challenges such as lack of proper waste management infrastructure, inadequate industrial zones, lack of political will, instability and professional knowledge. These provided the perspective that challenges in implementation environmental practices may pose variability depending on the country and industry.

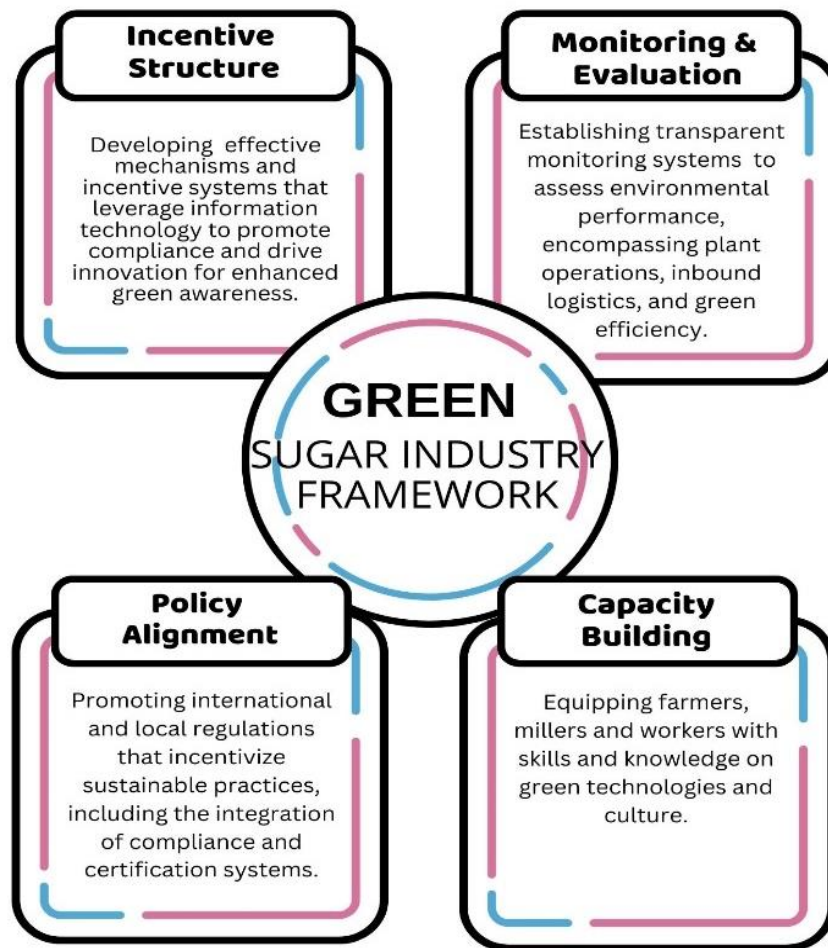
TABLE 11
PERCEIVED CHALLENGES IN IMPLEMENTING EMP

Challenge	f	Percent
Unclear leadership strategy and goals towards environmental issues	5	55.6
Quality of consultants	5	55.6
Lack of management commitment and support	4	44.4
Lack of engagement/ commitment from staff	4	44.4
Unclear responsibility regarding who is in charge of environmental policy/practice	4	44.4
Insufficient training regarding the importance of pro environmental behavior	4	44.4
Lack of time and resource to focus on environmental issues	4	44.4
Excessive financial constraints	4	44.4
Organization prioritizing commercial needs above environmental concern	3	33.3
Lack of availability for skilled staff	2	22.2
Too much paper work involved in the process	2	22.2
Sometimes exposes the organization environmental weakness to regulatory bodies	2	22.2
Lack of clarity among line managers regarding whether they are responsible for environmental concerns	1	11.1
Insufficient incentives in place to encourage environmental behavior	1	11.1

CONCLUSION

In conclusion, the findings of this study underscore the urgent need for a more sustainable and environmentally responsible sugar industry. The data reveal a fragmented landscape of greening efforts, marked by uneven adoption of eco-friendly practices, limited institutional support, and minimal policy coherence. To address these gaps, a **Green Sugar Industry Framework (GSIF)** is proposed, integrating four key components: (1) Policy Alignment promoting international and local regulations that incentivize sustainable practices, including the integration of compliance and certification systems; (2) Capacity Building—equipping farmers, millers, and workers with skills and knowledge on green technologies and culture; (3) Incentive Structure—developing effective mechanisms and incentive systems that leverage information technology to promote compliance and drive innovation for enhanced green awareness; and (4) Monitoring and Evaluation—establishing transparent monitoring systems to assess environmental performance, encompassing plant operations, inbound logistics and green efficiency. This framework aims to create an enabling ecosystem where sustainability becomes integral to the sugar industry's competitiveness, productivity, and resilience.

FIGURE 1
GREEN SUGAR INDUSTRY FRAMEWORK (GSIF)



ACKNOWLEDGEMENTS

Our sincere gratitude to all the participants who generously shared their time and insights during the survey, focus group discussions, and the framework presentation. Your contributions were invaluable in shaping the depth and direction of this study. All glory and honor to God for the wisdom, strength, and guidance throughout this research journey. This work is dedicated to our fellow Negrenses, whose resilience and commitment to sustainable development continue to inspire this advocacy for a greener sugar industry.

REFERENCES

- Ab Talib, M.S., Ai Chin, T., & Fischer, J. (2017). Linking Halal food certification and business performance. *British Food Journal*, 119(7), 1606–1618.
- Abuzeinab, A., Arif, M., Qadri, M.A., & Kulonda, D. (2018). Green business models in the construction sector: an analysis of outcomes and benefits. *Construction Innovation*, 18(1), 20–42.
- Ali, S.S., Kaur, R., & Marmolejo Saucedo, J.A. (2019). *Best practices in green supply chain management: A developing country perspective*. Emerald Publishing Limited.

- Amrutha, V.N., & Geetha, S.N. (2020). A systematic review on green human resource management: Implications for social sustainability. *Journal of Cleaner Production*, 247, 119131.
- Arimura, T.H., Hibiki, A., & Katayama, H. (2008). Is a voluntary approach an effective environmental policy instrument?: A case for environmental management systems. *Journal of Environmental Economics and Management*, 55(3), 281–295.
- Ariyanti, F.D. (2018, December). Green supply chain practices in Indonesia's industries. *IOP Conference Series: Earth and Environmental Science*, 195(1), 012028.
- Asaithambi, P., & Matheswaran, M. (2016). Electrochemical treatment of simulated sugar industrial effluent: Optimization and modeling using a response surface methodology. *Arabian Journal of Chemistry*, 9, S981–S987.
- Bauer, R.M., & Gegenhuber, T. (2015). Crowdsourcing: Global search and the twisted roles of consumers and producers. *Organization*, 22(5), 661–681.
- Bengtsson, E. (2007). A history of Scandinavian socially responsible investing. *Journal of Business Ethics*, 82(4), 969–983. <https://doi.org/10.1007/s10551-007-9606-y>
- Bienhaus, F., & Haddud, A. (2018). Procurement 4.0: Factors influencing the digitisation of procurement and supply chains. *Business Process Management Journal*, 24(4), 965–984.
- Bombiak, E., & Marciniuk-Kluska, A. (2018). Green human resource management as a tool for the sustainable development of enterprises: Polish young company experience. *Sustainability*, 10(6), 1739.
- Carlander, J., & Thollander, P. (2023). Barriers to implementation of energy-efficient technologies in building construction projects — Results from a Swedish case study. *Resources, Environment and Sustainability*, 11, 100097. <https://doi.org/10.1016/j.resenv.2022.100097>
- Carter, C.R., & Rogers, D.S. (2008). A framework of sustainable supply chain management: Moving toward new theory. *International Journal of Physical Distribution & Logistics Management*, 38(5), 360–387.
- Conrad, K.J., Yagelka, J.R., Matters, M.D., Rich, A.R., Williams, V., & Buchanan, M. (2001). Reliability and validity of a modified Colorado Symptom Index in a national homeless sample. *Mental Health Services Research*, 3, 141–153.
- Dahlmann, F., Branicki, L., & Brammer, S. (2019). Managing carbon aspirations: The influence of corporate climate change targets on environmental performance. *Journal of Business Ethics*, 158, 1–24.
- Escanciano, C., & Santos-Vijande, M.L. (2014). Reasons and constraints to implementing an ISO 22000 food safety management system: Evidence from Spain. *Food Control*, 40, 50–57.
- De Grosbois, D. (2012). Corporate social responsibility reporting by the global hotel industry: Commitment, initiatives and performance. *International Journal of Hospitality Management*, 31(3), 896–905.
- Dong, J.Q. (2019). Moving a mountain with a teaspoon: Toward a theory of digital entrepreneurship in the regulatory environment. *Technological Forecasting & Social Change*, 146, 923–930. [doi:10.1016/j.techfore.2018.07.050](https://doi.org/10.1016/j.techfore.2018.07.050)
- Dornfeld, H.C., da Silva Mansano, A., Borges, R.C., Oliveira, M.S., & e Paulillo, L.F.O. (2021). Impact of environmental strategies and practices on the socioeconomic development of the Brazilian sugar-energy sector. *Clean Technologies and Environmental Policy*, 23(9), 2655–2668.
- Evangelista, P., & Durst, S. (2015). Knowledge management in environmental sustainability practices of third-party logistics service providers. *Vine*, 45(4), 509–529.
- Fadly, D. (2020). Greening industry in Vietnam: Environmental management standards and resource efficiency in SMEs. *Sustainability*, 12(18), 7455.
- Fortuński, B. (2008). Does the environmental management standard ISO 14001 stimulate sustainable development? An example from the energy sector in Poland. *Management of Environmental Quality: An International Journal*, 19(2), 204–212.
- Fronzel, M., Krätschell, K., & Zwick, L. (2018). Environmental management systems: Does certification pay? *Economic Analysis and Policy*, 59, 14–24.

- Gritsenko, A.V., Glemba, K.V., & Petelin, A.A. (2021). A study of the environmental qualities of diesel engines and their efficiency when a portion of their cylinders are deactivated in small-load modes. *Journal of King Saud University-Engineering Sciences*, 33(1), 70–79.
- González-Benito, J., & González-Benito, Ó. (2005). Environmental proactivity and business performance: An empirical analysis. *Omega*, 33(1), 1–15. <https://doi.org/10.1016/j.omega.2004.03.002>
- Graves, L.M., & Sarkis, J. (2018). The role of employees' leadership perceptions, values, and motivation in employees' pro-environmental behaviors. *Journal of Cleaner Production*, 196, 576–587.
- Groves, S.K., Burns, N., & Gray, J.R. (2013). *The practice of nursing research: Appraisal, synthesis, and generation of evidence*. St; Louis, MO: Elsevier Saunders.
- Guillard, V., Gaucel, S., Fornaciari, C., Angellier-Coussy, H., Buche, P., & Gontard, N. (2018). The next generation of sustainable food packaging to preserve our environment in a circular economy context. *Frontiers in Nutrition*, 5, 121.
- Haddara, M., & Elragal, A. (2015). The readiness of ERP systems for the factory of the future. *Procedia Computer Science*, 64, 721–728. <https://doi.org/10.1016/j.procs.2015.08.598>
- Haddock-Millar, J., & O'Donohue, W. (2016). Green human resource management and talent management. In *Contemporary talent management* (pp. 315–333). Routledge.
- Hajmohammad, S., Vachon, S., Klassen, R.D., & Gavronski, I. (2013). Lean management and supply management: Their role in green practices and performance. *Journal of Cleaner Production*, 39, 312–320. <https://doi.org/10.1016/j.jclepro.2012.07.028>
- Haque, F., & Ntim, C.G. (2018). Environmental policy, sustainable development, governance mechanisms and environmental performance. *Business Strategy and the Environment*, 27(3), 415–435. <https://doi.org/10.1002/bse.2007>
- Holgado, M., Macchi, M., & Evans, S. (2020). Exploring the impacts and contributions of maintenance function for sustainable manufacturing. *International Journal of Production Research*, 58(23), 7292–7310.
- Horbach, J. (2008). Determinants of environmental innovation—New evidence from German panel data sources. *Research Policy*, 37(1), 163–173.
- Jackson, G., & Apostolou, A. (2010). Corporate social responsibility in Western Europe: An institutional mirror or substitute? *Journal of Business Ethics*, 94(3), 371–394.
- Jell-Ojabor, M., & Raha, A. (2022). Being good at being good—The mediating role of an environmental management system in value-creating green supply chain management practices. *Business Strategy and the Environment*, 31(5), 1964–1984.
- Jiefang, Z. (2019). Population, resources, the environment and sustainable development. *Meteorological and Environmental Research*, 10(1), 16–18, 25. Retrieved from <https://www.proquest.com/scholarly-journals/population-resources-environment-sustainable/docview/2176207294/se-2>
- Juholin, E. (2004). For business or the good of all? A Finnish approach to corporate social responsibility. *Corporate Governance: The International Journal of Business in Society*, 4(3), 20–31. <https://doi.org/10.1108/14720700410547477>
- Kabir, E., Kaur, R., Lee, J., Kim, K.H., & Kwon, E.E. (2020). Prospects of biopolymer technology as an alternative option for non-degradable plastics and sustainable management of plastic wastes. *Journal of Cleaner Production*, 258, 120536.
- Karaman, A.D., Cobanoglu, F., Tunalioglu, R., & Ova, G. (2012). Barriers and benefits of the implementation of food safety management systems among the Turkish dairy industry: A case study. *Food Control*, 25(2), 732–739.
- Kasser, T. (2002). Sketches for a self-determination theory of values. In E.L. Deci, & R.M. Ryan (Eds.), *Handbook of Self-determination Research* (pp. 123 e140). University of Rochester, Rochester, NY.
- Khan, M.S., Saengon, P., Alganad, A.M.N., Chongcharoen, D., & Farrukh, M. (2020). Consumer green behaviour: An approach towards environmental sustainability. *Sustainable Development*, 28(5), 1168–1180. <https://doi.org/10.1002/sd.2066>

- Lasi, H., Fettke, P., Kemper, H.G., Feld, T., & Hoffmann, M. (2014). Industry 4.0. *Business & Information Systems Engineering*, 6, 239–242.
- Latip, M., Sharkawi, I., Mohamed, Z., & Kasron, N. (2022). The Impact of External Stakeholders' Pressures on the Intention to Adopt Environmental Management Practices and the Moderating Effects of Firm Size. *Journal of Small Business Strategy*, 32(3), 45–66.
- Li, S., Ngniatedema, T., & Chen, F. (2017). Understanding the impact of green initiatives and green performance on financial performance in the US. *Business Strategy and the Environment*, 26(6), 776–790.
- Liu, T., Chen, L., Yang, M., Sandanayake, M., Miao, P., Yang, S., & Yap, P. (2022). Sustainability considerations of green buildings: A detailed overview on current advancements and future considerations. *Sustainability*, 14(21), 14393. <https://doi.org/10.3390/su142114393>
- Liyanage, J.P. (2007). Operations and maintenance performance in production and manufacturing assets: The sustainability perspective. *Journal of Manufacturing Technology Management*, 18(3), 304–314.
- Mafini, C., & Muposhi, A., (2017). The impact of green supply chain management in small to medium enterprises: Cross-sectional evidence. *Journal of Transport and Supply Chain Management*, 11(0), a270. <https://doi.org/10.4102/jtscm.v11i0.270>
- Malokani, D.K.A.K., Qureshi, A.A., Inayat, A., & Mahar, Q. (2023). Impact of reduction of waste and waste, green employee behavior and reduction of resource use on environmental strategy: Manufacturing companies top management's perception. *Journal of Social Sciences Review*, 3(2), 27–39.
- Manrique, S., & Martí-Ballester, C.P. (2017). Analyzing the effect of corporate environmental performance on corporate financial performance in developed and developing countries. *Sustainability*, 9(11), 1957. <https://doi.org/10.3390/su9111957>
- Masri, H.A., & Jaaron, A.A. (2017). Assessing green human resources management practices in Palestinian manufacturing context: An empirical study. *Journal of Cleaner Production*, 143, 474–489.
- Massoud, M.A., Fayad, R., Kamleh, R., & El-Fadel, M. (2015). *Environmental management system (ISO 14001) certification in developing countries: Challenges and implementation strategies*.
- Molina-Azorín, J.F., Tari, J.J., Pereira-Moliner, J., Lopez-Gamero, M.D., & Pertusa-Ortega, E.M. (2015). The effects of quality and environmental management on competitive advantage: A mixed methods study in the hotel industry. *Tourism Management*, 50, 41–54.
- Munir, K., & Ameer, A. (2020). Nonlinear effect of FDI, economic growth, and industrialization on environmental quality: Evidence from Pakistan. *Management of Environmental Quality: An International Journal*, 31(1), 223–234.
- Ososanmi, A.O., Ojo, L.D., Ogundimu, O.E., & Oke, A.E. (2022). Drivers of green supply chain management: A close-up study. *Environmental Science and Pollution Research*, 29(10), 14705–14718.
- Paillé, P., Valéau, P., & Carballo-Penela, A. (2023). Green rewards for optimizing employee environmental performance: Examining the role of perceived organizational support for the environment and internal environmental orientation. *Journal of Environmental Planning and Management*, 66(14), 2810–2831.
- Porter, M.E., & Kramer, M.R. (2006). The link between competitive advantage and corporate social responsibility. *Harvard Business Review*, 84(12), 78–92.
- Ranjan, P., Singh, S., Muteen, A., Biswas, M.K., & Vidyarthi, A.K. (2021). Environmental reforms in sugar industries of India: An appraisal. *Environmental Challenges*, 4, 100159.
- Raut, R.D., Gardas, B., Luthra, S., Narkhede, B., & Kumar Mangla, S. (2020). Analysing green human resource management indicators of automotive service sector. *International Journal of Manpower*, 41(7), 925–944.
- Rujnić-Sokele, M., & Pilipović, A. (2017). Challenges and opportunities of biodegradable plastics: A mini review. *Waste Management & Research*, 35(2), 132–140.

- Sahu, O.P., & Chaudhari, P.K. (2015). Electrochemical treatment of sugar industry wastewater: COD and color removal. *Journal of Electroanalytical Chemistry*, 739, 122–129.
- Solomon, S., Quirk, R.G., & Shukla, S.K. (2019). Green management for sustainable sugar industry. *Sugar Tech*, 21(2), 183–185.
- Steg, L., Bolderdijk, J.W., Keizer, K., & Perlaviciute, G. (2014). An integrated framework for encouraging pro-environmental behaviour: The role of values, situational factors, and goals. *Journal of Environmental Psychology*, 38, 104–115.
- van den Broek, K., Bolderdijk, J.W., & Steg, L. (2017). Individual differences in values determine the relative persuasiveness of biospheric, economic and combined appeals. *Journal of Environmental Psychology*, 53, 145–156.
- Velenturf, A.P., & Purnell, P. (2021). Principles for a sustainable circular economy. *Sustainable Production and Consumption*, 27, 1437–1457.
- Viana, K.R., & Perez, R. (2013). Survey of sugarcane industry in Minas Gerais, Brazil: Focus on sustainability. *Biomass and Bioenergy*, 58, 149–157.
- Waxin, M.F., Knuteson, S.L., & Bartholomew, A. (2019). Drivers and challenges for implementing ISO 14001 environmental management systems in an emerging Gulf Arab country. *Environmental Management*, 63, 495–506.
- Wolf, J., Hubbard, S., Bräuer, M., Ambelu, A., Arnold, B.F., Bain, R., . . . Boisson, S. (2022). Effectiveness of interventions to improve drinking water, sanitation, and handwashing with soap on risk of diarrhoeal disease in children in low-income and middle-income settings: a systematic review and meta-analysis. *The Lancet*, 400(10345), 48–59. [https://doi.org/10.1016/s0140-6736\(22\)00937-0](https://doi.org/10.1016/s0140-6736(22)00937-0)
- Xiao, J., Xu, Z., Xiao, A., Wang, X., & Skare, M. (2024). Overcoming barriers and seizing opportunities in the innovative adoption of next-generation digital technologies. *Journal of Innovation & Knowledge*, 9(4), 100622.
- Yadav, M., Yadav, R.K., & Gole, V.L. (2021). Sugar industry wastewater treatment: Current practices and advances. In *Microbial ecology of wastewater treatment plants* (pp. 151–174). Elsevier.
- Yaguchi, Y., Takeuchi, K., Waragai, T., & Tateno, T. (2020). Durability evaluation of an additive manufactured biodegradable composite with continuous natural fiber in various conditions reproducing usage environment. *International Journal of Automation Technology*, 14(6), 959–965.
- Yang, J., Han, Q., Zhou, J., & Yuan, C. (2015). The influence of environmental management practices and supply chain integration on technological innovation performance—Evidence from China's manufacturing industry. *Sustainability*, 7(11), 15342–15361.
- Younis, H., Sundarakani, B., & O'Mahony, B. (2020). Investigating the relationship between green supply chain management and corporate performance using a mixed method approach: Developing a roadmap for future research. *IIMB Management Review*, 32(3), 305–324.
- Zhenjing, G., Chupradit, S., Ku, K.Y., Nassani, A.A., & Haffar, M. (2022, May 13) *Impact of Employees' Workplace Environment on Employees' Performance: A Multi-Mediation Model*. *Front Public Health*, 10, 890400. doi: 10.3389/fpubh.2022.890400. PMID: 35646787; PMCID: PMC9136218
- Zhuo, Y.G., Li, W., Li, W., Deng, J., & Lin, Q. (2023). A review on takeaway packaging waste: Types, ecological impact, and disposal route. *Environmental Pollution*, 337, 122518. <https://doi.org/10.1016/j.envpol.2023.122518>