

Original Article

Retractions of academic papers in green economics: a case of green turning red

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Data sets analyzed during the current study were retrieved from the Scopus database.

Author contributions

Conceptualization: S.B., R.M.; methodology, formal analysis, visualization, and writing—original draft: S.B., R.M.; writing—review and editing: R.M. The final version of the manuscript was approved by both authors.

Declaration of generative AI in scientific writing

During the preparation of this work, the authors used DeepSeek to enhance the readability and language of the manuscript. After using this tool, the authors thoroughly reviewed and edited the content as needed and assume full responsibility for the final published article.

Declaration of Interests

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Abstract

Background: The integrity of scholarly literature is paramount, yet retracted research remains largely unexamined within the rapidly growing field of green economy.

Objectives: As the first systematic analysis of retracted research publications in the green economy, this study aims to (1) quantify the proportion of retractions and identify temporal and geographic patterns of retractions, (2) map the intellectual structure of the retracted literature, and (3) identify the primary causes and impacts of these retractions.

Methods: A corpus of 61,273 Scopus-indexed documents on the green economy was analyzed; of these, 181 retracted publications were systematically identified and examined. The analysis included quantitative assessment of the proportion of retractions and keyword co-occurrence using VOSviewer in addition to qualitative content analysis of retraction notices.

Results: The proportion of retractions (retraction rate) was 29.5 retractions for every 10,000 publications, significantly higher than that in many scientific disciplines. Two distinct crisis periods were identified, 2009–2011 and 2021–2024, involving different publication channels (conference proceedings and journals), with 86% of the retractions originating from China. The leading causes of the retractions were compromised peer review (78%) and referencing issues (66%), particularly affecting research in sustainability–industry linkages, energy transitions, and climate-related economic policy. Notably, 59% of the retractions came from in Q1/Q2 journals, and some of the retracted papers had been cited as many as 121–177 times.

Conclusion: The findings revealed critical systemic vulnerabilities in the scholarly ecosystem, including the exploitation of special issues and opaque retraction processes. The authors propose three evidence-based interventions to reinforce integrity: enhanced conference governance, AI-assisted validation of peer reviews, and adoption of standardized metadata on retractions.

Keywords:

Academic publishing, circular economy, ethical misconduct, peer review manipulation, publication ethics, research integrity

Introduction

Green economy, a concept that has gained prominence over the past few decades, aims to reconcile economic growth with environmental sustainability. This concept emerged in response to the limitations of traditional economic models and emphasized ecological sustainability, social justice, and decentralization.¹ It gained traction in policy and political discussions, with support from international organizations such as the United Nations and the Global Green Growth Institute.² The concept has evolved to address economic, climate-related, and environmental challenges and has now become a key policy paradigm globally.³

The field of green economy is multidisciplinary, increasingly relevant to the world today, and is growing rapidly, as highlighted by bibliometric analyses.⁴ Despite its growth, however, the field faces challenges in defining and empirically scrutinizing its broad concepts.² For instance, the intersection of sustainability and the principles of green economy presents thematic tensions that still require further exploration.⁴

Green economy is a vital framework for sustainable development, yet the reliability of its research base faces growing threats from the global rise in scientific retractions. Over recent decades, retraction rates have increased significantly across disciplines – a trend reflecting both improved detection of flawed research and escalation in cases of misconduct.^{5–9}

Retraction of a research paper is the process by which a published scientific paper is withdrawn from the scientific record. Publications are retracted for diverse reasons, broadly categorized into ethical misconduct (for example, plagiarism, duplicate publication, authorship disputes), scientific distortion (for

example, data manipulation, unsupported conclusions, non-replicability), and administrative errors (for example, publishers' mistakes).¹⁰ Guided by the principles laid down by COPE, the Committee on Publication Ethics, a retraction serves several key functions: it corrects the scholarly record by removing or flagging unreliable content, preserves the integrity of the published literature, and formally alerts the reader that the findings should no longer be relied upon.¹¹ However, a significant and persistent challenge undermining this corrective process is the continued citation of retracted works, even after their formal withdrawal from the academic record.¹²

Given the critical role of research integrity – particularly in fields with direct policy implications – understanding retraction patterns in green economy becomes urgent. As this field informs sustainability policies and economic decisions, compromised research integrity could have far-reaching societal consequences. This study therefore uses retractions in this field as a salient case study to examine broader vulnerabilities within contemporary scholarly publishing. The authors systematically analyzed retracted research in green economy with three key objectives: (1) to quantify retraction rates and their temporal and spatial patterns, (2) to identify predominant reasons for retraction, and (3) to identify the affected countries and source journals. By analyzing these dimensions, the work aims to identify systemic vulnerabilities and to inform strategies for safeguarding research quality in this policy-relevant field.

Methods

The Scopus database (<https://www.scopus.com/>) was selected for this study because

of its broad coverage and user-friendly search functionality.¹³ The Boolean search query [TITLE-ABS-KEY('green economy' OR 'low carbon economy' OR 'circular economy' OR 'eco-innovation' OR 'green growth') AND (LIMIT-TO(LANGUAGE, 'English'))] was used to retrieve documents related to the green economy. The search, conducted on 15 April 2025, was restricted to English-language documents. The initial data set consisted of 61,273 documents, comprising 38,303 articles, 8596 conference papers, 6245 reviews, 5731 book chapters, 717 books, 471 editorials, 411 conference reviews, 254 notes, 184 retracted documents, 176 short surveys, 131 errata, 27 data papers, and 27 letters.

Using the document type filter (*Retracted*), the search was narrowed to retracted documents. Manual verification revealed three records that were labeled as 'Corrigendum' (rather than 'Retraction') and were therefore excluded. The retraction metrics were quantified using two measures: (1) the absolute number of retracted papers and (2) the number of retracted papers for every 10,000 published documents. The final data set comprising 181 retracted documents was exported to SciVal (an Elsevier-developed analytical tool accessible by subscription at <https://www.scival.com/>) for further analysis of the publications, citations, and collaboration metrics.

The reasons for retraction were ascertained from the publisher-hosted retraction notices and manually classified into nine thematic categories based on their substantive content: (1) plagiarism, (2) unreliable content, (3) compromised peer review, (4) referencing issues (inappropriate or irrelevant references), (5) authorship issues, (6) ethical issues, (7) retraction by the authors (doing the right thing), (8) errors, and (9) undefined (no retraction details available). Each retracted paper

was carefully reviewed and assigned to one or more of these categories based on the publisher's stated rationale. The records assigned to each category were counted to identify the predominant reasons for retraction.

Subsequently, the Scopus data file (.csv) of retracted documents was imported into VOSviewer (accessible at www.vosviewer.com) to generate a keyword co-occurrence network.¹⁴

Ethics

Ethical approval was not required for this study as it involved analysis of publicly accessible information and did not include human participants, animals, or identifiable personal data.

Results

Of the 61,273 relevant documents retrieved from Scopus, 181 were retracted and formed the data set, a global retraction rate of 29.5 for every 10,000 publications. About 20% of the retracted documents were open access. The retracted works were predominantly papers published in journals (110) and in conference proceedings (71). Publishers with the highest retraction counts were Springer (80 retractions) and IEEE (70), followed by Elsevier and Hindawi (9 each).

Keyword co-occurrence analysis, which identifies how frequently terms appear together in a corpus of publications, revealed three distinct thematic clusters among the retracted papers (Figure 1). The first cluster (red) centered on sustainability and industrial applications, featuring keywords such as 'green economy', 'sustainable development', and 'commercial phenomena'. The second cluster (blue) focused on energy systems, encompassing 'renewable energy', 'carbon emissions', and 'energy policy'. The third

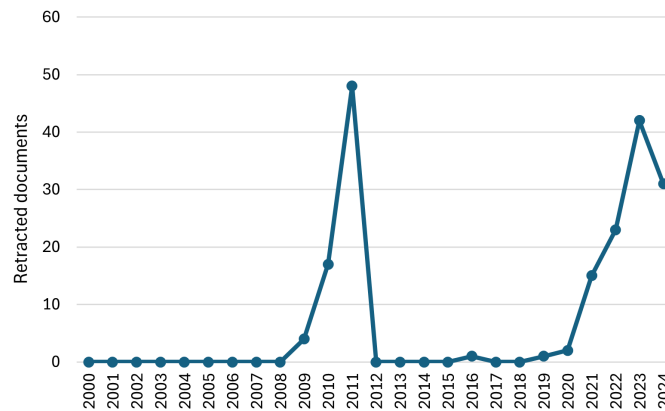


Figure 2. Evolution of retractions in the field of green economy, by year of publication.

2011 *International Conference on E-Business and E-Government* (25 documents); 2011 *International Conference on Artificial Intelligence, Management Science, and Electronic Commerce* (8); 2011 *International Conference on Business Management and Electronic Information* (5); 2010 *Conference on Environmental Science and Information Application Technology* (4); 2010 *International Conference on E-Business and E-Government* (3); 2009 *International Conference on Management and Service Science* (3); 2010 *IEEE International Conference on Advanced Management Science* (3); as well as 13 other conferences with 1–2 retractions each. As to the reasons for retractions, violations of IEEE’s publication principles topped the list, although retraction notices lacked further specifics.

Analysis of retractions during the second peak (2021–2024, 108 retractions) revealed a near-monopoly of journal articles (107), with conference proceedings represented by only one case. The journals that featured most frequently in the list were *Environmental Science and Pollution Research* (41 retractions), *Economic Change and Restructuring* (24), *Arabian Journal of Geosciences* (8), and *Operations Management Research* (4).

During the second peak, the most frequent reasons for retraction were compromised peer review processes (78% of the retractions)

and referencing issues (66%). Retractions due to unreliable content were also significant, although less prevalent (11%). Other factors, such as plagiarism, authorship disputes, ethical violations, author-initiated retractions, and errors, were comparatively rare (Figure 3).

Discussion

Our analysis offers critical insights into the retraction landscape of green economy research, exposing systemic vulnerabilities in academic publishing. The authors noted a rising trend in the rates of retraction (retractions for every 10,000 published papers) within this field in recent years, consistent with the patterns observed in other disciplines.^{15–19} With a retraction rate of 29.5, this field faces significant challenges related to integrity. For instance, several studies showed much lower retraction rates – 7.5 in the engineering sciences,²⁰ 3.7 in neurosurgery,²¹ 2.2 in the humanities²², and 2 in general science.²³ Retractions were generally more common in such fields as medicine, life sciences, and technology.^{22,24,25}

The geographical distribution of the retractions was markedly skewed, with China accounting for 86% of them, and other Asian countries (India, Pakistan, Vietnam) also

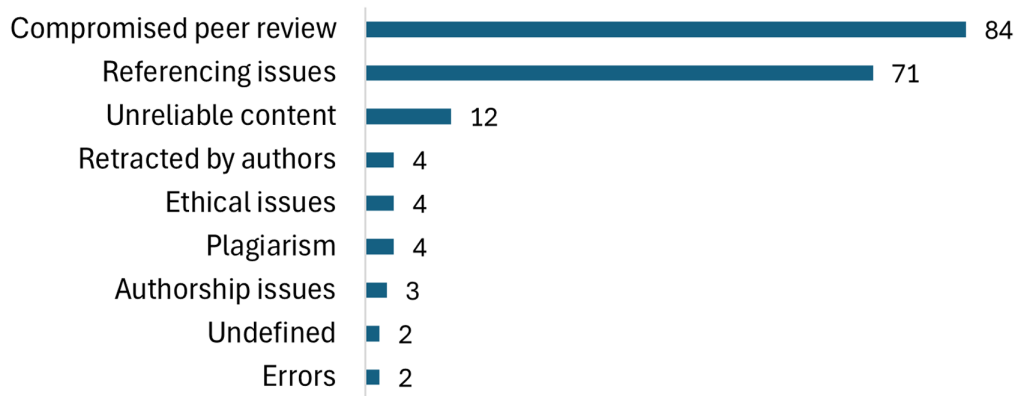


Figure 3. Reasons for retraction in the literature of green economy (2021–2024).

prominently represented. This regional skew may reflect institutional incentives, although the limited international collaboration (20%) in retracted works implies localized misconduct. Incentives can encourage rent-seeking behaviour, expending resources to obtain rewards without regard to social value.^{9,26} This behaviour can lead to unethical practices and potentially greater risk of retractions.

The temporal distribution of the retractions uncovered two distinct crisis periods: 2009–2011, which was dominated by 69 retractions involving IEEE conference proceedings due to opaque policy violations, and 2021–2024, which was driven by journal articles (107 retractions from a total of 108 retractions), 41 of those involving *Environmental Science and Pollution Research*. A significant proportion of retracted documents (59%) originated from Q1 and Q2 journals, indicating that even high-ranking journals are not free from breaches of publication ethics. The higher retraction rate of high-impact journals was probably due to their higher visibility and more stringent scrutiny, coupled with strict retraction policies that empower editors to retract articles without the authors’ consent, ensuring a more rigorous process.^{21,27} In contrast, only 1% and 0.5% of the retractions were linked to Q3 and Q4 journals respectively. Interestingly, 39% of the retracted papers were published in

non-quartile-affiliated conference proceedings, predominantly under one publisher, namely IEEE. Nevertheless, retractions involving IEEE generally do not disclose specific reasons for retractions; instead, a standard statement is issued, indicating that the paper was found to be in violation of IEEE’s publication principles following a review by a duly constituted expert committee. On the other hand, retractions involving Q1 and Q2 journals are often more transparent. Among these, four papers were retracted at the authors’ request, three were withdrawn owing to concerns raised by third parties, and the rest were the result of internal investigations by the publishers or editors (93%). This suggests increased awareness and scrutiny by publishers.

Since the formalization of retraction guidelines by COPE in 2009, the retraction rate of scholarly articles has risen significantly.²⁸ This trend reflects heightened awareness and improved reporting of misconduct and errors. Retraction notices now cite investigations by journal authorities more frequently,²⁹ leading to greater transparency in the process. However, further standardization – such as retraction forms and checklists aligned with the COPE guidelines – is necessary to strengthen the integrity of scientific literature.³⁰

An analysis of the duration between publication and retraction revealed that publishers responded markedly faster during the recent wave (2021–2024) of retractions: of the 108 retractions, 85% (92 papers) were retracted within a year of their publication, indicating a swift corrective process. This short lag signals a significant improvement in post-publication detection and enforcement of integrity compared to that seen in the past, with papers being retracted in some cases more than 4 years after their publication.³¹

In 2024, following an internal investigation, Springer – in agreement with the Editor-in-Chief of *Economic Change and Restructuring* – retracted several articles after determining that the peer review process for a guest-edited collection had been compromised; 24 of these retracted articles were related to the green economy. However, it remains unclear whether the authors participated in or were aware of the manipulation. The retraction notice did not specify whether the authors had disagreed with the decision to retract, leaving their role in the underlying misconduct ambiguous.

Additionally, in 2024, Springer retracted 41 green-economy-related publications from *Environmental Science and Pollution Research* due to serious integrity concerns, including compromised peer review, inappropriate referencing, and problematic citations. Some authors were flagged three or four times for the same integrity concerns. These cases highlight recurring patterns of editorial and ethical violations warranting further scrutiny.

Peer review manipulation occurs when authors, editors, or reviewers exploit the evaluation process to ensure publication without proper scrutiny. Authors may suggest fraudulent reviewers (supplying fake identities or suggesting their colleagues as reviewers, for

example) or collude with reviewers. Guest editors in special issues sometimes hand-pick biased reviewers or bypass supervision by the journal, and unethical reviewers may provide superficial assessments, sabotage competitors, or accept bribes. Common tactics include fake reviewer emails, peer-review rings or cartels, editorial bypass for special issues, and AI-generated manuscripts from paper mills.

Faked peer reviews have been identified as a novel and growing cause for retraction.³² A review of retracted papers due to faked peer reviews found that 250 papers were retracted across 48 journals, with a significant number of these papers originating from China.³² Another analysis found that 95 out of 343 retractions related to Iranian institutions were due to fake peer reviews.³³ This suggests a systemic issue within certain regions and journals. Addressing this problem requires a multifaceted approach, including regulatory reforms, education, and robust peer review standards.

Thematic analysis revealed three research fronts particularly susceptible to retractions: industry–sustainability linkages, energy transitions, and climate–economic policy – all high-stakes, policy-relevant domains. The analysis of the most cited but retracted papers revealed a pattern of concern within environmental sustainability and energy research, particularly evident in *Environmental Science and Pollution Research*. The four most cited retracted papers (<https://doi.org/10.1007/s11356-024-34314-6>; <https://doi.org/10.1007/s11356-024-34268-9>; <https://doi.org/10.1007/s11356-024-34322-6>; and <https://doi.org/10.1007/s11356-024-34311-9>), which had accumulated 121–177 citations each, were all retracted in July 2024 as a part of a broader investigation by the publisher. The retraction notices cited multiple and serious breaches of integrity, including

compromised peer review, inappropriate referencing, and content falling outside the journal's scope. This combination of issues points to a fundamental breakdown in editorial scrutiny, with standard manuscript evaluation and scoping protocols being circumvented. The substantial citations accrued by these papers raise questions about citation dynamics. Although some citations may represent legitimate prior use, the concentration of retracted papers from journals such as *Environmental Science and Pollution Research* – which has publicly addressed 'problematic citation behavior' as a core integrity issue – suggests that manipulating citations, by citation stacking or cartels for example, may be a contributing factor.³⁴ This pattern aligns with the 'referencing issues' in retraction notices, indicating that manipulated citations may inflate some metrics. Such distortions highlight how systemic editorial failures compromise the scientific record, particularly when flawed papers gain high citation counts pre-retraction.

The sophistication with which integrity is breached, through fake peer reviews and citation networks for example, demands scalable technological countermeasures. Artificial intelligence (AI) and machine learning tools are increasingly capable of detecting suspicious patterns such as fraudulent reviewer identities, citation cartels, and submissions from paper mills with their characteristic features at a scale impractical for manual oversight. Integrating such AI-assisted validation into manuscript handling systems would provide a critical pre-screening layer, enhancing the integrity of peer review in such policy-sensitive fields as green economics.

The present study systematically analyzed retracted publications in green economy research employing a dual-method approach that integrated quantitative bibliometrics

with qualitative content analysis of retraction notices. The primary strength of the paper lies in the construction and rigorous examination of a specialized, policy-relevant corpus, offering novel insights into integrity challenges facing a rapidly growing and multidisciplinary field. However, several limitations must be acknowledged. First, the reliance on the Scopus database, while ensuring broad and reputable coverage, means the data set may not be exhaustive, potentially omitting retractions from channels not indexed by this platform. Second, the interpretative depth of the content analysis is constrained by the variable transparency of retraction notices. Notably, a significant portion of notices from major publishers such as IEEE use standardized, non-specific language (for example, 'violation of publication principles'), which precludes a more nuanced classification of the causes of misconduct and may skew their quantitative distribution. Finally, the inherent lag between publication and retraction means that the number of retractions identified at the time of data collection probably underrepresents the true scale of the issue. These limitations highlight the need for caution in generalizing the precise prevalence of any specific cause of retraction. Future qualitative research, including interviews with authors whose papers have been retracted and journal editors in this field, is crucial to understand the specific motivations and pressures revealed by the analysis.

The present study is the first systematic analysis of retractions in the field of green economy, revealing critical vulnerabilities in its scholarly ecosystem. A retraction rate of 29.5 for every 10,000 publications – far greater than the average in many disciplines – highlights two distinct crisis periods (2009–2011 and 2021–2024) driven by compromised peer review and referencing issues,

predominantly concentrated in Chinese-affiliated research.

The prevalence of retractions in high-impact journals and their policy-sensitive themes (energy transitions, industrial sustainability, and climate–economic interactions) underscores the far-reaching consequences of these integrity failures.

The concentration of retractions within this field points to specific systemic vulnerabilities. The high policy relevance of green economy as a field, its rapid growth, and its interdisciplinary nature may collectively make it more susceptible to breaches of integrity. The pressure to produce timely, policy-impactful research – amplified by institutional alignment with frameworks such as the UN Sustainable Development Goals (SDGs) – can create incentives that outpace robust supervision. Furthermore, the interdisciplinary character of the subject, although a strength, can blur methodological standards and complicate editorial scrutiny, potentially allowing manipulated work to pass through compromised review processes in targeted venues.

Although increased scrutiny by publishers has improved detection, systemic gaps persist—particularly in managing special issues of journals and the transparency of retraction. To lower these risks, the authors propose three actionable measures: (1) stringent scrutiny of conference proceedings and of guest-edited collections, (2) adoption of AI-assisted tools for validating the integrity of peer review and for detecting anomalies in citations, and (3) standardized metadata related to retraction and aligned with the COPE guidelines.

For sustainability science to credibly inform global policy, institutions, funders, and publishers must prioritize research quality controls alongside rapid production of

knowledge. The present study serves as both a diagnostic framework and a call for coordinated reforms to safeguard the integrity of scholarship in the field of green economy.

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