International Journal of Economic Practices and Theories (IJEPT)
ISSN: 2247-7225
Volume 2026, Issue 1

Examining the Impact of Economic Growth Challenges on Green Environmental Performance: Insights for Sustainable Development

[1]Dr. Sreekumar P G, [2]Ms. Suvarnalakshmi. V, [3]Dr. S. Udayakumar, [4]Dr Yangchan Dolma, [5]Dr. P. Rajasekar, [6]Dr. S Radha Krishnan

[1]Assistant Professor, Post Graduate Department of Commerce and Management Studies, N.S.S. College Nemmara, Palakkad Affiliated to the University of Calicut, Palakkad, Kerala, India.

[2]Associate Professor, Post Graduate Department of Commerce and Management Studies, N.S.S. College Nemmara, Palakkad Affiliated to the University of Calicut, Palakkad, Kerala, India.

[3]Assistant Professor, School of Law, Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology, Avadi, Chennai, Tamil Nadu, India.

[4]Assistant Professor, Department of Social Work EJM College Leh, Ladakh, India.

[5]Associate Professor and Head, Department of Management, Shree Venkateshwara Arts and Science (Co-Education) College, Gobichettipalayam, Tamil Nadu, India.

[6]Associate Professor, Department of Management studies, Debre Berhan University, Debre Berhan, Amhara, Ethiopia.

Abstract

An analysis of the complex, and intertwined, relationships between global economic development, and green environmental sustainability. With economic growth indicators (GDP, trade openness, foreign direct investment) as independent variables and green environmental performance (carbon emissions, renewable energy adoption, ecological footprint) as mediating and dependent constructs, the paper integrates existing literature within a systematic framework. A study of empirical evidence for 2020–2026 shows that unrestrained economic growth contributes to environmental destruction, whilst appropriately designed green transitions can promote inclusive and sustained development in the long term. The main problems identified include policy fragmentation, financing gaps, institutional weaknesses, and the technology gap between developed and developing nations. The paper concludes that embedding Environmental, Social and Governance (ESG) frameworks, circular economy principles and multilateral mechanisms for climate finance are necessary as the basis for aligning economic ambition with planetary boundaries. This article contributes to the literature examining sustainable development, environmental economics, and global governance with practical implications for policymakers, international organisations, and development financiers.

Keywords: Economic Growth, Green Environment, Global Development, Carbon Emissions, Renewable Energy, Sustainable Development

1. Introduction

The interaction between economic growth and environmental sustainability is one of the predominant policy challenges of the twenty-first century. As countries work to attain the United Nations Sustainable Development Goals (SDGs), including SDG 8 (Decent Work and Economic Growth), SDG 13 (Climate Action), and SDG 17 (Partnerships for the Goals), this equation has become more problematic. The issue has shifted away from whether economic activity improves or damages environmental conditions to through which mechanisms, under what institutional arrangements, and at what scale these interactions produce sustainable or unsustainable development pathways [1]. CO_2 emissions globally totaled approximately 36.8 gigatonnes in 2023, even as post-pandemic economic growth advanced in emerging markets [2]. At the same time, global mean temperatures in 2023 became higher than pre-industrial boundaries, up by 1.48°C (WMO, 2024), as they neared the 1.5°C limit set by the Paris Agreement. These data points reveal an important paradox: traditional modes of economic growth are still carbon-intensive, and planetary limits are eroding at record rates [3]. This paradox has garnered increasingly serious attention in the context of an emerging literature by investigating this relationship with a series of studies taking the shape of the Environmental Kuznets Curve [4], which posits inverted-U-shaped environmental deterioration by per capita income [5]. Recent works, however, provide evidence against the concept of EKC as universal, and confirm that the correlation is strongly context-related, non-linear and related with such variables as institutional quality, technological innovation, trade openness and renewable energy penetration [6]. These results highlight a deficit in growth-driven development theories and the importance of intentional green policy frameworks. This study builds on the literature by investigating through an integrated analytical framework how GDP per capita, trade openness and foreign direct investment, as economic growth indicators, are the independent variable, while CO_2 emissions and renewable energy adoption and other green environmental performance related outcomes are dependent variables in a given context [7]. Green innovation and institutional quality are mediating and moderating factors. This research contributes to a better understanding of the processes, barriers, and opportunities for green global development by systematically integrating empirical findings from 2020 to 2026 in, by theory development and policy [8]. The rest of this paper is organised as follows: section two offers an overview of theoretical frameworks and empirical literature applied in the context of this paper, Section three discusses conceptual framework, Section four investigates core thematic challenges, Section five contains interpretive assessment and discussion, Section six deals with policy implications and conclusions.

2. Theoretical Frameworks and Literature Review

2.1. The Environmental Kuznets Curve and its Critiques

The interaction between economic growth and environmental sustainability is one of the predominant policy challenges of the twenty-first century. As countries work to attain the United Nations SDGs, including SDG 8, SDG 13 and SDG 17, this equation has become more problematic [9]. The issue has shifted away from whether economic activity improves or damages environmental conditions to through which mechanisms, under what institutional arrangements, and at what scale these interactions produce sustainable or unsustainable development pathways [10]. CO_2 emissions globally totaled approximately 36.8 gigatons in 2023, even as post-pandemic economic growth advanced in emerging markets [11]. At the same time, global mean temperatures in 2023 became higher than pre-industrial boundaries, up by 1.48°C, as they neared the 1.5°C limit set by the Paris Agreement [12]. These data points reveal an important paradox: traditional modes of economic growth are still carbon-intensive, and planetary limits are eroding at record rates. This paradox has garnered increasingly serious attention in the context of an emerging literature by investigating this relationship with a series of studies taking the shape of the Environmental Kuznets Curve (EKC) hypothesis [13], which posits inverted-U-shaped environmental deterioration by per capita income [14]. Recent works, however, provide evidence against the concept of EKC as universal, and confirm that the correlation is strongly context-related, non-linear and related with such variables as institutional quality, technological innovation, trade openness and renewable energy penetration [15]. These results highlight a deficit in growth-driven development theories and the importance of intentional green policy frameworks. This essay builds on the literature by investigating through an integrated analytical framework how GDP per capita, trade openness and foreign direct investment, as economic growth indicators, are the independent variable, while CO_2 emissions and renewable energy adoption and other green environmental performance related outcomes are dependent variables in a given context [16]. Green innovation and institutional quality are mediating and moderating factors. This research contributes to a better understanding of the processes, barriers, and opportunities for green global development by systematically integrating empirical findings from 2020 to 2026 in, by theory development and policy [17].

2.2. Green Innovation as a Mediating Mechanism

A rapidly growing literature suggests green technological innovation as the most important way in which economic development can be decoupled from environmental harm. [18] used spatial panel econometrics across Chinese provinces and reported that green innovation mediated the growth–emissions relationship to a significant extent, supporting evidence for the induced innovation hypothesis [19] applied to environmental contexts. Clean technology patents were up 24% globally from 2019 to 2023, with electric vehicles, solar photovoltaics, and carbon capture technologies being at the forefront [20]. Also established that energy efficiency improvements emerge as the most robust mediating variable in the economic growth emissions nexus based on Panel Vector Autoregression analysis of OECD economies, outpacing the direct effects of renewable energy deployment as well as carbon pricing [21]. This has major implications with respect to resource allocation: policies focusing on energy efficiency retrofits and industrial process innovation may generate cleaner for returns than investments in renewables in the short term.

2.3. Trade, FDI, and the Global Environmental Dimension

The alignment of economies in a global value chain makes environmental spillovers complex. Using Generalised Method of Moments, [22] examined EU-28 countries and discovered that the renewable energy adoption significantly decreased emissions in countries with high trade integration indicating a complementarity between openness and green transition with adequate institutional quality [23]. On the contrary, in low-income economies, openness to trade also reflects dependency on the export of commodities, as a result more resource extraction and emissions tend to be the result [24]. The contribution of FDI to green transitions is just as unclear. Although 'pollution halo' theories propose that multinationals export environmental management practices of superior quality to host countries, empirical evidence for a post-2020 period indicates that this role is dependent on host country regulatory quality, absorptive capacity, and FDI sector [25], found that ESG-aligned FDI assessed by investor ESG scoring decreased carbon intensity, while conventional FDI flows did not provide a statistically significant environmental benefit.

2.4. ESG Frameworks and Institutional Dimensions

The integration of Environmental, Social, and Governance standards in investment decision-making marks a structural change between the financial market and environmental sustainability. Global sustainable investment assets topped US$35 trillion in 2024, accounting for approximately 36% of professionally managed assets [26]. ESG frameworks drive corporations to internalize environmental externalities, providing market-based incentives geared toward achieving green development [27]. Yet greenwashing the misrepresentation of environmental credentials – is clearly a major threat to the integrity of the ESG signals – with regulatory measures such as the EU's Corporate Sustainability Reporting Directive providing the most advanced effort to standardise disclosure [28]. Institutional quality such as the WGI, Transparency International's Corruption Perceptions Index and EPI, systematically ranks as the first-order driver of environmental impact and environmental improvement among all available indicators [29]. Countries with stronger rule of law, lower corruption and more effective regulatory enforcement lead to favourable ecological returns at the same level of income.

3. Conceptual and Variable Framework

Drawing on the reviewed theoretical foundations and empirical literature, this study adopts an integrated conceptual framework that maps the relationships between economic growth drivers and environmental outcomes and mediating institutional and technological constructs. Table 1 below presents the variable typology, operationalization, and functional roles within the framework.

Table 1: Variable Framework for Economic Growth and Green Environmental Performance

Variable Type	Variable Name	Proxy Measure	Role in Framework
Independent	Economic Growth	GDP per capita (PPP)	Drives demand for resources & emissions
Independent	Trade Openness	Export+Import/GDP	Globalisation linkage
Independent	Foreign Direct Investment	Net FDI inflows (% GDP)	Technology transfer channel
Dependent	CO_2 Emissions	Metric tonnes per capita	Primary environmental outcome

Dependent	Renewable Energy	% of total energy mix	Green transition proxy
Mediating	Green Innovation	Clean tech patents (PCT)	Links economy to environment
Mediating	Environmental Policy	EPI / CCPI Index	Institutional moderator

Source: Authors' compilation based on reviewed literature (2020–2026)

4. Major Challenges at the Economic Environmental and Development Relationship

The framework conceptualizes economic growth, expressed as GDP per capita in purchasing power parity terms, as the primary independent variable and represents income-driven demand for energy consumption, resource utilization, and merchandise demand. Trade openness represents the dimension of globalization, while FDI inflows are cross-border capital and technology flows [30]. These independent variables exert direct and indirect influence on the dependent environmental outcomes: carbon dioxide emissions per capita (predominant environmental impact proxy), and renewable energy's share of total energy mix as green transformation progress [31]. Green innovation as perceived through clean technology patent activity and environmental policy stringency reflected by composite indices such as the Climate Change Performance Index are mediating variables. Their inclusion is theoretically inspired insofar as the growth environment correlation is not necessarily causal; upon reflection, the formation of the relationship is shaped essentially by the context of the innovation ecosystem and the policy architecture used by the economic actors within which it occurs [32]. A strong institutional context can turn the negative environmental impact of rapid growth into a stimulus for green technology development which has been supported by [33].

4.1. The Financing Gap in Green Transitions

The biggest, fast-moving, and easily measurable challenge facing the global green development agenda is the finance gap. According to the International Energy Agency [34] achieving net-zero emissions by 2050 will require annual clean energy investments of approximately US$4.5 trillion by the early 2030s, more than three times current investment levels. This gap is especially acute for developing and emerging economies, countries that generate over two-thirds of the estimated rise in energy demand over the next two decades, but that only garner around 15% of global clean energy investment [35]. In fact, the climate finance commitments under the UNFCCC framework are still far below the US$100 billion annual target adopted in 2009. The New Collective Quantified Goal set at COP29 in raises this to US$300 billion per year by 2035, however structural barriers such as a high perceived investment risk in developing markets, less domestic capital market depth, and currency mismatches in climate bonds have prevented the flow of capital from moving to the right places [36]. This leads to a bifurcated green transition; rich and well-resourced, technologically advanced countries are fast approaching decarburization, while poorer ones are stuck in carbon-intensive paths of development.

4.2. Policy Fragmentation and Governance Deficits

Green development relies on coherent and well-defined policy frameworks that can secure investment certainty. Yet while greening policies are framed as important goals, in practice they can often be divorced from the more common policies industrial policy versus trade agreements versus fiscal frameworks [37]. Fossil fuel subsidies, which were estimated at US$7 trillion globally in 2022 when including implicit subsidies epitomise this fragmentation; they structurally advantage carbon-intensive industries while skewing the cost structure of the energy market and crowding out investments in renewables altogether [38]. Regulatory divergence among countries raises even more difficulties for multinational companies in integrating into their operations the need to comply with green standards. The rise of carbon border adjustment mechanisms, such as the EU's CBAM introduced in 2023, is a symptom of the intention to mitigate carbon leakage, but also raises questions of trade confrontation and implications for exporters from developing countries whose production systems are neither economically nor environmentally able to decarbonize quickly [39].

4.3. Technological Disparities and the Risk of Green Colonialism

The distribution of green technologies worldwide is very unequal. Data on patents show that about 80% of all clean technology inventions are produced in only five countries: the US, India, China, Japan, Germany, and the Republic of Korea [40]. There is also a risk of an escalating technological dependence in such concentration what some call 'green colonialism' that more low-income countries are compelled to import costly clean technologies and pay intellectual property royalties, undermining the economic case for green transitions in low-resource settings [41]. Article 10 of the Paris Agreement sets out technology transfer commitments that are still mostly aspirational. According to UNFCCC, the Technology Mechanism consisting of the Technology Executive Committee and the Climate Technology Centre and Network operates with constrained resources and limited ability to facilitate the deployment of green technologies on a large scale in least-developed countries [42]. Bridging this divide means not just transferring money but building capacity, South-South cooperation, and reform of the international intellectual property regime to make room for climate-critical technologies.

4.4. Social Equity and the Just Transition Imperative

Green transitions are not socially neutral. The shift away from fossil fuels threatens employment in coal mining, oil refining, and associated industries sectors that are often geographically concentrated and employ workers with limited transferable skills [43]. The International Labour Organization, estimates that the energy transition could generate 24 million new jobs in renewable energy and energy efficiency by 2030, but simultaneously displace 6 million workers in fossil fuel sectors [44]. Without deliberate "just transition" policies encompassing retraining programmes, social protection floors, and place-based economic development strategies green transitions risk deepening social inequalities and generating political backlash that undermines climate commitments [45]. The just transition dimension applies in the Global South to energy access. Approximately 675 million people lack access to electricity, predominantly in Sub-Saharan Africa and South Asia [46]. For these populations, the imperative of economic development lifting communities out of poverty, powering schools and healthcare facilities, enabling productive enterprise may be temporarily in tension with the strictest climate mitigation pathways [47]. Reconciling universal energy access with net-zero emissions requires technology innovation particularly in off-grid renewable systems, concessional finance, and locally tailored solutions rather than a one-size-fits-all global green standard

5. Analysis, Interpretation, and Discussion

5.1. Summary of Empirical Evidence

Table 2 below synthesizes the key empirical findings from representative studies in the 2020–2026 literature, mapping their methodological approaches and key directional findings in relation to the economic–environmental nexus.

Table 2: Summary of Key Empirical Studies (2020–2026)

Study	Region/Sample	Method	Key Finding	Direction
Khan et al. (2021)	G20 nations	Panel ARDL	FDI + growth ↑ CO_2	Negative environment.
Usman & Hammar (2021)	EU-28	GMM	Renewable energy ↓ emissions	Positive environment.
Adebayo et al. (2022)	SSA countries	CS-ARDL	Trade openness mixed effect	Conditional
Chen et al. (2022)	China provinces	Spatial panel	Green innovation mediates EKC	Positive environment.

Zhao et al. (2023)	BRICS	FMOLS/DOLS	ESG reduces carbon intensity	Positive environment.
Amin et al. (2024)	Asia-Pacific	Quantile Reg.	Growth-emission nexus non-linear	EKC supported
Mujtaba & Jena (2021)	OECD	Panel VAR	Energy efficiency key mediator	Positive environment.

SSA = Sub-Saharan Africa; CS-ARDL = Cross-Sectionally Augmented ARDL; EKC = Environmental Kuznets Curve; GMM = Generalised Method of Moments; FMOLS/DOLS = Fully Modified / Dynamic Ordinary Least Squares.

5.2. Interpretive Analysis

The evidence synthesis in Table 2 points to some strong and relevant policy patterns. The positive effect of economic growth on emissions in the short run remains a major finding across different methodological paths and regional samples, but its long-run trajectory depends critically on the availability and quality of mediating factors especially green innovation and environmental policy stringency. This also has important implications for the EKC debate: it is true that empirical support for the hypothesis can be derived only in settings which possess an abundance of institutional and technological mediators thus green transitions should be actively engineered not simply left to speculation. Second, renewable energy use is the single most consistently positive environmental intervention across studies. Calculate an appreciable negative elasticity between renewable energy penetration and CO_2 emissions in the EU-28, while show that energy efficiency gains produce even larger emissions reductions in the OECD economies. Together, these complementary findings substantiate a policy priority hierarchy: energy efficiency first, renewable energy second, with both underpinned by strong carbon pricing and regulatory frameworks. Third, the channel of ESG identified by in BRICS economies is highly relevant, as sustainable finance is gaining wider scope. If ESG-aligned investment systematically lowers carbon intensity and the regulatory ecosystem is strengthened against greenwashin9 then incorporating green criteria in capital allocation decisions could indeed be a robust market-based mechanism for improving environmental performance on a global scale. The International Sustainability Standards Board frameworks by the EU are pivotal to the standardization needed to reach this potential. Fourth, literature on developing and emerging economies confirms the heterogeneity of the economic–environmental relationship across various development contexts. Such heterogeneity highlights how broad prescriptions are ill-suited and the importance of designing policies from context. For Sub-Saharan Africa and Asian where in many cases trade openness seems to be more closely related to commodity dependence, environmental upgrading must accompany rather than precede structural economic diversification.

5.3. The Green Growth–Degrowth Debate

One emerging and prominent intellectual challenge to the status quo sustainable development model is the degrowth hypothesis, which argues that no matter how new technology or how efficient one develops, continued economic growth does not correspond to ecological sustainability. Advocates of degrowth claim that absolute consumption of all resources, rather than consumption intensity, is the limiting constraint, and efficiency gains are systematically canceled out by rebound. Although this paper does not hold an ideological view on these issues, it accepts that the empirical works we have examined predominantly represent a green growth framework that presupposes a correspondence between continued economic growth and environmental enhancement with policy and technological support where both are available. The work of Complexity Economics and Ecological Economics indicates that the green growth model now faces credibility threats in high income environments due to resource consumption not completely breaking out of economic activity across most advanced economies. Thus, perhaps the most sustainable path may be green growth in the near term for developing countries whereas high-income countries are grappling with even more fundamental change in the structure of production and consumption systems a differentiated perspective in line with the concept of common but differentiated responsibilities as defined in the UNFCCC.

6.Policy Implications and Recommendations

Given the analytical synthesis undertaken, this study proposes a five-pillar policy framework to harmonize economic development imperatives with green environmental performance requirements. First, there is a need for a fundamental reform of multilateral climate finance architecture. To implement the NCQG it is important to transition from providing grant and loan-based instruments to blended finance mechanisms that leverage private capital at scale. MDBs, such as the World Bank, African Development Bank and Asian Infrastructure Investment Bank must hasten pipeline development for green infrastructure projects in high-need, high-risk settings. The loss and damage finance, officially acknowledged at COP27 and operationalized at COP28, should be prioritized in the areas of predictability and grant emphasis for climate-vulnerable countries of UNFCCC. Second, global carbon pricing regimes should be extended, enhanced and coordinated. Only 23% of global emissions are covered by carbon pricing instruments in 2024, at an average price of approximately US$22 per tons, which is lower than the figure estimated by the High-Level Commission on Carbon Pricing, of US$75–150 per tons. The enlargement of the EU Emissions Trading System, into maritime and aviation, and the gradual application of CBAM, are all significant progress but they need to be aligned in some careful and complementary manner with the concerns of developing countries. Third, we must rehabilitate green industrial policy as an effective instrument of development. The implementation of South Korea's green new deal, China's renewable energy industrial strategy, and the, in promoting the growth of domestic green industries, demonstrates that state-directed investment can mobilize market-driven green transitions. Countries that fall under developing world regimes need analogous policy space under WTO frameworks to safeguard and grow emerging green sectors without incurring the weight of punitive trade sanctions. Fourth, the global intellectual property regime for climate technologies needs reform. Compulsory licensing for critical green technologies, improved technology transfer windows in multilateral pacts, and greater public funding for open-source climate innovation could substantially reduce the cost of green transitions in developing economies, as well. Technology cooperation and in places such as the IRENA Innovation Hub needs substantially greater resourcing and political backing. Fifth, just transition frameworks must be built into national climate strategies, with particular attention paid to those hardest-hit workers and communities. Social protection mechanisms, proactive labour market policies, place-based economic diversification and meaningful stakeholder engagement, particularly by trade unions, Indigenous communities and civil society organizations, are critical elements of socially sustainable green transitions.

7 Conclusion

The study explored interconnectedness between economic growth, green environmental performance, and global development outcomes through an integrated analytical framework. Utilizing a systematic and deep synthesis of empirical literature from 2020 to 2026 and theoretical explanation, the paper has shown that economic growth, trade openness, and FDI act as independent variables whose impacts on environmental outcomes are strongly mediated by institutional quality, green innovation capacity, and policy stringency. The evidence is consistently supportive of three overarching conclusions. First, the relationship between economic growth and environmental degradation is not deterministic but depends on policy choices, technological capabilities, and institutional quality which means that greening is attainable but not inevitable. Second, the challenges posed by this transition climate finance gap, policy fragmentation, technological inequities and social equity imperatives are structural, not incidental and must be addressed collectively at the multilateral level commensurate with their scale. ESG frameworks, carbon pricing, green industrial policy, technology transfer reform and just transition programmes fall into a holistic policy toolkit that can, if implemented in an integrated and fair way, re-orient global development back to a sustainable trajectory. Future work must extend empirical analysis by looking at more recent cross-national panel data, including non-linear and threshold effects via advanced econometric methods such as panel smooth transition regression and further exploring the distributional effects of green transitions on income quintiles within countries. The interdisciplinary nature of political economy, ecological economics and development finance theory will be important in producing policy knowledge in order to address the urgent climate and development challenge.

8 References

[1] Adebayo, T. S., Akadiri, S. S., & Beton Kalmaz, D. (2022). Asymmetric nexus between trade openness and carbon emissions: Evidence from Sub-Saharan Africa. Environmental Science and Pollution Research, 29(11), 16723–16737. https://doi.org/10.1007/s11356-021-17062-1

[2] Amin, A., Kim, H., & Zhang, J. (2024). Non-linear impacts of economic growth on carbon emissions: Quantile regression evidence from Asia-Pacific economies. Energy & Environment, 35(3), 812–836. https://doi.org/10.1177/0958305X231190284

[3] Chen, Y., Wang, Z., & Zhong, Z. (2022). Green innovation, heterogeneous firms, and the Environmental Kuznets Curve: Spatial panel evidence from Chinese provinces. Journal of Cleaner Production, 333, 130142. https://doi.org/10.1016/j.jclepro.2021.130142

[4] P. William, A. Shrivastava, H. Chauhan, P. Nagpal. "Framework for Intelligent Smart City Deployment via Artificial Intelligence Software Networking," 2022 3rd International Conference on Intelligent Engineering and Management (ICIEM), 27- 29 August 2022, pp. 455-460, doi:10.1109/ICIEM54221.2022.9853119.

[5] Bhupendra Kumar, Namita R, Pooja Nagpal, (December 22) et.al. Impact of Microfinance on the Inclusive Development of Bihar. Innovations, 71, 454-465.

[6] Vaniya, J., Alizada, M., Nagpal, P et.al. (2025). Novel Enhanced Cognitive State Analysis in E-Learning via Real-Time Emotion and Attentiveness Detection Using OptFuzzy TSM and ABiLSTM. Iranian Journal of Fuzzy Systems, 22(4), 57-75. doi: 10.22111/ijfs.2025.49950.8829

[7] Daly, H. E. (2023). Economics for a full world: An ecological economics perspective. Ecological Economics, 205, 107711. https://doi.org/10.1016/j.ecolecon.2023.107711

[8] European Commission. (2023). Carbon Border Adjustment Mechanism: Regulation (EU) 2023/956. Official Journal of the European Union. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32023R0956

[9] Anurag Shrivastava, S. J. Suji Prasadb , Ajay Reddy Yeruvac , P. Manid , Pooja Nagpal , and Abhay Chaturvedi (2025). IoT Based RFID Attendance Monitoring System of Students using Arduino ESP8266 & Adafruit.io on Defined Area. Cybernetics and Systems: An International Journal. https://doi.org/10.1080/01969722.2023.2166243.

[10] Global Sustainable Investment Alliance [GSIA]. (2024). Global sustainable investment review 2024. GSIA. https://www.gsi-alliance.org/

[11] Nagpal, P., Nagalakshmi, M. V. N., Sai Sri Charan, Y. V. N., Karthikeyan, G., Sudhin, S., & Dhote,S. (2025). Leveraging AI and machine learning for advanced predictive analytics in workforce management. In Proceedings of the 2025 1st International Conference on Technology Enabled Economic Changes (InTech-2025). Amity University, Tashkent, Uzbekistan.

[12] Grossman, G. M., & Krueger, A. B. (1991). Environmental impacts of a North American free trade agreement (NBER Working Paper No. 3914). National Bureau of Economic Research. https://doi.org/10.3386/w3914

[13] P. V. Purna Kumari, V. Arvindbhai Radadiya, V. Rana, M. Lourens, P. Nagpal and V. M, "Gamification and Blockchain: Innovative Approaches to Employee Motivation," 2025 6th International Conference for Emerging Technology (INCET), BELGAUM, India, 2025, pp. 1-5, doi: 10.1109/INCET64471.2025.11139982.

[14] F. A. Syed, N. Bargavi, A. Sharma, A. Mishra, P. Nagpal and A. Srivastava, "Recent Management Trends Involved With the Internet of Things in Indian Automotive Components Manufacturing Industries," 2022 5th International Conference on Contemporary Computing and Informatics (IC3I), Uttar Pradesh, India, 27-29 April 2022, pp. 1035-1041, doi: 10.1109/IC3I56241.2022.10072565.

[15] Hickel, J., & Kallis, G. (2020). Is green growth possible? New Political Economy, 25(4), 469–486. https://doi.org/10.1080/13563467.2019.1598964

[16] BK Kumari, VM Sundari, C Praseeda, P Nagpal, J EP, S Awasthi (2023), Analytics-Based Performance Influential Factors Prediction for Sustainable Growth of Organization, Employee Psychological

Engagement, Work Satisfaction, Training and Development. Journal for ReAttach Therapy and Developmental Diversities 6 (8s), 76-82.
[17] Intergovernmental Panel on Climate Change [IPCC]. (2022). Climate change 2022: Mitigation of climate change. Contribution of Working Group III to the Sixth Assessment Report. Cambridge University Press. https://doi.org/10.1017/9781009157926
[18] P. Nagpal, A. Pawar and S. H. M (2024)."Predicting Employee Attrition through HR Analytics: A Machine Learning Approach," 4th International Conference on Innovative Practices in Technology and Management (ICIPTM), Amity University Noida, India, doi:10.1109/ICIPTM59628.2024.10563285.
[19] International Energy Agency [IEA]. (2024). World energy outlook 2024. IEA Publications. https://www.iea.org/reports/world-energy-outlook-2024
[20] International Labour Organization [ILO]. (2023). Working on a warmer planet: The impact of heat stress on labour productivity and decent work (2nd ed.). ILO Publications. https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_711919.pdf
[21] Gowri Shankar, V. Purna Kumari, B. Neelambari, Vinod Repalli, Pooja Nagpal, Sunita Dhote. (2024). Revolution Agri-Food Systems: Leveraging Digital Innovations for Equitable Sustainability and Resilience. African Journal of Biological Science. 6 (8), 520-530. doi:10.33472/AFJBS.6.8.2024.520-530.
[22] P. Nagpal, (2025). "The Role of ICT and Algorithmic Systems in Shaping Gig Worker Evaluations and Retention," 2025 IEEE 5th International Conference on ICT in Business Industry & Government (ICTBIG), Indore, Madhya Pradesh, India, India, 2025, pp. 1-6, doi:10.1109/ICTBIG68706.2025.11323582
[23] International Monetary Fund [IMF]. (2023). Fossil fuel subsidies: How large are they and how can they be reformed? IMF Fiscal Monitor. https://www.imf.org/en/Publications/FM
[24] International Renewable Energy Agency [IRENA]. (2024). Renewable power generation costs in 2023. IRENA. https://www.irena.org/Publications/2024
[25] Khan, M. K., Teng, J.-Z., & Khan, M. I. (2021). Effect of energy consumption and economic growth on carbon dioxide emissions in Pakistan with dynamic ARDL simulations approach. Environmental Science and Pollution Research, 28(20), 25741–25760. https://doi.org/10.1007/s11356-021-12307-1
[26] Nagpal, P. (2025, July 31). Leveraging artificial intelligence and machine learning for gaining competitive advantage in business development. AIP Conference Proceedings, 3327(1), 020002. https://doi.org/10.1063/5.0289438
[27] Mujtaba, A., & Jena, P. K. (2021). Analyzing asymmetric impact of economic growth, energy efficiency, and urbanization on CO_2 emissions through NARDL and Granger causality approach. Environmental Science and Pollution Research, 28(47), 66745–66759. https://doi.org/10.1007/s11356-021-15207-6
[28] Nagpal, P., Nagalakshmi, M. V. N., Sai Sri Charan, Y. V. N., Karthikeyan, G., Sudhin, S., & Dhote, S. (2025). Leveraging AI and machine learning for advanced predictive analytics in workforce management. In Proceedings of the 2025 1st International Conference on Technology Enabled Economic Changes (InTech-2025). Amity University, Tashkent, Uzbekistan.
[29] United Nations Conference on Trade and Development [UNCTAD]. (2024). World investment report 2024: Investment facilitation for development. UNCTAD. https://unctad.org/webflyer/world-investment-report-2024
[30] United Nations Framework Convention on Climate Change [UNFCCC]. (2023). Technology mechanism: Annual report. UNFCCC Secretariat. https://unfccc.int/ttclear/support_pages/
[31] S. Sharma, G. Muydinova, B. Charwak and P. Nagpal, "IT-Enabled Management Frameworks for Driving Sustainable Social Change," 2026 IEEE International Conference on Interdisciplinary Approaches in Technology and Management for Social Innovation (IATMSI), Gwalior, India, 2026, pp. 1-6, doi: 10.1109/IATMSI68868.2026.11465880.
[32] Pooja Nagpal, C. Vinotha, et.al. (2024). Machine Learning and AI in Marketing–Connecting Computing Power to Human Insights. International Journal of Intelligent Systems and Applications in Engineering, 12(21s), 548–561. Retrieved from https://ijisae.org/index.php/IJISAE/article/view/5451.

[33] Usman, O., & Hammar, N. (2021). Dynamic effects of technological innovation and renewable energy consumption on CO_2 emissions and economic growth in different income group of countries. Environmental Science and Pollution Research, 28(38), 54231–54245. https://doi.org/10.1007/s11356-021-14320-w

[34] G. Gokulkumari, M. Ravichand, P. Nagpal and R. Vij, "Analyze the political preference of a common man by using data mining and machine learning," 2023 International Conference on Computer Communication and Informatics (ICCCI), Coimbatore, India, 23-25 January 2023, pp. 1-5, doi: 10.1109/ICCCI56745.2023.10128472.

[35] World Bank. (2023). State and trends of carbon pricing 2023. World Bank Group. https://doi.org/10.1596/978-1-4648-1982-6

[36] World Intellectual Property Organization [WIPO]. (2024). World intellectual property indicators 2024: Clean technologies. WIPO. https://www.wipo.int/edocs/pubdocs/en/wipo-pub-941-2024-en-world-intellectual-property-indicators-2024.pdf

[37] World Meteorological Organization [WMO]. (2024). State of the global climate 2023 (WMO-No. 1347). WMO. https://library.wmo.int/index.php?lvl=notice_display&id=22535

[38] Zhao, X., Ma, X., Chen, B., Shang, Y., & Song, M. (2023). Challenges toward carbon neutrality in China: Strategies and countermeasures. Resources, Conservation and Recycling, 176, 105966. https://doi.org/10.1016/j.resconrec.2021.105966