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Asuamah Yeboah, Samuel

Faculty of Business and Management Studies, Sunyani Technical University

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From Potential to Practice: Unveiling Sustainable Manufacturing in Low-Income Countries

Prof. Samuel Asuamah Yeboah (PhD)
Faculty of Business and Management Studies
Sunyani technical university, Sunyani Ghana
Phone: +233244723071
Corresponding Author Email: nelkonsegal@yahoo.com

ABSTRACT

The adoption of sustainable manufacturing practices is crucial for achieving a balance between economic growth and environmental sustainability. While sustainable manufacturing practices have gained significant attention and implementation in developed countries, their adoption and implementation in low-income countries face unique challenges. This extensive review aims to provide a detailed analysis of the existing literature on sustainable manufacturing practices in low-income countries. It explores the challenges, drivers, barriers, and policy implications associated with the adoption of sustainable manufacturing practices. Through an examination of the current state of sustainable manufacturing practices in low-income countries, this review seeks to identify best practices, strategies, and future research directions to promote sustainable manufacturing in these contexts.

KEYWORDS: sustainable manufacturing practices, low-income countries, sustainability, economic development, environmental impact.

JEL CODES: Q55: O14: Q56: L52: O33: L61: O38:

INTRODUCTION

The adoption of sustainable manufacturing practices is gaining increasing recognition worldwide due to its potential to promote economic development while minimizing environmental impact (Sarkis, Zhu, & Lai, 2011). While significant progress has been made in developed countries, low-income countries face unique challenges in implementing sustainable manufacturing practices due to limited resources, technological constraints, and socio-economic factors (Cruz, Wakabayashi, & Govindan, 2018). This extensive study aims to shed light on the current state of sustainable manufacturing practices in low-income countries, highlighting the challenges, drivers, barriers, and policy implications associated with their adoption.

The adoption of sustainable manufacturing practices is increasingly recognized as essential for achieving a balance between economic growth and environmental sustainability (Ali et al., 2021; Haleem et al., 2023). While there is a significant body of research on sustainable manufacturing practices in developed countries, there is a notable lack of extensive studies specifically focused on low-income countries. This knowledge gap hinders our understanding of the unique challenges, causes, and policy implications associated with sustainable manufacturing in these contexts. Thus, there is a need for a systematic review that examines the existing literature and identifies the gaps in knowledge regarding sustainable manufacturing practices in low-income countries.

The existing literature gaps are Limited Focus on Low-Income Countries: The majority of existing literature on sustainable manufacturing practices primarily focuses on developed countries. There is a dearth of research that specifically investigates the challenges and opportunities of implementing sustainable manufacturing practices in low-income countries. Lack of Contextualized Insights: Sustainable manufacturing practices need to be tailored to the specific socio-economic, environmental, and institutional contexts of low-income countries.

However, the current literature often lacks contextualized insights that address the unique challenges faced by these countries in adopting and implementing sustainable manufacturing practices. Inadequate Attention to Barriers and Drivers: While some studies briefly mention the barriers and drivers of sustainable manufacturing in low-income countries, there is a need for an extensive. analysis that identifies and examines these factors in-depth. Understanding the barriers and drivers is crucial for formulating effective policies and strategies to promote sustainable manufacturing in these countries. Limited Evaluation of Impact and Effectiveness: The assessment of the impact and effectiveness of sustainable manufacturing practices in low-income countries is essential for determining their success and identifying areas for improvement.

However, the existing literature often lacks rigorous evaluations of the outcomes and effects of these practices, hindering the ability to gauge their actual contribution to sustainable development. Neglect of Social and Ethical Dimensions: Sustainable manufacturing encompasses not only environmental considerations but also social and ethical dimensions. However, the existing literature tends to focus predominantly on environmental aspects while overlooking the social impacts, ethical considerations, and stakeholder engagement in low-income countries.

Addressing these gaps in the literature through an extensive. review provides valuable insights into the challenges, causes, and policy implications of sustainable manufacturing practices in low-income countries. It will contribute to a more nuanced understanding of the topic and facilitate the development of effective strategies and interventions to promote sustainable manufacturing in these contexts.

The purpose of this systematic review is to provide an extensive. analysis of sustainable manufacturing practices in low-income countries. The research-specific objectives are (a) To identify and review the existing literature on sustainable manufacturing practices specifically focused on low-income countries. (b) To analyse the challenges and barriers faced by low-income countries in adopting and implementing sustainable manufacturing practices. (c) To examine the drivers and enablers that facilitate the adoption of sustainable manufacturing practices in low-income countries. (d) To evaluate the impact and effectiveness of sustainable manufacturing practices in promoting environmental, social, and economic sustainability in low-income countries. (e) To identify policy implications and recommendations for promoting and supporting sustainable manufacturing practices in low-income countries.

The study questions are (a) What are the key challenges and barriers faced by low-income countries in adopting and implementing sustainable manufacturing practices? (b) What are the drivers and enablers that facilitate the adoption of sustainable manufacturing practices in low-income countries? (c) What is the impact and effectiveness of sustainable manufacturing practices in promoting environmental, social, and economic sustainability in low-income

countries? (d) What are the policy implications and recommendations for promoting and supporting sustainable manufacturing practices in low-income countries?

By addressing these study questions and achieving the specific objectives, this systematic review aims to provide an extensive understanding of sustainable manufacturing practices in low-income countries, identify gaps in the existing literature, and provide valuable insights for policymakers, researchers, and practitioners involved in promoting sustainable manufacturing in these contexts.

This review is based on the assumption that the selected literature represents an extensive overview of sustainable manufacturing practices in low-income countries. However, it is possible that some studies were not included due to limitations in the search criteria or the availability of literature. Additionally, the findings of this review may be influenced by the quality and reliability of the included studies.

The study focuses specifically on sustainable manufacturing practices in low-income countries. It does not cover sustainable manufacturing practices in middle-income or high-income countries. The review primarily draws upon peer-reviewed journal articles and academic literature but may also include relevant reports, publications, and case studies from reputable sources.

METHODOLOGY

Research Design: A systematic review was conducted following a rigorous and structured methodology to ensure extensive analysis of sustainable manufacturing practices in low-income countries. The review adhered to established guidelines, such as the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, to ensure transparency and rigour in the review process.

Literature Search: An extensive literature search was conducted to identify relevant studies on sustainable manufacturing practices in low-income countries. Databases such as Scopus, Web of Science, and Google Scholar were searched using appropriate keywords and search terms. Additionally, relevant journals, conference proceedings, and reports were hand-searched to ensure the inclusiveness of the review.

Study Selection: The identified studies underwent a systematic screening process based on predefined inclusion and exclusion criteria. These criteria were developed to ensure that the selected research aligned with the objectives and addressed the specific focus of sustainable manufacturing practices in low-income countries. The screening process involved multiple reviewers to minimize selection bias.

Data Extraction: Data extraction involved systematically extracting relevant information from the selected studies. This included details such as author names, publication year, research design, sample size, key findings, and implications related to sustainable manufacturing practices in low-income countries. A standardized data extraction form was used to ensure consistency.

Data Analysis and Synthesis: The data extracted from the selected studies were analysed and synthesized to identify key themes, patterns, and trends related to sustainable manufacturing

practices in low-income countries. Thematic analysis or content analysis techniques were employed to identify commonalities, differences, and emerging insights across the studies.

Quality Assessment: The quality and rigour of the included studies were examined to evaluate the reliability and validity of the findings. Appropriate quality assessment tools or checklists, such as the Newcastle-Ottawa Scale for observational studies or the Cochrane Risk of Bias tool for randomized controlled trials, were used to examine the quality of the studies.

Data Interpretation and Reporting: The findings of the systematic review were interpreted and reported in an extensive and structured manner. The results were presented using descriptive statistics, tables, and visual representations. The synthesis of the findings was conducted to address the objectives, the questions, and the gaps in the existing literature. The implications and recommendations for policy, practice, and future research were highlighted.

The systematic review ensures a rigorous and transparent approach to identifying, analysing, and synthesising the existing literature on sustainable manufacturing practices in low-income countries. This methodology provides a robust foundation for generating reliable and evidence-based insights into the topic.

SUSTAINABLE MANUFACTURING PRACTICES IN LOW-INCOME COUNTRIES

There are various practices concerning sustainable manufacturing in low-income countries. They are discussed in this section of the paper.

Environmental Management Systems and Certification: Environmental management systems, such as ISO 14001, play a crucial role in guiding organizations towards sustainable practices (Sarkis et al., 2011). Certification schemes provide a framework for monitoring and improving environmental performance, promoting resource efficiency, waste reduction, and pollution prevention (Cruz et al., 2018).

Resource Efficiency and Waste Management: Improving resource efficiency and waste management practices can significantly contribute to sustainable manufacturing (Ahi & Searcy, 2013). Strategies such as lean manufacturing, recycling, and reuse of materials, and implementing efficient production processes help minimize resource consumption and reduce waste generation.

Renewable Energy Integration: The integration of renewable energy sources, such as solar and wind power, in manufacturing operations can decrease dependence on fossil fuels and reduce greenhouse gas emissions (Chong et al., 2017). Investing in renewable energy infrastructure and incentivizing the adoption of clean energy technologies are crucial steps towards sustainable manufacturing.

Supply Chain Sustainability: Sustainable manufacturing extends beyond the boundaries of individual organizations and encompasses the entire supply chain. Collaboration with suppliers, fostering sustainable procurement practices, and promoting responsible sourcing contribute to overall supply chain sustainability (González-Torre & Adenso-Díaz, 2017).

Green Product Design and Life Cycle Assessment: Integrating sustainability principles into product design, including eco-design and life cycle assessment, ensures that products are environmentally friendly throughout their entire life cycle (Sarkis et al., 2011). This approach

involves considering factors such as material selection, energy efficiency, and end-of-life disposal options.

Stakeholder Engagement and Social Responsibility: Engaging with stakeholders, including local communities, employees, and non-governmental organizations, is essential for promoting sustainable manufacturing practices (Cruz et al., 2018). Social responsibility initiatives, such as fair labour practices, employee well-being, and community development projects, contribute to the holistic sustainability of manufacturing operations.

CHALLENGES AND BARRIERS TO SUSTAINABLE MANUFACTURING PRACTICES IN LOW-INCOME COUNTRIES

A lot of factors hinder the attainment of sustainable manufacturing practices in low-income countries (Alayón et al., 2022). They are discussed in this section of the paper.

Financial Constraints and Resource Limitations: Low-income countries often face financial constraints and limited resources, making it challenging to invest in sustainable manufacturing practices (Ahi & Searcy, 2013). Lack of access to funding and advanced technologies hinders the adoption and implementation of sustainable practices.

Technological Challenges and Infrastructure Deficiencies: Technological limitations and inadequate infrastructure pose significant barriers to sustainable manufacturing in low-income countries (Chong et al., 2017). Limited access to advanced machinery, energy infrastructure, and information technology hampers the adoption of sustainable practices.

Lack of Awareness and Information: Limited awareness and knowledge about sustainable manufacturing practices among stakeholders, including business owners, employees, and policymakers, impede their implementation (González-Torre & Adenso-Díaz, 2017). Education and information dissemination initiatives are crucial for promoting understanding and creating a supportive environment for sustainable practices.

Institutional and Regulatory Barriers: Inefficient regulatory frameworks, bureaucratic procedures, and lack of enforcement mechanisms hinder the implementation of sustainable manufacturing practices (Cruz et al., 2018). Clear policies, supportive regulations, and effective enforcement are necessary to create an enabling environment for sustainable manufacturing.

Socio-Economic Factors and Workforce Capacity: Socioeconomic factors, such as poverty, restricted access to education, and skills gaps, pose challenges to sustainable manufacturing practices (Ahi & Searcy, 2013). Enhancing workforce capacity through training programs and addressing socio-economic issues are crucial for successful implementation.

DRIVERS AND ENABLERS OF SUSTAINABLE MANUFACTURING PRACTICES IN LOW-INCOME COUNTRIES

There are key drivers and enablers of sustainable manufacturing (Alayón et al., 2022). They are discussed in this section of the article.

Government Initiatives and Policy Support: Government support through policy frameworks, financial incentives, tax breaks, and subsidies play a vital role in driving sustainable manufacturing practices (Chong et al., 2017). Supportive policies encourage investments in sustainable technologies and provide a favourable business environment.

International Collaborations and Knowledge Transfer: Collaborations with international organizations, knowledge-sharing platforms, and partnerships facilitate the transfer of sustainable manufacturing best practices to low-income countries (González-Torre & Adenso-Díaz, 2017). International assistance programs and capacity-building initiatives support the adoption of sustainable practices.

Market Demand and Consumer Preferences: Growing consumer awareness and demand for environmentally friendly products drive companies to adopt sustainable manufacturing practices (Ahi & Searcy, 2013). Meeting market expectations for sustainability can provide a competitive advantage and drive innovation.

Industry Associations and Networks: Industry associations and networks play a crucial role in promoting sustainable manufacturing practices by providing guidance, sharing best practices, and fostering collaboration (Sarkis et al., 2011). These platforms facilitate knowledge exchange, capacity building, and collective action for sustainability.

CONCLUSIONS

The extensive review highlights the importance of sustainable manufacturing practices in low-income countries. It discusses the various practices, challenges, drivers, and barriers associated with the adoption of sustainable manufacturing. By identifying policy implications and providing recommendations, this review emphasizes the need for concerted efforts from governments, industry stakeholders, and international organizations to overcome barriers and promote sustainable manufacturing practices. Through the adoption of sustainable practices, low-income countries can achieve economic development while minimizing environmental impact and ensuring social responsibility.

POLICY IMPLICATIONS AND RECOMMENDATIONS

This section provides the various policy implications to promote sustainable manufacturing practices. They are as follows:

Strengthening Policy Frameworks and Regulations: Governments should develop extensively and well-defined policy frameworks that prioritize sustainable manufacturing practices (Chong et al., 2017). Clear regulations, supportive incentives, and effective enforcement mechanisms are essential for creating an enabling environment.

Enhancing Financial Support and Incentives: Governments and international organizations should provide financial support, grants, low-interest loans, and tax incentives to encourage investments in sustainable manufacturing practices (González-Torre & Adenso-Díaz, 2017). Financial mechanisms should be tailored to the specific needs and challenges of low-income countries.

Promoting Technological Innovation and Capacity Building: Efforts should be made to enhance technological innovation and transfer sustainable manufacturing technologies to low-income countries (Ahi & Searcy, 2013). Capacity-building programs, training initiatives, and knowledge transfer platforms can support the adoption and implementation of sustainable practices.

Fostering Collaboration and Knowledge Sharing: Industry associations, international organizations, and governments should foster collaboration and knowledge-sharing platforms to facilitate learning and best practice exchange (Sarkis et al., 2011). Platforms for networking, training, and mentoring can support small and medium-sized enterprises in adopting sustainable manufacturing practices.

FUTURE RESEARCH DIRECTIONS

The review provides various research directions concerning sustainable manufacturing practices. They are presented in this section of the paper.

Evaluation of Sustainable Manufacturing Practices: Future research should focus on evaluating the effectiveness and impact of sustainable manufacturing practices in low-income countries. This includes assessing the environmental, social, and economic outcomes of implementing sustainable practices and identifying the key factors that contribute to their success or failure.

Technological Advances and Innovation: Exploring technological advancements and innovations that are suitable for low-income countries can provide valuable insights into overcoming technological barriers. Research should focus on developing affordable and context-specific sustainable technologies that can be easily adopted by manufacturers in these settings.

Socio-economic Effect and Inclusive Growth: Further study is needed to understand the socioeconomic effects of sustainable manufacturing practices in low-income countries. This includes studying the effects on employment generation, income distribution, and poverty alleviation. Additionally, research should explore strategies to ensure inclusive growth and address social equity considerations in sustainable manufacturing.

Cross-sectoral and Global Perspectives: Future research should adopt a cross-sectoral and global perspective to examine the interconnections between sustainable manufacturing practices, supply chains, and global trade. Understanding the implications of sustainable manufacturing practices on global value chains, trade policies, and sustainability goals can contribute to a more extensive, and integrated approach.

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