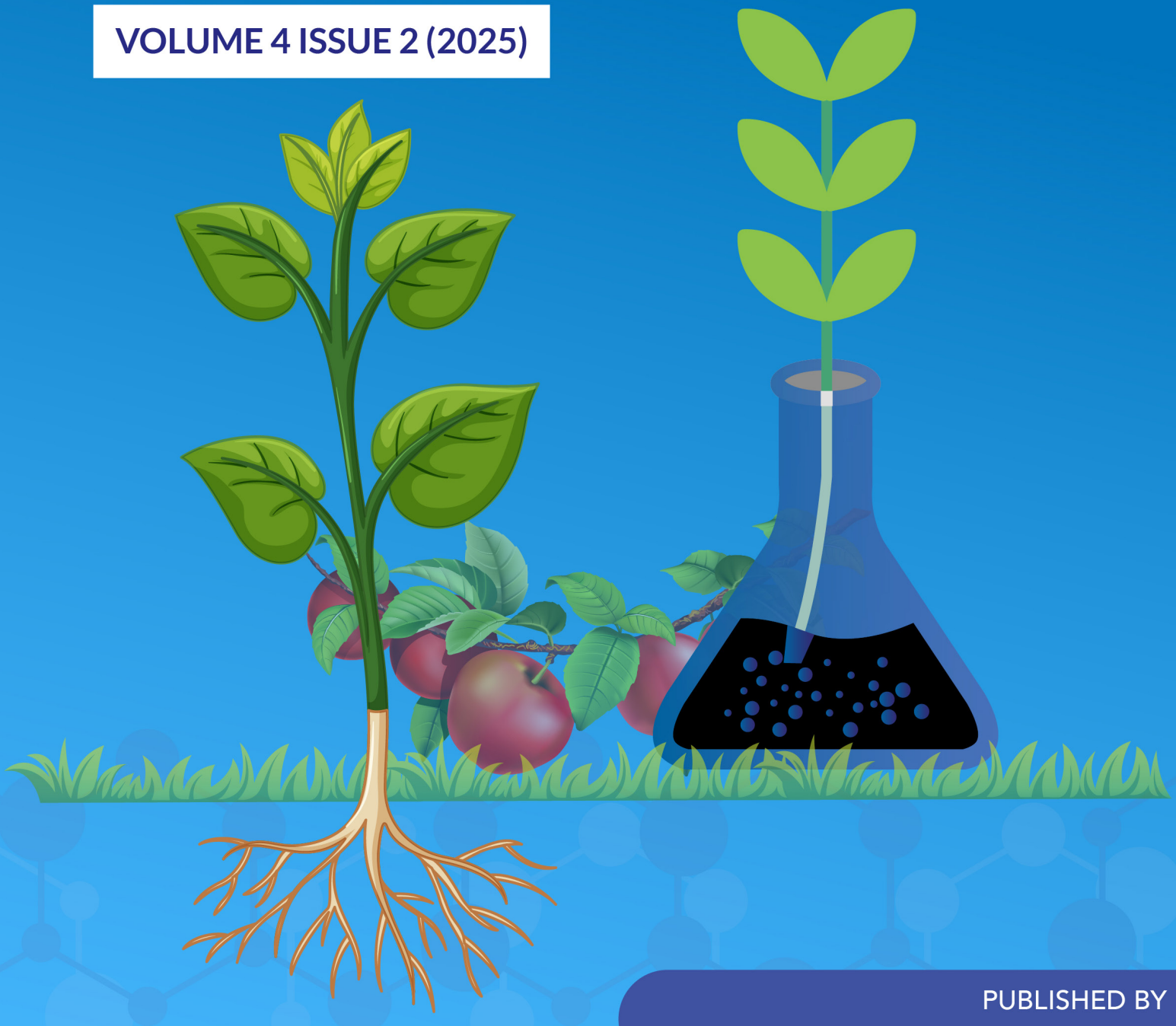
American Journal of Food Science and Technology (AJFST)

ISSN: 2834-0086 (ONLINE)

VOLUME 4 ISSUE 2 (2025)



PUBLISHED BY
E-PALLI PUBLISHERS, DELAWARE, USA

American Journal of Food Science and Technology (AJFST)

Volume 4 Issue 2, Year 2025
ISSN: 2834-0086 (Online)
DOI: https://doi.org/10.54536/ajfst.v4i2.5778
https://journals.e-palli.com/home/index.php/ajfst

Green Growth and Renewable Energy Adoption in Bangladesh: Economic and Policy Perspectives

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Article Information

Received: July 20, 2025

Accepted: August 24, 2025

Published: September 19, 2025

Keywords

Bangladesh, Economic Growth, Energy Transition, Green Economy, Policy Development, Renewable Energy, Sustainability

ABSTRACT

The purpose of this paper is to highlight the potential implications and nexus of green growth with renewable energy uptake in Bangladesh, providing a policy context that sets examples crucial for ensuring an appropriate understanding of sustainable development on a longer-term horizon. Based on a detailed bibliometric analysis of 6,794 research papers from the Web of Science database related to renewable energy ownership by inducible, published between 1990 and June 2023, this paper provides an updated understanding of the evolution of renewable energy in response to Bangladesh's economic growth. Detailing significant findings, academic luminaries, and thematic trends on the subject, this study provides a critical analysis of renewable energy in supporting Bangladesh's green economic transition. One understated point made by the study is that to curb environmental degradation, renewable energy use is more than necessary; it is also beneficial for a growing economy. Renewable energy holds the key to a green economy in Bangladesh, which will generate employment, improve local community welfare, and support energy security. The study further reveals an extensive positive relationship between the deployment of Renewable Energy and key economic parameters, such as GDP growth, industrial output & innovation in technology. The correlation is robust in resource-rich locations of Bangladesh, demonstrating the significant economy-wide implications of renewable energy, including its ability to draw in appropriate investment needed for higher economic growth and inclusive development. The study underscores the importance of proper policy frameworks and strategies to mainstream renewable energy in the Bangladesh economy model. Bangladesh must align its economic policies with the practice of sustainable energy if it wants to light up and flourish a resilient tomorrow for itself. The study provides important insights for policymakers, academics, and other stakeholders to further green growth of Bangladesh through renewable energy and achieve sustainable development in the long run.

INTRODUCTION

One of the most critical elements of national agendas throughout the world has been the pursuit of economic growth, which spurred improvements in technology, infrastructure, and industrialization in various industries and sectors. However, the relentless pursuit of economic growth, primarily driven by fossil energy sources, has had severe repercussions for the environment (Wang & Zhang, 2023). The situation was further exacerbated by global development, prompting climate studies to warn international organizations, such as the Intergovernmental Panel on Climate Change and the United Nations Environment Programmed, to call for a rapid transition to sustainable energy. As a means of promoting green growth that fosters growth-oriented policies without the harmful side effects of traditional energy sources, the implementation of renewables such as solar, wind, hydro, and geothermal has been crucial (Khalid *et al.*, 2024). In Bangladesh, the transition towards green energy is one of the primary factors that ensures both economic and environmental sustainability (Kilinc-Ata *et al.*, 2025). Further, the use of renewable energy holds the potential to reduce the contamination of the environment resulting from the burning of fossil fuels. Green energy and the renewables industry also promise to disrupt the establishment through job creation, revenue generation, and infrastructure. Nonetheless, renewables have been challenged by issues such as high costs, technological hitches, and policy (Issa *et al.*, 2023). It is resourceful to examine the relationship between renewable energy and the economy in Bangladesh and what policymakers could do to encourage the use of these forms of energy (Akash *et al.*, 2024). The literature on the use of energy and economy has been explored by other researchers, showing that reduced emissions through more cycle-efficient energy use are life-enhancing. Policymakers can examine energy efficiency and innovative economies to develop strategies that encourage investors and consumers to favor renewable resources over existing ones (Mushafiq *et al.*, 2023). Bangladesh offers a unique opportunity to explore these issues since it is endowed with massive potential for the development of renewable energy resources.

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Research Questions

1. To what extent does the utilization of renewable energy sources correlate with key economic indicators such as GDP growth, industrial productivity, and technological innovation in Bangladesh?

2. How does renewable energy integration contribute to job creation, local development, and enhanced energy security in Bangladesh, particularly in regions rich in renewable resources?

3. What are the emerging research themes, significant works, and influential authors in the field of economic growth and renewable energy, as revealed by a bibliometric analysis of studies from 1990 to June 2023? How can these insights inform strategies for promoting sustainable economic growth in Bangladesh through renewable energy adoption?

This study aims to bridge existing research gaps, providing a comprehensive understanding of the complex relationship between renewable energy, economic growth, and policy development in Bangladesh. The findings will offer valuable guidance to policymakers, industry leaders, and researchers in shaping effective strategies for achieving green growth and sustainable development.

LITERATURE REVIEW

Economic growth came to be closely associated with the burning of fossil fuels, a major cause for many of the ecological challenges that we now face, including climate change and environmental degradation (Li *et al.,* 2023). The Intergovernmental Panel on Climate Change (IPCC) advises that the world needs to take a new and better path towards all things economic, and relying on renewables is just one of these steps (Fressoz, 2025). In this literature review, the proposed study will search for relevant studies that scrutinize the relationship between economic growth and renewable energy adoption from many different perspectives. Thereas is doing a fantastic job linking to some of the most important findings along with where more research is needed, as well as emerging trends that should be considered in future investigations (Marvi *et al*., 2025). A large body of empirical research finds a positive association between the deployment of renewable energy (RE) and a wide array of economic indicators, most notably growth in Gross Domestic Product (GDP). All these studies highlight the double nature of renewable energy solutions: environmentally friendly and economically profitable (Hayat *et al.,* 2023). Switching to renewable energy sources can contribute to significant economic growth and serve as a boost for those heavily dependent on non-renewable sources. This enables renewable energy infrastructure that lessens traditional energy source impacts on the environment and can also be an economic development tool for nations (Gayen *et al.,* 2024). The findings of this body of research underscore the broad value and beneficial aspects of renewable energy as a policy and investment driver to deliver sustainable economic growth. Regional and country contexts influence the relationship between renewable energy penetration and regional heterogeneity in economic growth (Yu *et al.,* 2021). They are considered STS as they differ greatly in terms of local energy mix, regulatory environments, and socio-economic conditions that influence the success in implementing VREs. Solar and wind power could be significant sources of renewable energy in Bangladesh, provided national energy policies are crafted to complement them effectively. A policy cannot be developed without understanding the regional and national contexts (Wyborn & Evans, 2021). Policymakers can develop pathways to optimally capitalize on the economic prospects of renewables by adapting strategies according to national resources, technical capabilities, and institutional conditions. For instance, the local potential of renewable resources, combined with socio-economic conditions, will determine how to leverage renewable energy technologies best to create sustainable economic growth (Abdalla *et al.,* 2023). There are, however, several obstacles to using renewable energy sources, despite their long list of benefits. These include constraints from technology, expensive upfront investments, insufficient infrastructure, and regulatory challenges. Conducted a thorough review of renewable energy deployment in the country and found that policy norms are one of the most formidable challenges faced by Chinese renewable energies, like other renewables, all over the world (Lo, 2014). Given the technological challenges, such as integrating renewable sources and maintaining grid stability, which is complicated by the unpredictability and variability of renewables, these require modern energy storage solutions and smarter grids to store excess power during sunny/windy days. Furthermore, for countries like Bangladesh, the lack of financing for large investments to initiate renewable projects has been identified as a key hurdle (Aziz *et al.,* 2025). To mitigate these hurdles, financial tools such as subsidies and incentives are required to encourage investment in renewable energy infrastructure (Onabowale, 2025). An even greater obstacle is the lack of proper infrastructure, especially in terms of energy transmission and distribution, not to mention the obvious financial and technological constraints. To unlock the potential for renewable energy, both to feed into existing grids and simultaneously help rejuvenate them with modernized powerlines. Although non-renewable energy has seen us through growth in the past, renewable power stands out as a more environmentally friendly option that could carry our economy through and long into the future. The combination of solar, wind, hydro, and geothermal power is replacing fossil fuel sources of energy because they offer clean alternatives that guarantee a much more reliable supply to help remove the need for finite resources and increase energy security (Mallik, 2024). In addition, investing in R&D and infrastructure for renewable energy would have the co-benefit of creating jobs, fostering innovation, and driving economic growth. Green growth in Bangladesh will not be possible unless renewable energy adoption takes precedence (Mallik, 2024). Renewable energy can play an important role in

this process, helping to mitigate negative environmental impacts, increase energy security, and support sustainable economic growth in the country (Mallik & Rahman, 2024). But they will need to solve for the technological, financial, and infrastructural challenges if we are to reach this potential. Successful policies, strategic investments, and regional adaptation will be crucial in reaching the full potential for renewable energy as a piece of Bangladesh's economic development and environmental sustainability.

MATERIALS AND METHODS

Data Collection

The study used the Web of Science database, a prestigious resource for scholarly literature from numerous fields. The comprehensive database hosts countless peer-reviewed journals, conference proceedings, and scientific publications that could greatly aid in obtaining prior knowledge on the relationship between renewable energy adoption and economic growth within the span of Bangladesh. So, to collect an accurate and contextualized dataset, an exact but systematic method was implemented for the collection process. We inserted keywords such as renewable energy and economic growth, along with some nouns, into these two points. The systematic review was concisely performed after searching the literature from 1990 to June 2023, including only relevant and up-to-date studies. The articles were selected to be consistent with the study objectives, emphasizing research that sought to determine how economic growth and green growth have been influenced by renewable energy adoption. The review focused on the global and regional literature regarding the opportunities and constraints associated with integrating renewable energy, including existing case studies addressing how renewable energy can support green economic growth. Following an initial search of the Web of Science database, strict screening processes were applied. Titles, abstracts, and keywords were scanned to assess the relevance of these articles related to research questions. This brought the number of articles to be included in the dataset down to 6,794 scholarly articles (those with a PubMed ID) that met our selection criteria. At least, this holistic data collection strategy substantially improved the validity of the study, and enabled a thorough examination of the research landscape on another aspect in economic terms for the adoption of renewable energy.

Bibliometric Analysis

This study utilized bibliometrics, a powerful research tool, to investigate the intricate relationship between renewable energy adoption and economic growth. A bibliometric analysis is a quantitative analysis of written publications or a corpus. It reports the frequencies of publication, citation, authorship, and co-authorship, and keywords in academic papers, which are part of a systematic examination of written publications. In this study, the tools above are used to unravel the key publications, prolific authors, and propose research that focuses on the green economy, with a particular emphasis on renewable energy & economic growth. The review was supported by citation analysis, which revealed the most important contributions to the literature on economic growth and renewable energy. This method exposed foundational publications informing the field and recognized leading scholars contributing to advancing the conversation. The study also employed a co-citation analysis to identify thematic clusters in the literature, providing insights into how various research ideas are related and where urgent attention is required. The co-authorship analysis was also performed to explore the collaboration network and the most productive authors. In particular, the method used in this study provided insights into the interdisciplinary nature of research on renewable energy and economic growth and identified key research groups with considerable contributions to the field. Other results from this analysis revealed meaningful peer-reviewed partnerships that have impacted the knowledge on how renewable energy adoption can trigger economic development. To gain further insight from this search and discovery process, co-occurrence analysis was conducted on the model to examine keyword/term frequency and patterns in the literature. This analysis provided an in-depth examination of the central themes and emerging trends in this area, focusing on those aspects of renewable energy-economic growth that have been a primary focus of academic investigation. It also suggested some new fields of research that could use additional development. This scient metric method, rather than an academic research tool, also benefits policymakers and industry executives. This approach also identifies areas requiring further study and offers insight into future research trends. It plays a role in influencing the formulation of policies and programs to support renewable energy usage and promotes sustainable economic innovation. The implications derived from this bibliometric study provide a valuable eye-opener for researchers and policymakers to promote green growth/economic development by successfully integrating renewables in Bangladesh.

RESULTS AND DISCUSSION

Analysis of publication trends indicates that research on the interaction of renewable energy with economic growth has shown an increasing trend. Numbers were small in the first decade between 1996 and 2006, with the publication tally in any given year never exceeding a handful of papers. Yet there was a significant rise in the number of academic papers published around the mid-2000s. After 2010, this increase was greater and led to significantly more papers concerning these proposed objects of study. With more than 50 published papers, the number of reprints per year has consistently exceeded this count since 2010. Between 2017 and 2023, we observed a significant surge in publications, indicating a growing academic interest in the connection between renewable energy and economic growth. It is notable that 2021 and 2022 have been the most popular years by the number of published papers, with 1,308 and 1,731

papers, respectively. This surge serves to illustrate the growing relevance that renewable energy has as a catalyst for economic growth. While the data collection ends in June, which justifies a slight dip in 2023, these new publications suggest that researchers and policymakers are becoming more interested as well.

The study domains were distributed to reflect the interdisciplinary nature of the research. The most common subject of publication is Environmental Sciences and Ecology at 47.5% (focused on the environmental properties of renewable energy). This was in second place overall and came from a different perspective – the exploration of energy technologies within the context of a revolutionary shift to renewable energy, except Energy Fuels accounted for 31.4% of the entire articles shared. Notably, Science, Technology and Other Topics (26.3%), Business Economics (17.2%), and Engineering (10.6%) are the other top three areas emphasizing the larger scope of research across various fields involved in this study. The present fields: Thermodynamics, Public Administration, and Development Studies represent a multifaceted investigation on the socio-economic-technical basis of renewable energy. The interdisciplinary research underscores the need for collaboration across disciplines to adequately probe the multidimensional phenomena of renewable energy adoption as well as its place in sustainable economic development supporters. This holistic perspective is vital in creating successful frameworks for mainstreaming renewable energy into national economies (Mallik *et al.*, 2025).

The map of scientific papers showed the participation of different countries in scientific research, emphasizing that renewable energy has an economic growth effect on a global scale. China accounts for 37.3% of the publications, with authors affiliated to Chinese institutions highlighting its critical role in advancing renewable energy issues and utilizing renewable resources for sustainable development (as shown by Cheng). Turkey and Pakistan followed, both accounting for 13.1% of the papers, reflecting the increasing research activities in these countries, too. The United States (6.7% of the research output), India (6.5%), Malaysia, and several European nations are among the major contributors to this subject in terms of total numbers (Fig. The latter is illustrated in the following map of the distribution of research conducted between these countries, thus emphasizing regional priorities and concerns when accepting renewable energy. Each nation has its own set of resources, institutional structure, and needs that will determine its approach to renewable energy. The wide range of engagement suggests that the remaining entities are potential future collaboration partners and valuable contributors to global renewable energy adoption, enabling every country to maximize its strengths in this transformation through international collaboration and knowledge exchange. This study suggests a growing awareness regarding their importance as an economic policy for fostering sustainable development. As the research base continues to grow, public decision-makers need to draw on these scholarly works to develop better strategies for increasing the adoption of renewable energies. In addition, further research is necessary to address regional differences in renewable energy penetration and the particular hurdles for integrating renewable energy into developing nations like Bangladesh. Global cooperation for promoting inter-disciplinary research and international collaboration can speed up the transition to renewable energy, securing economic gains across continents. The detailed information obtained from this study will serve as a guide for those interested in planning further research. It will help realize the policy implications of integrating sustainable renewable energy into national economic portfolios, specifically in achieving green growth within Bangladesh.

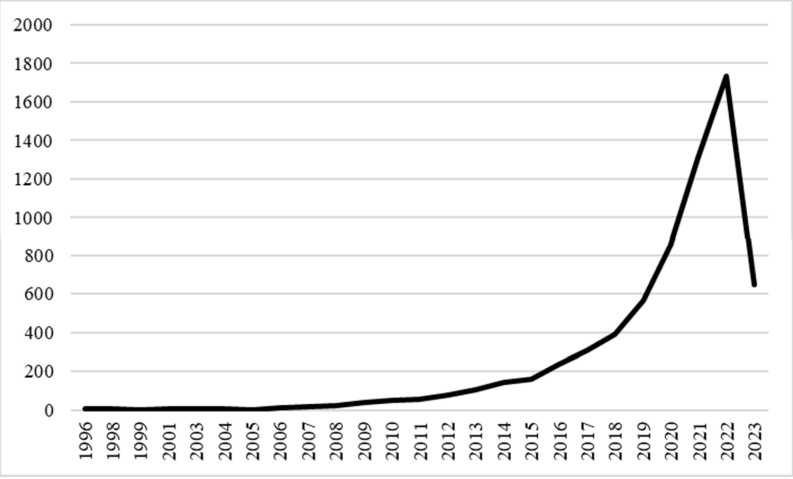

Figure 1: Publication years

Table 1: Citation analysis results by documents.

Article Title	Citations
Powering the planet: Chemical challenges in solar energy utilization	6415
The impact of human capital on the early success of necessity versus opportunity-based entrepreneurs	3423
China's 19-year city-level carbon emissions of energy consumptions, driving forces and regionalized mitigation guidelines	1058
Renewable energy consumption and economic growth: evidence from a panel of OECD countries	787
The effect of renewable energy consumption on economic growth: Evidence from top 38 countries	740
What an economic growth, renewable electricity, and natural resources contribute to CO2 emissions	704
CO_2 emissions, resource rent, renewable and nonrenewable energy in 16-EU countries	663
CO_2 emissions, nuclear energy, renewable energy and economic growth in the US	620
Renewable energy and economic regeneration in Devon, UK: The role of stakeholders in the transition to a low-carbon economy	614

The analysis of co-authorship reveals important patterns of collaboration and highlights the influential authors in the field of renewable energy and economic growth. As shown in the table below, several authors have made significant contributions to the body of research, both in terms of the number of publications and citations received.

Co-Authorship Analysis

Table 2: Co-Authorship number of publication

Author	Number of Publications	Citations
Tomiwa Adebayo	95	3845
Festus Victor Bekun	80	4564
Ilhan Ozturk	74	7673

One of the top 10 most prolific authors is Tomiwa Adebayo, who has written a reasonable number of entries and accumulated 95 articles with over 3,845 citations. Similarly, Festus Victor Bekun is not far behind with 80 publications and 4,564 citations to boot, reiterating his academic presence as well. Ilhan Ozturk, who has published 74 articles and a significant number of citations with 7,673; his contribution to the renewable energy and economic growth literature is very remarkable in 3rd place. The strong research productions of these authors have increased the knowledge at the aggregate level about how renewable energy adoption impacts sustainable economic growth.

Table 3: Co-authorship analysis results.

Author	Affiliation	Country	Docs	Citations	TLS
Adebayo, Tomiwa Sunday	Cyprus International University	Cyprus	95	3845	160
Bekun, Festus Victor	Istanbul Gelisim University	Turkey	80	4566	138
Ozturk, Ilhan	University of Sharjah	UAE	74	7673	115
Murshed, Muntasir	North South University	Bangladesh	73	2846	117
Shahbaz, Muhammad	Beijing Institute of Technology	China	70	6670	80
Kirikkaleli, Dervis	European University of Lefke	Turkey	69	3206	103
Alola, Andrew Adewale	CREDS	Norway	51	3237	58
Lin, Boqiang	Minjiang University	China	47	2050	5
Fuinhas, Jose Alberto	Universidade de Coimbra	Portugal	44	932	46
Balsalobre-Lorente, Daniel	University of Castilla-La Mancha	Spain	43	2906	77

Various scholars have made a meaningful contribution to the development of research in this field. Most notably, Murshed, Muntasir, Shahbaz, Muhammad, and Kirikkaleli, Dervis, have published 73, 70, and 69 documents, 2,846, 6,670, and 3,206 citations. These authors have addressed a wide range of issues related to economic development and the use of renewable energy sources, which indicates their authority in this matter. Other authors also made a significant contribution to science. For example, Andrew Alola Adewale, whose publications were cited 3,237 times from 51 articles, Lin Boqiang, cited 2,050 times from 47 articles, Jose Alberto Fuinhas, 932 times from

44 published works, Daniel Balsalobre-Lorente, whose articles were cited 2,906 times from 43 citations. These authors, due to the wide range of work published, have shown a high activity and contribution to science. The reliability of these authors and the reliability of their work can be judged by the total link strength. Total Link Strength is an indicator that shows the scientific links between authors based on the number of joint articles published by these authors. In other words, the metric calculated shows the reference resources from the author's collaboration. Therefore, a more detailed study of the co-authorship network, which contains information about the number of related documents, disciplines, and interdisciplinary relationships, will allow one to track how the knowledge is generated and disseminated within the subject field. The knowledge and cooperation of these scientists are useful in developing the best policies and interventions to successfully integrate renewable energy into Bangladesh's economic growth. The interdisciplinary nature of the field and the importance of cooperation in achieving the SDGs are once again emphasized by these authors.

Table 4: Co-citation analysis results by Source.

Source	Docs	TLS
Energy Policy	29,344	1,494,010
Renewable and Sustainable Energy Reviews	24,588	1,276,801
Environmental Science and Pollution Research	22,915	1,297,011
Energy Economics	19,087	1,061,435
Journal of Cleaner Production	16,071	900,721
Energy	12,528	718,279
RENEW Energy	10,737	615,019
Science of The Total Environment	7,751	470,287
Applied Energy	6,988	387,000
Ecological Economics	5,910	345,509

Transitioning to sustainable economic development and mitigating environmental damage is impossible without being realized. Solar and wind power, renewable energies, help increase energy security and have a significant impact on energy efficiency while also mitigating the greenhouse effect of production. These are the technologies that lay the foundation for a stronger and greener energy system. The production of alternative energy can lead to an economic boom, creating jobs and at the same time providing a way to use natural resources responsibly with sustainability. Understanding the integration of technology and policy replacements can lead to the decoupling of energy consumption from economic growth, thereby reducing resource waste and environmental pollution. Adoption of renewable energy can result in the creation of new employment opportunities, which serve as an accelerator for local and regional economic development. This is a taste of what a green economy, where economic growth and sustainability are intertwined, could offer. The relationships among economic development, environmental sustainability, and renewable energy adoption are intricate. Thus, the emphasis on carbon emissions, the environment, and pollution all demonstrate we need to act today to solve the environmental problems arising after years of economic growth. A key part of this is an increasingly greater role for renewable energy sources, which have the potential to lessen the environmental burden substantially. The findings also raise important policy questions regarding the need for ecological considerations in foreign direct investment (FDI), financial development, trade, and pro-growth policies. In addition to that, the technological progress in clean energy & renewable energy systems is a notable tool for environmental sustainability. There is a clear requirement for international trade policies that support sustainable practices and, at the same time, reduce ecological externalities to achieve a balance of economic growth with the conservation of our planet. Decades of research have shown that while energy use and economic development are related on a fundamental level, the precise nature of this relationship is subject to considerable variability. Researchers have examined how changes in energy consumption can influence essential measures of economic performance, for instance, GDP. Communication about long-term equilibrium in economic growth and energy consumption often involves the concept of cointegration. This approach has provided insight into the long-term relationship between these entities. In addition, the use of non-renewable energy is interconnected with oil prices and economic growth (Mallik, 2025).

In this framework, the research studying the effects of changes in oil prices on both economic performance and energy consumption remains a fascinating field to investigate, especially when considering the impact of renewable energy on sustainable development. This core research cluster probes modeling techniques employed in an examination of the linkage between economic expansion, environmental deterioration, and sustainability. Central models, such as the Autoregressive Distributed Lag (ARDL) model, focus on the causation visibility between financial performance and environmental

outcomes, in this case, measuring CO_2 emissions. The Environmental Kuznets Curve (EKC) hypothesis is most pertinent in this respect as it posits an inverted U-shaped nexus between income and environmental pollution. Using these models, researchers can better understand the trade-off between trade, development, and ecological sustainability. These models have the potential to clarify how economic growth can be compatible with sustainable development goals, emphasizing striking a tenuous balance between economic activity and environmental conservation. The interconnections between human activities, population growth, and energy consumption provide a context for analyzing carbon emissions, thereby aiding our quest for ecological sustainability (Raihan & Tuspekova, 2022). The results of the carbon emissions, energy consumption, and population dynamics analysis demonstrate how consumptive forms of urbanization and further population increase result in higher energy demand and consequently larger volumes of carbon trapped in our atmosphere. The aim is to scan energy usage patterns, industrial processes, and transportation networks in search of insights into the components that trigger greenhouse gases. Actions to reduce carbon footprints and mitigate emissions include increasing energy use efficiency, introducing renewables, and leveraging technology. At the same time, urbanization and a growing population are two significant challenges for efficient energy systems and for reducing carbon. It is imperative to understand these dynamics to ensure balanced urban planning and sustainability in the face of rising population and energy consumption, while also protecting our environment.

CONCLUSIONS

This paper presents an up-to-date bibliometric review of 6794 scientific articles from 1996 to June 2023, utilizing the Web of Science (WoS) database. The review focuses on energy development and economic growth, with a specific scope on renewable generation and its contribution to sustainable development. The results will support our readers in understanding the study context, key areas, significant papers, contributions, leading scholars, and emerging concepts. The findings underscore renewables as an essential pathway to sustainable economic growth over the long term. Renewable energy adoption represents a move towards an environmentally sustainable economy, thereby mitigating the negative environmental externality that comes with traditional energy sources. In addition to the ecological advantages offered with renewable energy, it also represents considerable commercial opportunities for advancing clean energy that enhances energy security, promotes regional economic growth, and creates employment opportunities. Analysis of scholarly literature citations shows a significant contribution of key publications and authors. A primary reference publication has now taken hold in the academic community, illustrating its impact with scholars and practitioners. Related works have also played a crucial role in framing the nexus of renewable energy as well as economic advancements. The sources with the highest frequency of co-citation for renewable energy and economic growth are the journals that contributed the most to shape scholarly discussions and direct future research in this domain; The average number of citations those sources receive per year; The size and composition of five thematic clusters based on the results from co-occurrence analysis. The first cluster relevant to energy efficiency and environmental damage in this area highlights that renewable energies are a crucial factor. The second cluster focuses on the environmental problems caused by economic growth, including the role of renewable energy in addressing these issues. The results underscore the need for stakeholders to foster an economy that balances economic development with environmental concerns, including carbon emissions and inadequate wastewater treatment. However, the study has limitations, notably its reliance on more granular, sector-specific data for a tighter coupling of local environmental challenges. Additionally, the use of cross-sectional analysis in this study implies that future research should consider using longitudinal techniques to examine the sustainability initiatives over time. Future work should investigate whether technological progress or environmental regulation can break the link between economic growth and the environment. In addition, a focus on the social dimensions of sustainability can inform policy development related to behavioral and societal factors that implicitly drive sustainable practices.

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