Jurnal Ekonomi dan Bisnis, Vol. 14 No. 3 September 2025
P - ISSN : 2503-4413
E - ISSN : 2654-5837, Hal 749 – 765

HUMAN CAPITAL IN GREEN ECONOMIES: A SYSTEMATIC REVIEW OF WORKFORCE TRANSFORMATION OF ENVIRONMENTAL SUSTAINABILITY

Nofriansyah*
Doctoral of Economic Education, Universitas Pendidikan Indonesia, Indonesia
Dadang Dahlan
Doctoral of Economic Education, Universitas Pendidikan Indonesia, Indonesia
Nani Sutarni
Doctoral of Economic Education, Universitas Pendidikan Indonesia, Indonesia
Endang Supriatna
Economic Education, Universitas Linggabuana PGRI Sukabumi, Indonesia
Sri Rahayu
Economic Education, Universitas Pamulang, Indonesia
Maya Meilia
Management, Sekolah Tinggi Ekonomi dan Bisnis Islam Lampung, Indonesia
Jery Wardiman
Master of Economic Education, Universitas Negeri Padang, Indonesia

***Corresponding Author**
Nofriansyah
nofriansyah10@upi.edu

ARTICLE INFO

Article history :

Received:
04 January 2025
Revised:
10 July 2025
Accepted:
21 August 2025

ABSTRACT

Development focused on both environmental sustainability and economic growth, as demonstrated by the current global economic boom, is highly relevant. Emphasizing green skills development and green human resource management (GHRM), the role of human capital in transforming the workforce towards a green economy is crucial. This study examined 20 relevant articles out of 1,760 found in the Semantic Scholar and Scopus databases using the PRISMA approach. The findings show that the adoption of green technologies, particularly in sustainable industry and renewable energy, depends on the development of green human capital. Cooperation between the government, business community, and academic institutions is necessary to address structural barriers and skills gaps. Significant investments in education, training, and policies promoting sustainability and worker well-being are essential for transitioning the workforce to a green economy. The study also identifies major opportunities for job creation, environmental impact reduction, and the challenges faced in implementing a green economy.

Keywords: Environmental Sustainability, Green Economy, Green Skill, Human Capital, Workforce Transformation

INTRODUCTION

The current global economic growth increasingly highlights the importance of development that not only prioritizes economic improvement, but also environmental sustainability. The green economy concept refers to economic growth that is low in carbon emissions, resource-efficient, and socially inclusive, with environmental sustainability being one of the main pillars. In the midst of climate change, the role of human capital is key in supporting the transition to a green economy. The shift towards a green economy has become a major focus in efforts to achieve environmental sustainability around the world. In this context, human capital plays a pivotal role in the transformation of the workforce required to support green initiatives. Human capital, which encompasses the knowledge, skills and abilities of individuals, is key in implementing green practices in various industrial sectors (Munteanu et al., 2020; Becker, 1993).

An empirical explanation of the urgency of this research is grounded in the pressing global need to realign workforce capabilities with the sustainability agenda. The increasing demand for environmentally responsible practices and the rapid expansion of green industries have resulted in a skills mismatch and gaps in green knowledge, particularly in developing countries. Without strategic efforts to enhance green human capital, the transition to a sustainable economy will face serious implementation bottlenecks. This research is therefore timely and necessary to provide an evidence-based overview of how human capital contributes to environmental sustainability through green workforce transformation.

The research problem addressed in this study is the limited understanding of the role of human capital in supporting green economic transformation, particularly in terms of workforce readiness and the development of green skills. The objective of this study is to systematically review empirical findings related to green human resource development and its contribution to workforce transformation, with a particular emphasis on how green skills, training, and leadership support sustainability goals in various sectors.

Green human resource management (GHRM) can increase an organization's commitment to sustainability and encourage employees to actively participate in green initiatives (Yusliza et al., 2017; Rayner & Morgan, 2018). In the context of developing countries, challenges in implementing GHRM are often related to a lack of understanding of the practices and the need for better training (Roscoe et al., 2019; Tsironis, 2023). Therefore, it is important to conduct proper training needs assessments to ensure that the workforce is prepared for the evolving demands of the green economy (Czabanowska & Feria, 2024).

Transforming the workforce towards a green economy involves not only improving technical skills, but also changes in mindset and organizational culture. Top management committed to corporate social responsibility (CSR) and GHRM plays an important role in creating a work environment that supports sustainability (Yusliza et al., 2017; Yusliza et al., 2019). In addition, research shows that the development of clear green goals for all employees can help translate environmental goals into concrete action plans, thereby encouraging active participation from the entire workforce (Shah, 2019). The green

economy focuses on reducing carbon emissions and efficient use of resources, which requires a transformation in the skills and knowledge of the workforce (Makhloufi et al., 2024; Asad et al., 2023). With increasing awareness of the environmental impact of industrial activities, it is important for organizations to integrate sustainability practices in their business models (Chaudhary, 2020). Human capital, which includes the skills, knowledge and values held by workers, is key in this transition (Roscoe et al., 2019). Previous research shows that green skills development can improve a company's environmental performance.

THEORETICAL FRAMEWORK AND EMPIRICAL STUDIES

Human capital is the skills, knowledge, and competencies acquired through education, which increase labor productivity and drive economic growth (Matashu & Skhephe, 2022). The shift to a green economy that prioritizes sustainability and environmental protection presents new challenges for the global workforce. In this transition process, significant changes in the skills and knowledge of the workforce are key factors in achieving sustainability goals. As green technologies, energy efficiency and green policies advance, the workforce will need to adapt to the demand for new skills that support these changes. Therefore, an in-depth understanding of human capital in the context of a green economy is essential to shape a workforce capable of addressing environmental challenges without compromising economic growth.

Human Capital Theory

Human capital theory is a concept that emphasizes the important role of investment in education and skills as a major factor in increasing the productivity and income of both individuals and organizations. While it has influenced various fields, such as economics, education and sociology, it has also received a lot of criticism since it was first developed. The theory evolved as a result of a rethinking of the role of humans in the post-industrial economy, where humans are no longer seen as “complements” to capital, but rather as the main production factor driving economic growth through their intellectual and creative potential (Musthafa et al., 2024). Human capital theory emphasizes the importance of education and skills as economic capital that can increase productivity and economic growth (Sweetland, 1996; Mayilyan & Yedigaryan, 2022).

Green Economy Theory

The Green Economy concept is a multidimensional concept that focuses on trade-offs and synergies between economic and environmental dimensions, with key differences in environmental focus and boundaries (Merino et al., 2020). Green economy concepts, approaches, and tools include environmental economics, ecological economics, cleaner production, waste hierarchy, bioeconomy, industrial ecology, circular economy, nature-based solutions, and dematerialization (Loiseau et al., 2016). The green economy aims to achieve sustainable development by transforming today's traditional economy into a system that consumes natural resources sustainably, reduces pollution, and combats

climate change (Souad, 2023). The green economy promotes sustainable development and achieves global goals by encouraging investment in natural capital, energy issues, organic food, land management, and resource management (Nesterov, 2023).

Sustainable Development Theory

Sustainable development is a concept that aims to improve human well-being without damaging ecosystems and resources that are essential for future life. It emphasizes the need to manage the global economy in harmony with the sustainable functioning of the earth's ecosystems, oceans, atmosphere and climate (Chakravarty, 2018; Fearnside, 2019). The basic principles of sustainable development include environmental protection, social justice, and integrated economic development (Dernbach, & Cheever, 2015). Environmentally sustainable economic development recognizes that environmental conservation and economic development can be mutually reinforcing (Barbier, 1987

RESEARCH METHODS

This study employs a literature review on human capital in green economies. The literature review was conducted using the online databases scopus and semantic scholar. Inclusion criteria included studies discussing green skills, human resource management, and their impact on environmental performance. The writing method for the findings of this review article began with a gap analysis, followed by the prisma (preferred reporting items for systematic reviews and meta-analyses) methodology. The prisma method consists of five stages: 1) defining eligibility criteria, 2) identifying information sources, 3) selecting data, 4) collecting data, and 5) extracting data.

The search involved using various keywords in english, particularly human capital, green economy, environmental sustainability, workforce transformation, and sustainable workforce development. Article selection was based on the assessment of titles, abstracts, and full texts according to the outlined criteria. To streamline the selection process, the researchers utilized the mendeley application, which facilitated a more structured approach during the selection phase. Subsequently, the coding, extraction, and analysis of the necessary information were carried out manually, with the data entered into a spreadsheet. Ultimately, 20 out of a total of 1,760 articles sourced from the scopus and semantic databases were excluded based on the criteria specified in the following table:

Tabel. 1 Inclution and Exclusion Criteria

No	Inclusion Criteria	Exclution Criteria
1.	Focused on human capital in green economy	Did not focus on human capital in green economy
2.	Published within the last five years to ensure their recency and relevance	Was published before the specified time periods
3.	Articles had international accreditation and were written in English	Articles were not internationally accredited and not written in English
4.	Available in full text format	Were not available in full text

A comprehensive overview of the article selection process is illustrated in the following Figure 1:

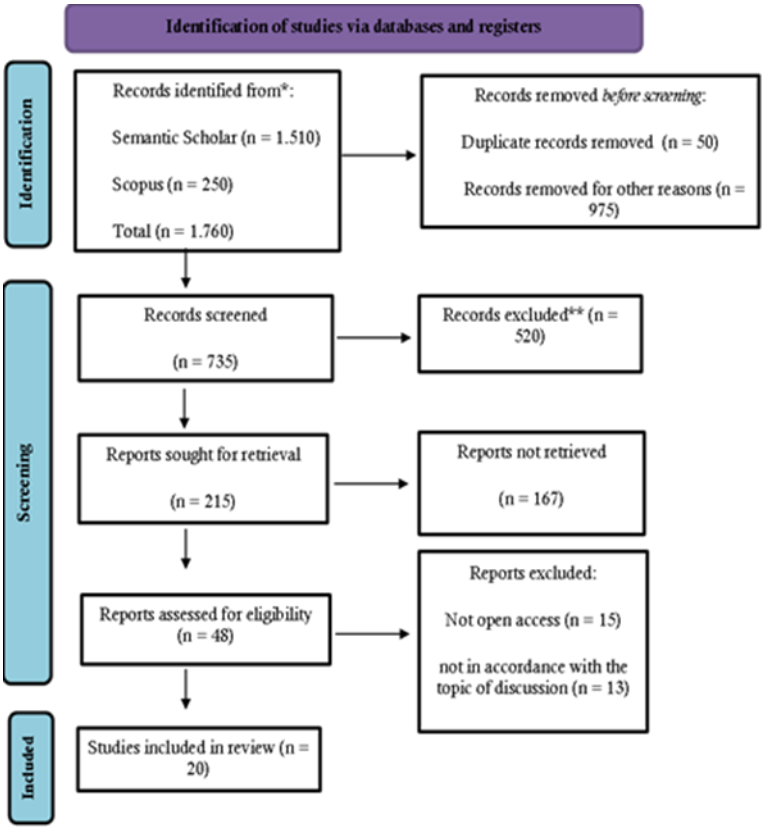

Figure 1. Article Selection Flow Diagram

Source: (Page et al., 2021)

RESULTS AND DISCUSSIONS

The review showed that sustainability focused human capital development can be done through various strategies, including green training and skills development (Roscoe et al., 2019; Huang et al., 2022). Research by Roscoe et al., (2019) emphasizes the importance of green human resource management in creating an organizational culture that supports sustainability. In addition, research by Bassi shows that the application of green economy models can improve the efficiency of resource use and reduce environmental impacts (Bassi, 2015). The required skills include an understanding of green technology and the ability to implement sustainable practices in daily operations (Liang et al., 2023).

Table 2. Research results that are relevant to the topics

Author and Years	Result
(Sgarbossa et al., 2020)	Research on human factors in design and the impact of Industry 4.0 technologies on production and logistics is limited. Most studies prioritize operational performance or worker well-being, with few adopting an integrated approach that considers both aspects and their influence on operational quality.
(Neagu et al., 2019)	Human capital positively correlates with gross value added in the bioeconomy sector across 26 European countries, with stronger effects in highly developed nations. In these countries, each additional employee increases gross value added by 43.7 units, nearly double the European average and 14.3 times higher than in developing economies.
(Bag & Gupta, 2020)	Green human capital enhances reverse logistics adoption and remanufacturing performance. Top management commitment moderates its impact on reverse logistics but not remanufacturing, while a sustainability culture strengthens its influence on both areas.
(Housawi et al., 2020)	The overall trainee satisfaction score of 69% did not meet the 80% target. The overall program director satisfaction score of 76% was slightly below the 80% target. The percentage of trainees who felt burnout was 66.7%, much higher than the 10% or below target.
(Biltagy & Nassar, 2020)	The Suez Canal Economic Zone focuses on attracting foreign investment, boosting exports, and implementing green strategies while enhancing local socio-economic conditions through capacity building, job creation, and local economic linkages, aiming to reduce regional disparities and benefit the local population.
(Ghobakhloo & Fathi, 2020)	Modernizing higher education and strategically recruiting international students are essential for Russia to foster an innovation-based, low-carbon economy and improve its global innovation ranking. Russian universities must better align recruitment efforts with research and innovation goals to enhance their impact.
(Petrusha et al., 2019)	Smaller manufacturers can effectively transition to Industry 4.0 by focusing on digitizing key operational areas and developing lean-digitized systems tailored to their unique needs, rather than attempting to overhaul the entire value chain
(Koleva, 2019)	In the machine-building sector, digitization is progressing slowly, affecting the workforce with new roles for 21%, partial impacts on 11%, and layoffs for 5%. Many employees feel uninformed and insecure, underscoring the need for better communication and adaptation strategies.
(Salmon & Read, 2018)	Most research prioritizes performance over worker well-being, with only 16 of 54 studies addressing both. Physical factors dominate, while mental and psychosocial aspects are overlooked, stressing the need for a balanced approach to improve performance and worker health.
(D'Adamo et al., 2020)	The SWOT-AHP method provides a robust framework for evaluating biomethane in transport, with stakeholder input improving analysis quality. The study highlights the need for supportive policies to promote greener transport in Europe.
(Aiello & Mellor, 2019)	A coordinated approach is vital to address the growing demands on health and social care services. Strategic workforce planning can tackle demographic shifts and workforce challenges, while collaboration among educational institutions, regulatory bodies, and

Author and Years	Result
	service providers is crucial for implementing effective integrated care.
(Hao et al., 2021)	The study shows that environmental taxes, renewable energy, and education significantly reduce CO2 emissions and support green growth. It urges G7 countries to strengthen policies, invest in renewables, and prioritize education for sustainable development.
(Qiu et al., 2021)	The study finds that stringent environmental regulations and environmentally aligned FDI boost GTFP by enhancing resource efficiency and green innovation. The positive effects are amplified under strong regulatory frameworks, with regional variations highlighting the need for tailored policies.
(Wang et al., 2021)	China's rapid growth in water and energy technology patents highlights its focus on climate change mitigation and green industry. However, reliance on traditional resources necessitates continued policy support and innovation for a full green transition.
(Hunjra et al., 2020)	Globalization enhances financial development and human capital's role in reducing emissions, while GDP growth and energy use raise them. The study suggests green financing, renewable energy investments, and tailored climate policies for sustainable growth.
(Sheraz et al., 2021)	The study finds that financial development and human capital reduce emissions, while GDP and energy consumption increase them. Globalization boosts financial development's impact, with recommendations for green financing, renewable energy, and education to achieve a low-carbon economy.
(Huang et al., 2022)	The higher human capital reduces emissions, with green energy further supporting environmental sustainability. The study highlights the need for investments in education, community awareness, and renewable energy to align economic growth with environmental protection.
(Song et al., 2022)	Digital inclusive finance boosts green development, with human capital enhancing its impact. The study emphasizes improving digital financial services and education investments to drive sustainable growth.
(Ding et al., 2021)	The study shows low-income countries depend on physical capital, while high-income nations gain more from human capital. It stresses education and skills investment for sustainability and calls for further research on economic development quality.
(Binh An et al., 2023)	The study finds that green innovation and renewable energy reduce PM2.5 pollution, enhancing health and environmental quality. It highlights the importance of regulations, long-term green benefits, and cross-country policy influences.

(Source: Secondary data processing)

Workforce Transformation in a Green Economy

Workforce transformation towards a green economy requires a large role of green human capital to support environmental sustainability and operational efficiency. Bag & Gupta, (2020) asserted that the availability of a workforce with green skills strongly influences the adoption of reverse logistics and remanufacturing practices in the automotive industry in South Africa. This suggests that a workforce skilled in sustainability directly influences green operational performance. Management commitment and a culture of sustainability also reinforce this adoption.

In addition, research by Neagu et al., (2019) showed a positive relationship between human capital and gross value added in the bioeconomy sector in the European Union. These results suggest that countries with a more environmentally skilled workforce tend to generate higher economic value added, especially in developed countries compared to developing countries in Eastern Europe.

Meanwhile, Sgarbossa et al., (2020) highlighted the importance of paying attention to human factors in future production and logistics systems, where the workforce needs to adapt to Industry 4.0 technologies that lead to operational sustainability. However, most studies still focus on operational performance without considering worker well-being, which needs to be addressed to create a balanced workforce transformation.

Skills Development in the Renewable Energy Sector

Green skills development is also crucial in the renewable energy sector. The importance of clean energy skills-directed training and education to prepare the workforce to support the transition to renewable energy. This is in line with the global need to reduce carbon emissions, where a workforce skilled in green technologies is key to achieving international environmental targets.

Skills development in the renewable energy sector in Indonesia is particularly important, given the challenges faced in transitioning from fossil energy to more sustainable energy. In this context, various efforts have been made to improve people's knowledge and skills, especially in areas underserved by conventional energy infrastructure.

First, the importance of education and socialization regarding renewable energy must start early. Introducing renewable energy to students in primary and secondary schools can help build awareness and understanding of the importance of sustainable energy sources. Research shows that many teachers face difficulties in delivering this material in an interesting and easy-to-understand manner (Irawati et al., 2021). Therefore, the development of appropriate teaching aids for renewable energy learning is needed, as it can increase students' understanding of how renewable energy works and benefits (Delima et al., 2023).

Furthermore, training and mentoring for community groups, such as farmers and fishermen, is also very important. For example, farmer groups in Salatiga have successfully implemented a Solar Power Plant (PLTS) system to fulfill their electricity needs (Setiyawan, 2021). Effective energy management training enables them to use this resource wisely and sustainably. In addition, community service programs that implement renewable energy technologies in remote areas, such as in Kiama Village, show that the application of appropriate technologies can help overcome the energy crisis in the area (Rumbayan et al., 2021).

On the other hand, the development of job skills in the renewable energy sector should also be considered. Research shows that marginalized communities often face barriers in accessing the necessary training and resources to develop their skills (Harahap et al., 2023). Therefore, collaboration between the government, educational institutions, and the private sector is essential to create inclusive and sustainable training programs.

Finally, challenges in renewable energy development in Indonesia, such as capitalization and business seriousness, must be addressed to ensure the sustainability of the sector (Sagala et al., 2023). By utilizing existing renewable energy potential, such as biomass and solar energy, Indonesia can reduce dependence on fossil energy and improve national energy security (Sonjaya et al., 2023).

Thus, skills development in the renewable energy sector is not only important to improve people's knowledge and skills, but also to support the transition towards a more sustainable and environmentally friendly energy system.

Challenges and Opportunities of Green Workforce Transformation

While green workforce transformation offers many opportunities, there are significant challenges related to workforce readiness and skills matching. Kwauk & Casey (2022) highlight the importance of education that supports green skills to address challenges in the green economy. This transformation requires collaboration between the public and private sectors to accelerate workforce adaptation to the needs of green industries. The analyzed literature shows that green human capital is a key element in supporting the transformation of the workforce towards a green economy. The development of green skills through training and continuing education will ensure that the workforce can effectively contribute to achieving environmental sustainability and global green economy goals.

Green workforce transformation faces significant challenges and opportunities in the era of a sustainable economy. One of the key challenges is the skills gap, where many workers currently lack the competencies needed to support green practices. Green industries require new skills related to clean technology, renewable energy and waste management, which demands large-scale reskilling and upskilling programs. Research by the International Labour Organization (2019) highlights that lack of access to green education is a major barrier to this transition, especially in developing countries. In addition, structural challenges such as the shift of industries from energy-intensive to green sectors could potentially lead to job losses in some traditional sectors that have not been integrated with sustainability practices.

Nevertheless, green workforce transformation also offers significant opportunities in creating new jobs and reducing environmental impacts. According to an Organisation for Economic Co-operation and Development (OECD) (2019), the transition to a green economy could create millions of new jobs in the renewable energy, energy efficiency and green infrastructure sectors. In addition, the implementation of Green Human Resource Management (Green HRM) policies can help companies develop a more adaptive, innovative and environmentally conscious workforce, thus supporting long-term sustainability. Green economy opportunities can also provide a chance for countries to reduce dependence on fossil energy, improve climate resilience, and strengthen local economies through the development of green industries.

Overall, green workforce transformation requires substantial investments in education and training, industry sector restructuring, and collaboration between government, industry and educational institutions. However, if managed well, the resulting

opportunities can support the achievement of sustainable development goals and drive the creation of a more inclusive and environmentally friendly economic ecosystem.

The Influence of Transformational Leadership in *Human Capital* Development

Transformational leadership plays a crucial role in developing human capital, especially in supporting organizational innovation, motivation, and productivity. It focuses on the leader's ability to inspire and motivate employees through a strong vision, positive change, and encouragement to grow personally and professionally. Transformational leadership style involves four main elements, namely inspirational motivation, idealized influence, individualized consideration, and intellectual stimulation. Through inspirational motivation, leaders create a clear vision that employees can follow, while idealized influence makes leaders role models of integrity and commitment to common goals.

In the context of human capital, transformational leadership not only motivates employees to improve their performance, but also encourages innovation and the development of new skills. Leaders who use intellectual stimulation foster a work environment that supports creativity, encouraging employees to think outside the box and find innovative solutions to challenges (Mahirun et al., 2021). In addition, leaders who pay attention to personal needs through individualized consideration are able to build strong relationships with employees, increase emotional engagement, and strengthen job satisfaction, which has a positive impact on workforce retention and organizational productivity (Kang & Sung, 2017).

Previous research shows that transformational leadership has a significant impact on increasing innovation, employee engagement, and achieving organizational goals. However, the successful implementation of this leadership style is also highly dependent on the characteristics of the leader and the cultural context in which the organization operates. Therefore, adaptation of the elements of transformational leadership is essential in achieving optimal results in various business and cultural environments. Thus, transformational leadership is an essential element in building highly competitive human capital amidst global challenges and rapid changes in the green and digital economy.

Innovation in Human Resource Policy

Innovation in human resource (HR) policies has become a key factor in driving organizational effectiveness, especially in the face of increasingly complex global demands. HR innovation includes the introduction of new strategies and management practices aimed at improving employee engagement, competency development, and creating an adaptive and innovative organizational culture. One prominent form of innovation is Green Human Resource Management (Green HRM), which supports environmental sustainability through the recruitment, training and development of employees focusing on environmentally friendly practices. Green HRM not only creates added value for companies in the context of sustainability, but also increases the competitiveness of organizations in the global market (Renwick et al., 2013).

In addition, innovations in HR policies also focus on digital and technological skills development, in line with the digital transformation sweeping across industries. Organizations that implement technology-based training and development strategies, such as e-learning and artificial intelligence-based training, are able to create a more flexible and skilled workforce in the face of rapid technological change. This is in line with research from Stone et al., (2015), which shows that innovation in technology-based HR training can significantly improve productivity and organizational performance.

Furthermore, innovations in HR policies also include work flexibility and *work-life balance,* where many companies are starting to implement remote work policies and flexible work schedules. These policies not only improve employee well-being, but also increase workforce retention and lower stress levels, as identified in a study by Aksoy et al. (2022), which showed that work flexibility has a positive impact on productivity and job satisfaction. Thus, innovations in HR policies create a more adaptive work environment, support work-life balance, and are able to respond more effectively to modern business challenges.

CONCLUSION, SUGGESTION, AND LIMITATION

Based on the literature review, the transformation of the workforce in the context of a green economy is significantly influenced by the availability of green human capital. Green skills play a crucial role in supporting the adoption of environmentally friendly technologies, particularly in the renewable energy sector and sustainable industries. Research also indicates that policies supporting the development of green skills are essential to ensure that the workforce can adapt to industry changes towards sustainability. Collaborative efforts between the government, industry, and educational institutions are needed to accelerate the development of green human capital. Additionally, more comprehensive policies must be implemented to promote training and education programs focused on green skills. Organizations should also integrate worker well-being with sustainability efforts to achieve a balanced transformation of the workforce.

Based on the findings of this review, several recommendations for future research can be proposed. First, future studies should investigate the effectiveness of green training programs in various industrial sectors using empirical and longitudinal approaches. Second, further exploration is needed on how leadership and organizational culture influence workforce adaptability to sustainability oriented change. Third, researchers are encouraged to examine inclusive strategies to address green skills gaps in developing countries, particularly among marginalized communities. Fourth, the impact of digital learning technologies in upskilling human capital for green economy demands should be further assessed. This study is limited by its reliance on secondary data obtained through systematic review, which may not fully capture emerging practices or innovations at the local level. Therefore, future research should consider conducting field based studies and cross-sectoral comparisons to enrich the findings and provide more context-specific and policy relevant insights.

REFERENCES

Aiello, M., & Mellor, J. D. (2019). Integrating health and care in the 21st century workforce. *Journal of Integrated Care*, *27*(2), 100–110. https://doi.org/10.1108/JICA-09-2018-0061

Aksoy, C. G., Barrero, J. M., Bloom, N., Davis, S. J., Dolls, M., & Zarate, P. (2022). Working from Home Around the World. *Brookings Papers on Economic Activity*, *2022-Fall*, 281–360. https://doi.org/10.1353/eca.2022.a901274

Asad, M., Majali, T., Aledeinat, M., Abdelkarim Almajali, D., & Akhorshaideh, A. H. O. (2023). Green entrepreneurial orientation for enhancing SMEs financial and environmental performance: Synergetic moderation of green technology dynamism and knowledge transfer and integration. *Cogent Business and Management*, *10*(3). https://doi.org/10.1080/23311975.2023.2278842

Bag, S., & Gupta, S. (2020). Examining the effect of green human capital availability in adoption of reverse logistics and remanufacturing operations performance. *International Journal of Manpower*, *41*(7), 1097–1117. https://doi.org/10.1108/IJM-07-2019-0349

Barbier, E. (1987). The Concept of Sustainable Economic Development. *Environmental Conservation*, 14, 101 - 110. https://doi.org/10.1017/S0376892900011449

Bassi, A. M. (2015). Moving towards integrated policy formulation and evaluation: The green economy model. *Environmental and Climate Technologies*, *16*(1), 5–19. https://doi.org/10.1515/rtuect-2015-0009

Becker, G. S. (1993). Human capital : a theoretical and empirical analysis, with special reference to education. In *TA - TT* - (3rd ed). The University of Chicago Press. https://doi.org/LK - https://worldcat.org/title/28180721

Biltagy, M., & Nassar, H. (2020). Human capital upgrading, social inclusion and new suez canal economic zone1 | Развитие человеческого капитала, социальная интеграция и новая экономическая зона Суэцкого канала. *Economy of Regions*, *16*(3), 962–974.

Binh An, N., Kuo, Y. L., Mabrouk, F., Sanyal, S., Muda, I., Hishan, S. S., & Abdulrehman, N. (2023). Ecological innovation for environmental sustainability and human capital development: the role of environmental regulations and renewable energy in advanced economies. *Economic Research-Ekonomska Istrazivanja* , *36*(1), 243–263. https://doi.org/10.1080/1331677X.2022.2120046

Chakravarty, S. (2018). Sustainable Development. *The European Journal of Development Research*, 3, 67-77. https://doi.org/10.1080/09578819108426541

Chaudhary, R. (2020). Green Human Resource Management and Employee Green Behavior: An Empirical Analysis. *Corporate Social Responsibility and Environmental Management*, *27*(2), 630–641. https://doi.org/10.1002/csr.1827

Czabanowska, K., & Feria, P. R. (2024). Training needs assessment tools for the public health workforce at an institutional and individual level: a review. *European Journal of Public Health*, *34*(1), 59–68. https://doi.org/10.1093/eurpub/ckad183

Dernbach, J., & Cheever, F. (2015). Sustainable Development and Its Discontents. *Transnational Environmental Law*, 4, 247 - 287. https://doi.org/10.1017/S2047102515000163

D'Adamo, I., Falcone, P. M., Gastaldi, M., & Morone, P. (2020). RES-T trajectories and an integrated SWOT-AHP analysis for biomethane. Policy implications to support a green revolution in European transport. *Energy Policy*, *138*(November), 111220. https://doi.org/10.1016/j.enpol.2019.111220

Ding, X., Huang, Y., Gao, W., & Min, W. (2021). A comparative study of the impacts of human capital and physical capital on building sustainable economies at different stages of economic development. *Energies*, *14*(19). https://doi.org/10.3390/en14196259

Ega Marita Delima, Afrizal Mayub, E. N. (2023). Jurnal Pendidikan MIPA. *Jurnal Pendidikan*, *14*(September), 723–731.

Fearnside, P. (2019). Sustainable Development. *Ecology*. https://doi.org/10.1093/obo/9780199830060-0227

Ghobakhloo, M., & Fathi, M. (2020). Corporate survival in Industry 4.0 era: the enabling role of lean-digitized manufacturing. *Journal of Manufacturing Technology Management*, *31*(1), 1–30. https://doi.org/10.1108/JMTM-11-2018-0417

Hao, L. N., Umar, M., Khan, Z., & Ali, W. (2021). Green growth and low carbon emission in G7 countries: How critical the network of environmental taxes, renewable energy and human capital is? *Science of the Total Environment*, *752*(March), 141853. https://doi.org/10.1016/j.scitotenv.2020.141853

Harahap, M. A. K., Azis, A. A., & Choerudin, A. (2023). Pengembangan Keterampilan Kerja dan Peluang Kerja bagi Masyarakat Terpinggirkan di Daerah Nyalindung. *Easta Journal of Innovative Community Services*, *1*(03), 184–194. https://doi.org/10.58812/ejincs.v1i03.125

Housawi, A., Amoudi, A. Al, Alsaywid, B., Lytras, M., Moreba, Y. H. B., Abuznadah, W., & Alhaidar, S. A. (2020). Evaluation of key performance indicators (Kpis) for sustainable postgraduate medical training: An opportunity for implementing an innovative approach to advance the quality of training programs at the saudi commission for health specialties (scfhs). *Sustainability (Switzerland)*, *12*(19), 1–37. https://doi.org/10.3390/su12198030

Huang, S. Z., Chien, F., & Sadiq, M. (2022). A gateway towards a sustainable environment in emerging countries: the nexus between green energy and human Capital. *Economic Research-Ekonomska Istrazivanja* , *35*(1), 4159–4176. https://doi.org/10.1080/1331677X.2021.2012218

Hunjra, A. I., Tayachi, T., Chani, M. I., Verhoeven, P., & Mehmood, A. (2020). The moderating effect of institutional quality on the financial development and environmental quality nexus. *Sustainability (Switzerland)*, *12*(9), 1–13. https://doi.org/10.3390/su12093805

International Labour Organization. (2019). *Skills For a Greener Future*. https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---ifp_skills/documents/publication/wcms_709121.pdf

Irawati, F., Kartikasari, F. D., & Tarigan, E. (2021). Pengenalan Energi Terbarukan dengan Fokus Energi Matahari kepada Siswa Sekolah Dasar dan Menengah. *Publikasi Pendidikan*, *11*(2), 164. https://doi.org/10.26858/publikan.v11i2.16413

Kang, M., & Sung, M. (2017). How symmetrical employee communication leads to employee engagement and positive employee communication behaviors: The mediation of employee-organization relationships. *Journal of Communication Management*, *21*(1), 82–102. https://doi.org/10.1108/JCOM-04-2016-0026

Koleva, N. (2019). An empirical study on human resoureces' attitude towards manufacturing digitalization. *International Conference on Creative Business for Smart and Sustainable Growth, CreBUS 2019*, 96–100. https://doi.org/10.1109/CREBUS.2019.8840057

Kwauk, C. T., & Casey, O. M. (2022). A green skills framework for climate action, gender empowerment, and climate justice. *Development Policy Review*, *40*(S2), 1–19. https://doi.org/10.1111/dpr.12624

Liang, P., Xie, S., Qi, F., Huang, Y., & Wu, X. (2023). Environmental Regulation and Green Technology Innovation under the Carbon Neutrality Goal: Dual Regulation of Human Capital and Industrial Structure. *Sustainability (Switzerland)*, *15*(3). https://doi.org/10.3390/su15032001

Loiseau, E., Saikku, L., Antikainen, R., Droste, N., Hansjürgens, B., Pitkänen, K., Leskinen, P., Kuikman, P., & Thomsen, M. (2016). Green economy and related concepts: An overview. *Journal of Cleaner Production*, 139, 361-371. https://doi.org/10.1016/J.JCLEPRO.2016.08.024

Mahirun, M., Suryani, S., & Nasution, N. B. (2021). Kepemimpinan Transformatif Sebagai Model Pengembangan Sumber Daya Manusia Yang Kreatif. *Pena Jurnal Ilmu Pengetahuan Dan Teknologi*, *35*(2), 64. https://doi.org/10.31941/jurnalpena.v35i2.1583

Makhloufi, L., Djermani, F., & Meirun, T. (2024). Mediation-moderation model of green absorptive capacity and green entrepreneurship orientation for corporate environmental performance. *Management of Environmental Quality: An International Journal*, *35*(1), 139–157. https://doi.org/10.1108/MEQ-05-2023-0164

Matashu, M., & Skhephe, M. (2022). Human Capital and Economic Growth in Sub Saharan Africa Countries ARDL and ECM Analysis. *Journal of Economics Education and Entrepreneurship*, *3*(1), 49-64.

Mayilyan, F., & Yedigaryan, K. (2022). The evolution of human capital theory. *Alternative Quarterly Academic Journal*, 68-79.

Merino-Saum, A., Clement, J., Wyss, R., & Baldi, M. (2020). Unpacking the Green Economy concept: A quantitative analysis of 140 definitions. *Journal of Cleaner Production*, 242, 118339. https://doi.org/10.1016/j.jclepro.2019.118339

Munteanu, A. I., Bibu, N., Nastase, M., Cristache, N., & Matis, C. (2020). Analysis of practices to increase the workforce agility and to develop a sustainable and competitive business. *Sustainability (Switzerland)*, *12*(9). https://doi.org/10.3390/SU12093545

Musthafa, I., Elfindri, E., Anas, Y., & Ariyanto, E. (2024). Human capital and performance of micro, small and medium enterprises: A literature review. *Cashflow Curr. Adv. Res. Sharia Financ. Econ. Worldw*, *3*, 250-275.

Neagu, O., Dumiter, F., Braica, A., Jimon, Ş., & David, G. (2019). The Correlation Between Human Capital and Gross Added Value in the Bioeconomy Sectors at the European Union (EU) Country Level. *Studia Universitatis Vasile Goldis Arad, Economics Series*, *29*(1), 1–20. https://doi.org/10.2478/sues-2019-0001

Nesterov, Y. (2023). Green Economy in the Paradigm of Sustainable Development. *Business, Economics, Sustainability, Leadership and Innovation*. https://doi.org/10.37659/2663-5070-2022-9-27-32

Organisation for Economic Co-operation and Development (OECD. (2019). *Development Co-operation Profiles at a Glance*. https://doi.org/10.1787/7b4b2437-en

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *The BMJ*, *372*. https://doi.org/10.1136/bmj.n71

Petrusha, P., Kozlova, D., & Ivanova, K. (2019). The human capital: Education and the green economy. *E3S Web of Conferences*, *110*. https://doi.org/10.1051/e3sconf/201911002074

Qiu, S., Wang, Z., & Geng, S. (2021). How do environmental regulation and foreign investment behavior affect green productivity growth in the industrial sector? An empirical test based on Chinese provincial panel data. *Journal of Environmental Management*, *287*(15), 112282. https://doi.org/10.1016/j.jenvman.2021.112282

Rayner, J., & Morgan, D. (2018). An empirical study of 'green' workplace behaviours: ability, motivation and opportunity. *Asia Pacific Journal of Human Resources*, *56*(1), 56–78. https://doi.org/10.1111/1744-7941.12151

Renwick, D. W. S., Redman, T., & Maguire, S. (2013). Green Human Resource Management: A Review and Research Agenda*. *International Journal of*

Management Reviews, *15*(1), 1–14. https://doi.org/10.1111/j.1468-2370.2011.00328.x

Roscoe, S., Subramanian, N., Jabbour, C. J. C., & Chong, T. (2019). Green human resource management and the enablers of green organisational culture: Enhancing a firm's environmental performance for sustainable development. *Business Strategy and the Environment*, *28*(5), 737–749. https://doi.org/10.1002/bse.2277

Rumbayan, M., Sompie, S., & Rumbayan, R. (2021). Penerapan Teknologi Energi Terbarukan Melalui Model Science Techno Park Di Desa Kiama Kepulauan Talaud. *Jurnal Abdimas Indonesia*, *1*(4), 1–9. https://doi.org/10.53769/jai.v1i4.137

Sagala, D., Frimawaty, E., & Sodri, A. (2023). Potensi Energi Terbarukan dari Pemanfaatan Energi Biogas POME (Palm Oil Mill Effluent) sebagai Sumber Energi Terbarukan di Provinsi Jambi. *Jurnal Ilmu Lingkungan*, *22*(1), 205–214. https://doi.org/10.14710/jil.22.1.205-214

Salmon, P. M., & Read, G. J. M. (2018). Using principles from the past to solve the problems of the future: Human factors and sociotechnical systems thinking in the design of future work. *Human Factors and Ergonomics In Manufacturing*, *28*(6), 277–280. https://doi.org/10.1002/hfm.20777

Setiyawan, A. (2021). Pembekalan Manajemen Energi Efektif Pemasangan Sel Surya Di Kandang Ternak Kelompok Tani Ngupoyo Upo Dusun Sumber Salatiga. *J-ABDI: Jurnal Pengabdian Kepada Masyarakat*, *1*(7), 1349–1360. https://doi.org/10.53625/jabdi.v1i7.498

Sgarbossa, F., Grosse, E. H., Neumann, W. P., Battini, D., & Glock, C. H. (2020). Human factors in production and logistics systems of the future. *Annual Reviews in Control*, *49*, 295–305. https://doi.org/10.1016/j.arcontrol.2020.04.007

Shah, M. (2019). Green human resource management: Development of a valid measurement scale. *Business Strategy and the Environment*, *28*(5), 771–785. https://doi.org/10.1002/bse.2279

Sheraz, M., Deyi, X., Ahmed, J., Ullah, S., & Ullah, A. (2021). Moderating the effect of globalization on financial development, energy consumption, human capital, and carbon emissions: evidence from G20 countries. *Environmental Science and Pollution Research*, *28*(26), 35126–35144. https://doi.org/10.1007/s11356-021-13116-0

Song, J., Zhou, H., Gao, Y., & Guan, Y. (2022). Digital Inclusive Finance, Human Capital and Inclusive Green Development—Evidence from China. *Sustainability (Switzerland)*, *14*(16). https://doi.org/10.3390/su14169922

Sonjaya, A. N., Marpaung, D., Lestari, S. W., Yanto, N. W., & Widyawati, Y. (2023). Potensi Energi Terbarukan di Sumatra Tahun 2020-2050 Menggunakan Long-range Energy Alternatives Planning System (LEAP). *Jurnal Teknologi*, *11*(1), 36–57. https://doi.org/10.31479/jtek.v11i1.277

Souad, H. (2023). The Green Economy as a Solution for Sustainable Development. *Humanities and Management Sciences - Scientific Journal of King Faisal University*. https://doi.org/10.37575/h/geo/230008

Stone, D. L., Deadrick, D. L., Lukaszewski, K. M., & Johnson, R. (2015). The influence of technology on the future of human resource management. *Human Resource Management Review*, *25*(2), 216–231. https://doi.org/10.1016/j.hrmr.2015.01.002

Sweetland, S. R. (1996). Human capital theory: Foundations of a field of inquiry. *Review of educational research*, *66*(3), 341-359.

Tsironis, A. (2023). *Preparing the Workforce for the Low-Carbon Economy: A Closer Look at Green Jobs and Green Skills*. *6*(262), 12. https://www.adb.org/publications/workforce-low-carbon-economy-green-jobs-skills

Wang, S., Pan, B., Wu, S., & Ji, Q. (2021). Deep Facial Action Unit Recognition and Intensity Estimation from Partially Labelled Data. *IEEE Transactions on Affective Computing*, *12*(4), 1018–1030. https://doi.org/10.1109/TAFFC.2019.2914654\

Yusliza, M. Y., Norazmi, N. A., Jabbour, C. J. C., Fernando, Y., Fawehinmi, O., & Seles, B. M. R. P. (2019). Top management commitment, corporate social responsibility and green human resource management: A Malaysian study. *Benchmarking*, *26*(6), 2051–2078. https://doi.org/10.1108/BIJ-09-2018-0283

Yusliza, M. Y., Othman, N. Z., & Jabbour, C. J. C. (2017). Deciphering the implementation of green human resource management in an emerging economy. *Journal of Management Development*, *36*(10), 1230–1246. https://doi.org/10.1108/JMD-01-2017-0027