International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Evolution of Research on Carbon Accounting and Trade Policy in the era of Digitalization: A Bibliometric Analysis

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Abstract

This study presents the nexus of research on Carbon accounting, trade policy in the generation of digitalization. Carbon emission has experienced a rapid increment in the trade and business across the globe. On these challenging issues, United Nations has taken several steps towards accounting and mitigating the carbon emissions in the Paris agreement held in the year 2015. This paper presents a comprehensive bibliometric analysis of evolution of scholarly trends and output on Carbon accounting, trade policy and digitalization over the years as well as mapping the intellectual and social structure of the domain by identifying the most influential authors, journals, institutions, and countries. Our study adopts the Dimension.ai (an open access database) for the collection of bibliometric datasets from the year 2015 to July 2025 which includes a broad range of research articles. We employed advance bibliometric tools and VOSviewer software to visualize the citation structure, publication trends, influential authors, journal and most publishing counties. Initially, the screening process followed on the datasets to access 36027 articles published before our inclusion criteria based on keyword search. Finally, 10185 articles met the criteria and included in our data analysis. Furthermore, our finding reveals that a marked increment in the research activity following the Paris agreement with an accelerating integration of digital tools, updated trade policies and proper accountability towards mitigating Carbon emissions. The annual growth rate of publications in this fields marked a vigorous expansion especially in the year 2020 and 2023 with 1528 and 2156 publications respectively coinciding with broadening interest in sustainability and inculcation of digitalization across trade policy. The mapping of the intellectual structures reflects the "Simone Abram" as the most cited authors while "Fu Jia" and "Soumya Deb Chowdhary" has highest numbers of published papers and total link strength respectively. Moreover, the most influential journals are, "Journal of Cleaner production" and "Sustainability" ranks highest in citations, total link strength and Publications respectively. The Social structures visualized through citations among organizations as well countries with published articles reveals robust transnational connections, reflecting global imperative of carbon accounting and trade policy inclusion with digitalization. "United Kingdom" and "China" rank highest cited countries with a citation of 20360 and 15192 where as China and
UK published 567 and 489 paper highest as compared to others. This bibliometric review indicates rapid and multidimensional evolution of research on carbon accounting, trade policy and digitalization which provides a roadmap for future research and policy development and underscores the necessity for ongoing interdisciplinary and cross-sectoral inquiry to address the challenges of sustainable trade in the digital era.

Keywords: Carbon Accounting, Trade Policy, Digitalization, VOSviewer, Bibliometric analysis,

Introduction

The nexus of environmental sustainability, international trade, and technological innovation has become a critical area of scholarly inquiry in recent decades. Climate change has emerged as one of the most pressing global challenges, and the role of carbon accounting has grown in importance as organizations and governments strive to meet emission reduction targets under frameworks such as the Paris Agreement (Zheng et al., 2022). Carbon accounting provides a systematic methodology for quantifying, reporting, and verifying greenhouse gas (GHG) emissions, thereby enabling transparency, comparability, and accountability in environmental performance (Steininger et al., 2016). Parallelly, trade policy has increasingly influenced carbon dynamics by regulating cross-border exchanges of goods and services and by shaping the implementation of climate-related trade mechanisms such as carbon border adjustment mechanisms (CBAMs) and green tariff regulations (Larrinaga, 2014).

The era of digitalization has added a new dimension to these discourses. Digital technologies including blockchain, artificial intelligence, big data analytics, and Internet of Things (IoT) systems are revolutionizing the practices of carbon accounting by improving data accuracy, transparency, and traceability across global value chains (Lippert, 2015). Similarly, digitalization influences trade policy through the rise of digital trade platforms, smart logistics, and the integration of environmental considerations into digitally enabled trade agreements (González, J. L., & Jouanjean, M. A., 2017). Thus, digital transformation serves both as an enabler of sustainable trade and as a disruptive force that compels new approaches to international climate governance. The study seeks to address the following research questions (RQs):

RQ1: How has the volume and focus of research publication trends on carbon accounting, trade policy, and digitalization evolved over time?

RQ2: Which authors, journals, institutions, and countries are the most influential in shaping this body of knowledge?

By addressing these questions, the study contributes to a deeper understanding of how the integration of digital technologies with carbon accountability and trade governance is reshaping academic inquiry and informing policy agendas for sustainable development.

Research Gap and Contribution

Although, after going through extensive literature exists on carbon accounting (Andrew & Cortese, 2011; Stechemesser & Guenther, 2012) and trade policy in the context of sustainability (Copeland & Taylor, 2004; Cosbey et al., 2019), the integration of these domains with digitalization remains underexplored. Most prior studies have examined carbon accounting primarily from the perspective of corporate reporting, environmental disclosure, and compliance, with limited attention to how digital technologies are reshaping measurement, verification, and transparency mechanisms (Buhmann et al., 2019; Müller et al., 2021). Similarly, research on trade policy has traditionally focused on economic efficiency, competitiveness, and trade liberalization, while environmental and digital dimensions have only recently been incorporated into mainstream discussions (Zhang & Baranzini, 2004; González, J. L., & Jouanjean, M. A., 2017). Another notable gap lies in the fragmentation of scholarly discourse. The majority of studies are discipline-specific, with environmental accounting researchers emphasizing reporting frameworks (e.g., GHG Protocol, ISO standards), trade economists focusing on border adjustments and carbon

leakage, and information systems scholars analyzing blockchain or artificial intelligence applications. A holistic synthesis that maps how these streams converge is largely missing. Furthermore, while bibliometric analyses have been conducted separately on sustainability accounting (Qian et al., 2021) and digital trade (López-González & Ferencz, 2018), no comprehensive attempt has been made to capture the triadic nexus of carbon accounting, trade policy, and digitalization.

Given the growing complexity of global sustainability challenges, there is a need to systematically map the intellectual progress on carbon accounting and trade policy in the context of digitalization. A bibliometric approach enables such an exploration by examining publication trends, intellectual linkages, and thematic developments across disciplines. Accordingly, the objectives of this study are threefold:

1. To analyse the evolution of research output on carbon accounting, trade policy, and digitalization over time, identifying key periods of growth and transformation.
2. To map the intellectual and social structures of the field by identifying the most influential authors, journals, institutions, and countries contributing to this domain.

The remainder of the paper is organized as follows: " Research Methodology" section presents the methodology, Data extraction sources and process. "Results and discussion" section explain about the findings extracted from the data analysis and its interpretations of the bibliometric analysis. Finally, "Conclusion" section of the paper provides the conclusion and suggestions for the researchers, corporates, governments, public etc. at the least limitations of the study will be discuss in this study.

Research Methodology

To explore the overall potential of the existing literature on the carbon accounting, trade policy and digitalisation adopts a bibliometric analysis approach in order to understand systematically. Bibliometric analysis techniques are rapidly employed in Accounting, Finance, Economics, management and sustainability research as the involves using quantitative evaluation of citation patterns, publication trends, bibliographic coupling and co-authorship networks and metrics to measure the influence (Aria & Cuccurullo, 2017; Donthu et al., 2021). It assists in evaluating the productivity of researchers, journals, institutions and countries, as well as identifying key research areas and trends with the disciplines. It is a quantitative method for evaluating and quantifying research material especially academic articles, journals and book chapters. The research design of the study is quantitative bibliometric analysis which evaluates the performance analysis i.e., trends, productivity, impact, and most influencing authors etc. and scientific mapping i.e., linkages and thematic clusters.

Data Extraction Source

For the purpose of fulfilling the objective of the study, bibliometric datasets were extracted from the Dimensions (https://www.dimensions.ai/). It is an open access database for bibliometric analysis of carbon accounting, trade policy and digitalization. The Dimension as a source for collecting the datasets because of its comprehensive database, advance analytical tools, and intuitive UI. Dimensions provides the user to access and perform analysis to an extensive library of academic publications either science, humanities, or social science journals, articles, book chapters, proceeding, and patents etc. Its vigorous bibliometric analysis abilities provide the user to derive a meaningful and significant insights likewise the publication trends, influencing authors, journals, most preferred literature, countries contributions, collaboration networks and emerging research areas etc. its broad and user- friendly databases allow the researchers to navigate the areas in a better strategic manner without imposing any kind of limitations.

Dimension provides various options to analyse the
datasets like visualization option, and networking options etc. making it an efficient and effective tool for exploring the literature on Carbon accounting, trade policy and digitalization.
The selection of Dimensions database as the primary source of bibliometric data for this study due to several advantages over the other databases such as Web of Science (WoS) and Scopus. It has broader coverage of publications more than 100 million research outputs across journals, articles, books, proceedings, and policy documents, providing broader range of interdisciplinary domains. This is most significant for a topic like carbon accountings, trade policy and digitalization which is spread within economics, environmental studies, and accounting & information systems. It has higher inclusive combination of regional, open- access, and recently updated journals which covers approx. all the relative areas. Moreover, previous studies mainly focused on the traditional databases like Scopus, WoS, and Google Scholar and very few studies utilised the Dimension databases. It is very significant to acknowledge that using the different database for the purpose of fulfilling the objectives can indeed yields different, particularly, concerning countries or researchers with significant contributions.

Data Extraction Process

In view of data extraction as depicted in Fig. 1. The process for data extraction begins with the search string carried with the term "Carbon Accounting, Trade Policy and Digitalization" which should be present in full paper of the document published. The study period for this data analysis is about 10-year 7months 25 days from the year 2015 to 26th August 2025. We got 36027 published documents. Moreover, the search is limited to publication type (i.e., Articles, chapters, and edited books) with English language having 10185 documents based on our research area Fig. 3. So, finally, we have 10185 documents for data analysis in view of fulfilling our requirements of research objectives and questions.

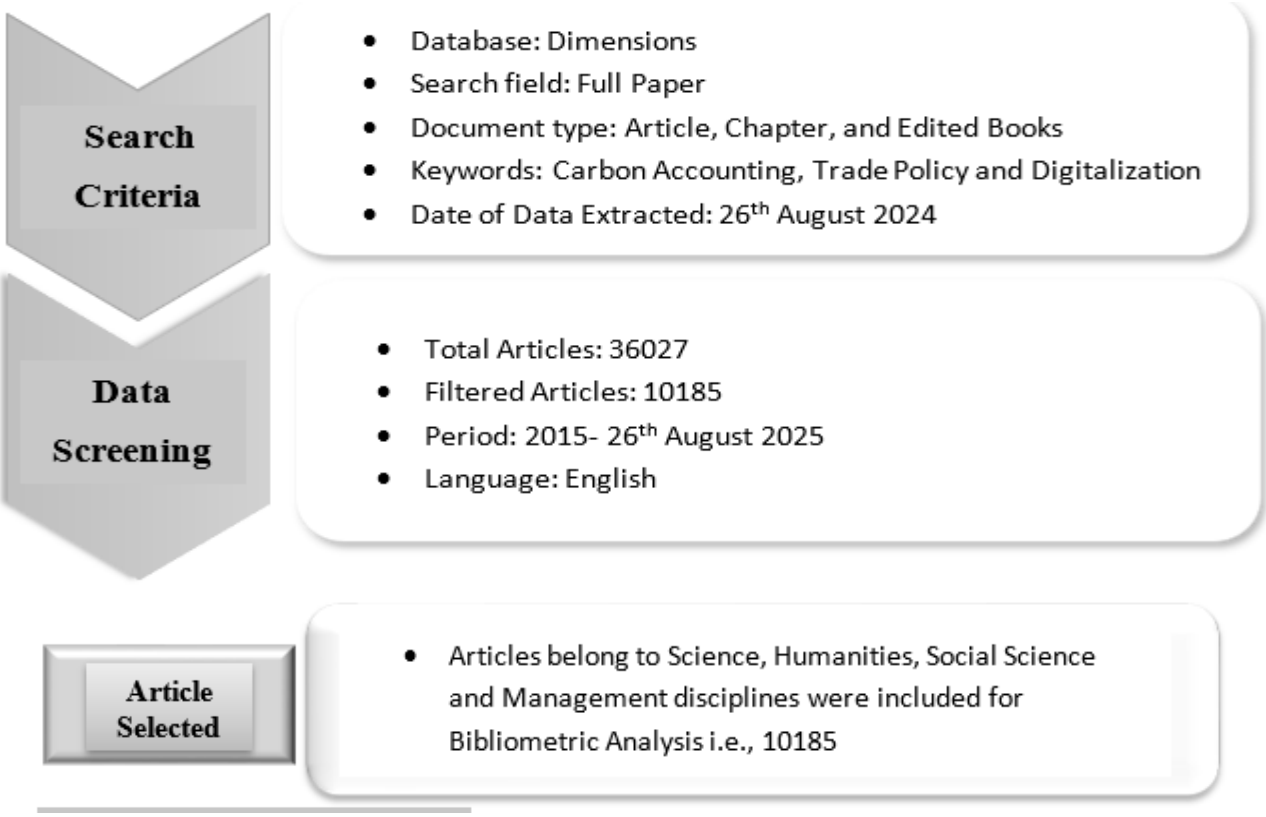

Fig.1: Data Extraction Process

Result and Discussion

Publication Trend

According to Fig. 2; the data reflects a significant growth in research publication output on carbon accounting and trade policy in the era of digitalization over the past decade. From 2015 to 2017, publication numbers rose gradually, from 40 papers in 2015 to 133 in 2017, indicating a modest but steady emergence of interest in the topic. A sharp increase began in 2018 (297 publications) and accelerated further in 2019 (393 publications), suggesting that global policy debates particularly the Paris Agreement's implementation phase and rising trade–climate linkages sparked wider academic engagement. The most dramatic surge occurred in 2020, with 1,528 publications, nearly a fourfold jump from the previous year. This peak likely reflects heightened attention to sustainability and digital solutions during the COVID-19 pandemic, when supply chain disruptions and green recovery policies brought carbon accounting and digital trade issues to the forefront. In subsequent years, the trend shows fluctuating but consistently high output:

- 2021 saw a drop to 803 publications, possibly due to transitional adjustments post- pandemic.
- Research rebounded in 2022 (1,361) and peaked again in 2023 (2,156), marking the highest level in the dataset.
- 2024 (1,790) and 2025 (1,583) show a slight decline, but still remain well above pre- 2020 levels, signalling consolidation of the field rather than waning interest.

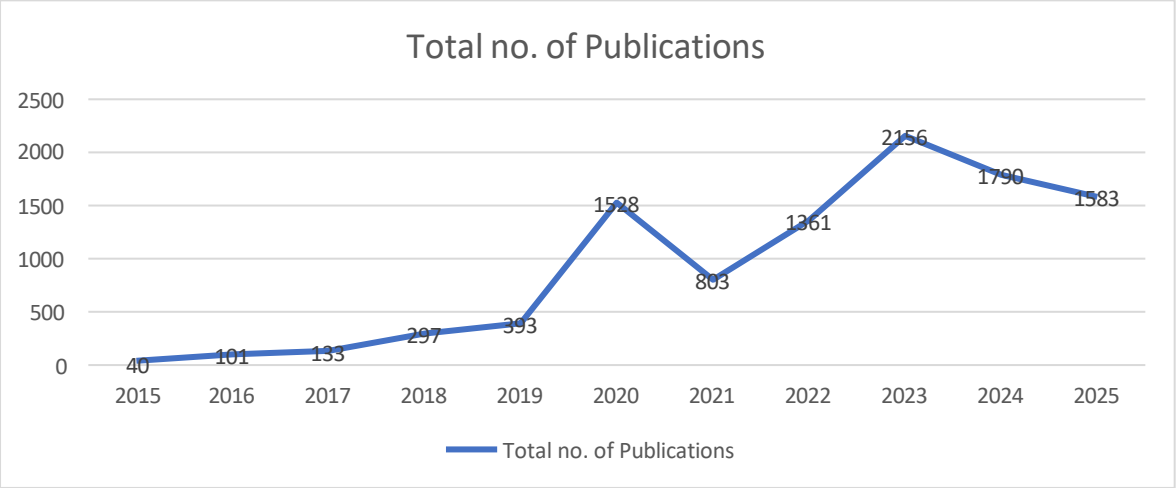

Figure 2: Total No. of Publication trends over the years
Source: Authors own Calculation

Overall, the total of 10,185 publications underscores the rapid evolution of this research area, with digitalization and climate-trade linkages becoming increasingly mainstream in academic and policy discourse.

Most Influential Authors

Table 1 highlights the most influential authors contributing to the field of carbon accounting, trade policy, and digitalization, based on their citations, number of documents, and total link strength (TLS, reflecting research collaboration and co-citation networks). Simone Abram stands out as the most cited author, with 2,029 citations from just 3 documents and a TLS of 33. This suggests that her contributions, though limited in number, are foundational and widely referenced across the literature. Tanveer Ahmed (894 citations, 2

documents, TLS 28) and Soumyadeb Chowdhary (885 citations, 5 documents, TLS 42) follow closely. While Ahmed's influence derives from fewer but highly impactful papers, Chowdhary demonstrates both influence and stronger connectivity within the research network, as indicated by the highest TLS in the table. Felix Creutzig (668 citations, 5 documents, TLS 41) also emerges as a highly networked scholar, showing that his work is not only well-cited but also well-integrated across collaborative and citation clusters. Authors like Surajit Bag (749 citations, TLS 36) and Yu Gong (774 citations, TLS 25) demonstrate a balance between citation impact and collaborative strength, suggesting consistent engagement in advancing the field. Fu Jia (736 citations, 6 documents) has the highest document count, highlighting steady and sustained contributions, even if his citation totals are more distributed across multiple works. Other authors, such as Young Kyu Dy, Abdul-Lateef, Bologun, and Xiang Feng Chen, have moderate citation counts (620–678) with fewer documents and lower TLS, reflecting more specialized or emerging contributions.

Table 1: Most influential Authors

Authors	Citations	Documents	Total Link Strength
Simone Abram	2029	3	33
Tanveer Ahmed	894	2	28
Soumyadeb Chowdhary	885	5	42
Felix Creutzig	668	5	41
Surajit bag	749	2	36
Yu gong	774	4	25
Fu jia	736	6	25
Young Kyu dy	678	2	24
Abdul-lateef	648	3	17
Bologun	648	3	17
Xiang feng Chen	620	2	13

Source: Author's own Calculation

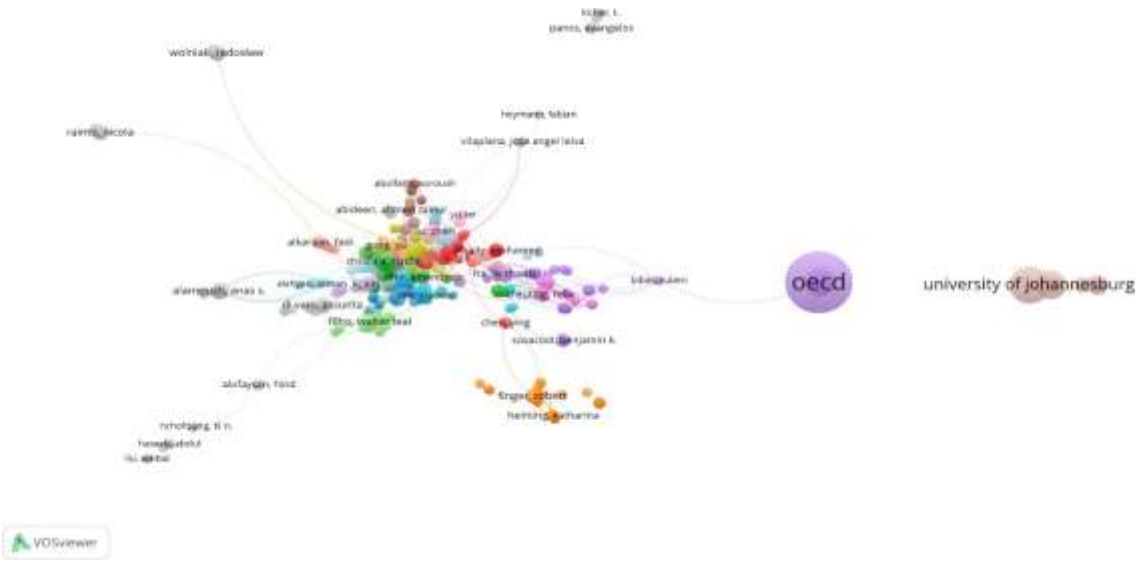

Fig. 3: Citations analysis among authors from 2015-2025 (Network Visualization)

Overall, the data indicates a dual pattern of influence: a few authors (e.g., Abram, Ahmed) with highly cited but limited publications, and others (e.g., Chowdhary, Creutzig, Fu Jia) whose influence stems from sustained contributions and stronger collaborative linkages. Together, these authors shape the intellectual core of the research domain as shown in fig. 3.

Most prominent Institutions

Table 2 and Fig. 4 highlights the most influential institutions in the domain of carbon accounting, trade policy, and digitalization, measured in terms of citations, number of documents, and total link strength (TLS). Collectively, these indicators capture not only the volume and impact of research output but also the extent of collaboration and integration within international scholarly networks. At the top of the list are Durham University and Heriot-Watt University, with 2,544 and 2,094 citations respectively, each based on only seven publications. This concentration of impact demonstrates how a small set of highly cited, potentially groundbreaking papers can establish an institution's reputation as a thought leader in the field. Their TLS values (Durham 57, Heriot-Watt 52) are moderate compared to others, suggesting that while their works are widely recognized and cited, they are not as deeply embedded in broader collaborative networks as some other institutions. These universities exemplify the strategy of achieving prominence through selective, high-quality scholarship. In contrast, institutions like ETH Zurich, the University of Cambridge, and the University of Johannesburg demonstrate influence through a combination of productivity and connectivity. ETH Zurich, with 22 documents and 1,725 citations, has the highest TLS (151), signalling that it is a central hub in global research collaborations. Similarly, Cambridge and Johannesburg, each with 36 publications, illustrate a model of sustained, large-scale contributions. Cambridge's 1,474 citations and TLS of 120, and Johannesburg's 1,160 citations with an even stronger TLS of 148, suggest that these universities play an anchor role in shaping intellectual debates, while also fostering extensive co-authorship and citation linkages across borders. Aston University provides an interesting middle ground: with 11 documents and 1,357 citations, it demonstrates strong scholarly visibility while maintaining a high TLS (140). This suggests that Aston's work is not only well-cited but also well-positioned within collaborative networks, giving it an influence that is disproportionate to its output volume. The Toulouse Business School and University of Newcastle also stand out as rising players. Though their outputs are moderate (8 and 12 publications, respectively), their TLS scores (132 and 91) indicate robust networking and integration into the field's discourse. The Toulouse Business School, in particular, seems to be emerging as a significant contributor by leveraging collaboration and co-citation networks, which could amplify its influence further in the coming years. Finally, the University of Nottingham presents a slightly different profile. With 1,133 citations from only 6 documents, it demonstrates strong per-publication impact. However, its TLS score of 43 suggests relatively weaker network centrality. This may mean that while Nottingham's contributions are individually impactful, they are not yet as connected to global collaborative clusters as those of institutions like ETH Zurich or Cambridge. Taken together, the data points to two distinct pathways to institutional prominence in this research area firstly, Focused impact with selective publications (e.g., Durham, Heriot-Watt, Nottingham), where a small number of influential works dominate citation counts. Then after Broad-based impact through productivity and collaboration (e.g., ETH Zurich, Cambridge, Johannesburg, Aston), where consistent publication activity combined with strong global linkages enhances both visibility and relevance.

Table 2: Most prominent Organisations

Institutions	Citations	Documents	Total link strength
Durham University	2544	7	57
Heriot-watt University	2094	7	52
Eth Zurich	1725	22	151
UNSW Sydney	1486	16	62
University of Cambridge	1474	36	120
Aston University	1357	11	140
University of Johnsburg	1160	36	148
University of Nottingham	1133	6	43
Toulouse business school	1064	8	132
University of Newcastle	1062	12	91

Source: Author's own calculations through VOSviewer

Fig. 4: most prominent organisations in publishing journals (Network Visualization)

These dual dynamic underscores the evolving structure of research in carbon accounting and trade policy. High-impact scholarship can emerge either from a few seminal contributions that set the intellectual agenda or from active participation in global, collaborative knowledge production networks. Together, these institutions form the backbone of scholarly inquiry in this rapidly expanding field, shaping both its theoretical frameworks and its practical policy relevance.

Most productive Countries

Table 3: Most leading Countries

Countries	Citations	Documents	Total Link Strength
United Kingdom	20360	489	1276
China	15192	567	1162
Germany	8756	230	656
United States	8064	296	546
India	6797	184	520
Italy	8052	252	471
Australia	7631	201	426

France	7095	119	381
Malaysia	6617	101	319
Spain	4946	158	366

Source: Author's own Calculation

Table 3 reflects the global landscape of research leadership in carbon accounting, trade policy, and digitalization, highlighting countries with the highest citations, publication volume (documents), and total link strength (TLS). Together, these metrics provide a picture of not only where research is being produced, but also how influential and interconnected it is in shaping global scholarship. The United Kingdom emerges as the most prominent contributor, with 20,360 citations across 489 publications and the highest TLS of 1,276. This reflects both a high volume of output and exceptionally strong integration into global research networks. The UK's leadership can be attributed to its combination of world-renowned universities, strong policy-oriented research traditions, and active engagement with European as well as international trade–climate debates. China follows closely with 15,192 citations from 567 documents and a TLS of 1,162. Interestingly, China has the highest number of publications among all listed countries, showing that its influence is rooted in large-scale research productivity. While its average citations per paper are lower than the UK's, China's high TLS confirms that it is a central actor in international collaborations, reflecting the country's growing academic presence in sustainability and digitalization research. Germany and the United States rank next, with 8,756 citations (230 documents, TLS 656) and 8,064 citations (296 documents, TLS 546), respectively. Germany demonstrates a strong balance of output and connectivity, consistent with its emphasis on green technologies and EU carbon governance. The United States, although slightly behind in TLS, still maintains global relevance through high-impact scholarship and policy-driven research. Interestingly, Italy (8,052 citations, 252 documents, TLS 471) ranks very close to the US in citation terms, suggesting significant intellectual influence despite having fewer international collaborations compared to European peers like Germany. Australia (7,631 citations, 201 documents, TLS 426) and France (7,095 citations, 119 documents, TLS 381) also contribute substantially, reflecting strong national priorities around sustainability and trade, though their collaborative reach is somewhat narrower. Among emerging players, India (6,797 citations, 184 documents, TLS 520) demonstrates rising influence, with a citation count comparable to advanced economies. India's relatively strong TLS indicates growing international collaborations, which likely reflect its increasing role in climate negotiations and digital policy frameworks. Malaysia (6,617 citations, 101 documents, TLS 319) represents another important contributor from the Global South. Despite its smaller output compared to China or India, Malaysia's work is gaining global recognition and carving out space in academic and policy dialogues.

Finally, Spain (4,946 citations, 158 documents, TLS 366), though lower in absolute citations, demonstrates solid engagement and networking, suggesting an expanding role in the research ecosystem, particularly within European sustainability and trade integration initiatives.

Taken together, these findings highlight a two-tiered global structure:

1. Established leaders (UK, China, Germany, US, Italy) with large-scale, influential research that anchors the field as clearly identified in fig. 5 and fig. 6.
2. Emerging contributors (India, Malaysia, Spain) who are building recognition through growing publication volume and increasing international collaboration.

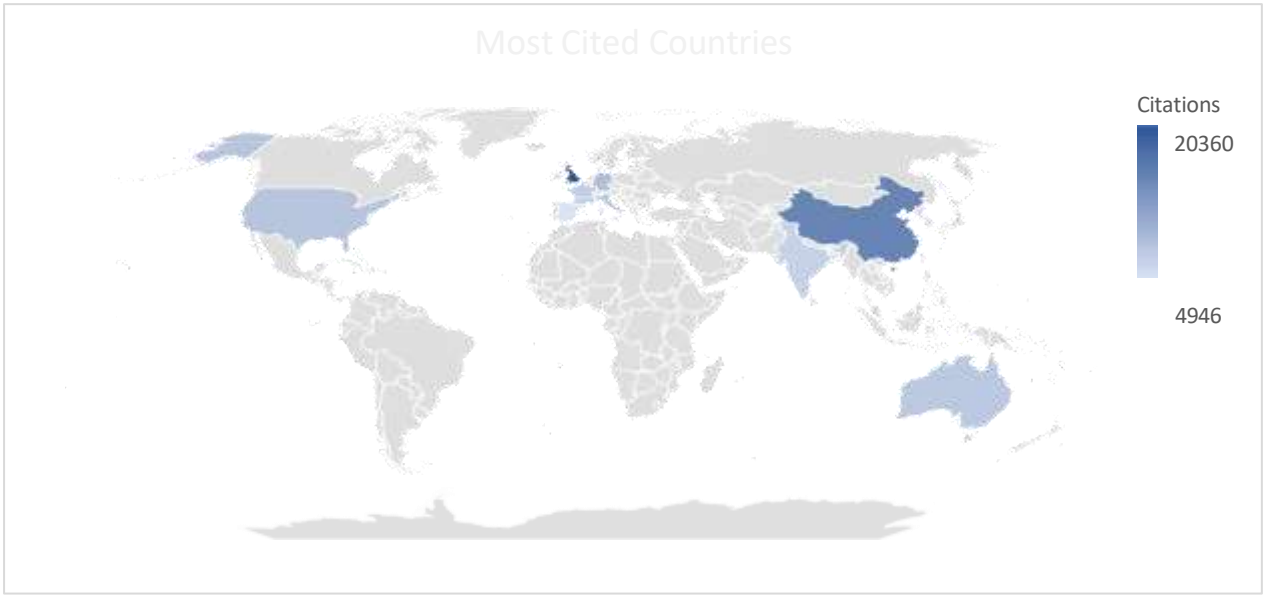

Fig. 5: Most leading Countries (in view of more Citations)

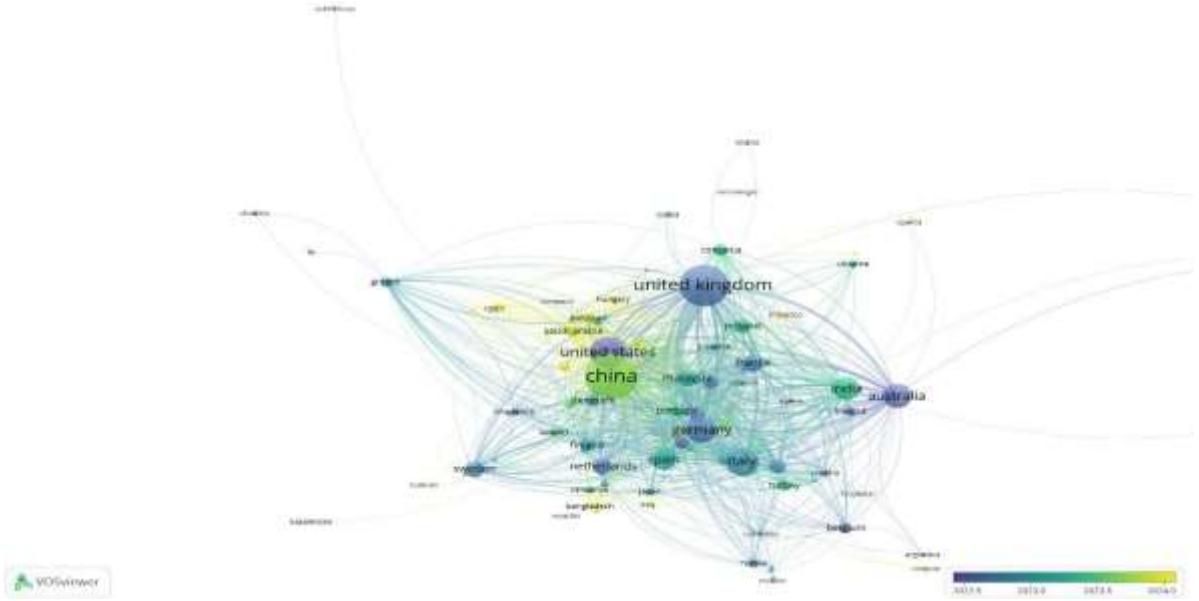

Fig. 6: Most Documents published by Countries (overlay Visualization)

Overall, the distribution reflects how research on carbon accounting and trade policy is no longer confined to advanced economies but is becoming increasingly globalized, with both developed and developing countries actively shaping the discourse in the era of digitalization.

Most Productive Journals

Table 4: Most leading Journals

Journals	Citations	Documents	Total Link Strengths
Journal of Cleaner Production	5588	72	252
Sustainability	4220	168	214
Renewable and Sustainable energy	3602	28	80

review			
Technological forecasting and Social Change	2540	49	137
International Journal of Information management	2002	3	5
Journal of business research	1528	10	71
Resource Conservation and recycling	1269	14	47
Energies	1150	54	52
Nature Communication	1006	3	9
Energy economics	763	26	54

Source: Author's own calculation

Table 4 identifies the core academic journals that have published influential research on carbon accounting, trade policy, and digitalization. The metrics of citations, publication volume, and total link strength (TLS) provide insights into each journal's role in shaping and disseminating knowledge in this interdisciplinary domain.

At the top of the list, the Journal of Cleaner Production is the most influential outlet, with 5,588 citations across 72 publications and the highest TLS (252). This demonstrates the journal's centrality in disseminating research that bridges sustainability, industrial practices, and environmental management. Its strong network connectivity suggests that it acts as a hub for interdisciplinary scholarship, attracting contributions from diverse fields such as supply chain studies, climate policy, and digital transformation. From fig. 7, Sustainability follows as the most prolific journal, with 168 documents contributing to the field and a strong 4,220 citations. Although its average citation per paper is lower than that of some specialized outlets, the journal's broad thematic scope and open-access model have made it an attractive platform for both established and emerging scholars. Its TLS of 214 reflects a wide collaborative network, highlighting its importance as a venue for building international research visibility. The Renewable and Sustainable Energy Reviews (3,602 citations, 28 documents, TLS 80) represents a high-impact, selective journal. Despite publishing fewer articles, it achieves high citation rates, indicating that papers published here tend to be seminal reviews or conceptual frameworks that shape subsequent research directions. Technological Forecasting and Social Change (2,540 citations, 49 documents, TLS 137) is another key interdisciplinary journal. Its focus on future-oriented policy, innovation, and socio-technical change aligns closely with the themes of digitalization and trade, making it an important forum for studies at the interface of technology, sustainability, and governance. The International Journal of Information Management stands out for its very high citation-to-document ratio: 2,002 citations from only 3 papers. This suggests that the few contributions published here are particularly influential, likely addressing the nexus between digital technologies and sustainability in ways that resonate strongly across the literature. Business and policy-oriented outlets also play a role. The Journal of Business Research (1,528 citations, 10 documents, TLS 71) reflects growing interest in how firms integrate carbon accounting and sustainability into trade and management practices. Similarly, Resource Conservation and Recycling (1,269 citations, 14 documents, TLS 47) emphasizes the circular economy and efficiency dimensions of carbon management. Broader energy-focused journals such as Energies (1,150 citations, 54 documents) and Energy Economics (763 citations, 26 documents, TLS 54) illustrate how carbon accounting and trade policy debates are increasingly intertwined with energy transition research. Their moderate TLS values suggest more

specialized but still meaningful contributions. Finally, Nature Communications (1,006 citations, 3 documents, TLS 9) represents a high-prestige, multidisciplinary outlet, where even a handful of contributions achieve significant visibility. Its lower TLS score reflects the fact that, while its publications are highly cited, they are less embedded within the field-specific research networks compared to domain-focused journals like Journal of Cleaner Production or Sustainability.

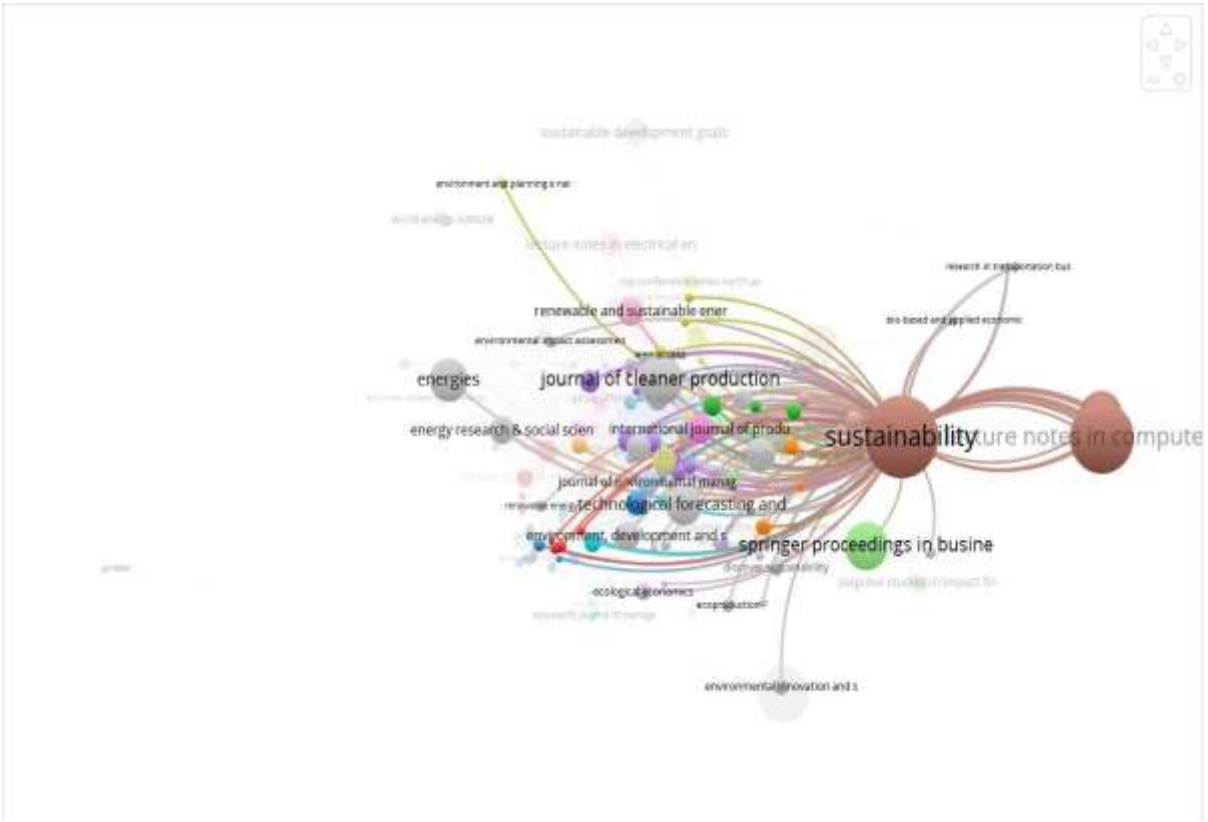

Fig. 7: Most productive journals (Network Visualization of documents publications)

Overall of fig. 7 and table 4 , the findings of the data analysis reveal a diverse publishing ecosystem such as Core sustainability journals (Journal of Cleaner Production, Sustainability) act as central hubs of research. High-impact selective journals (Renewable and Sustainable Energy Reviews, International Journal of Information Management, Nature Communications) provide visibility through fewer but more influential papers. Specialized thematic journals (Technological Forecasting and Social Change, Journal of Business Research, Resource Conservation and Recycling, Energies, Energy Economics) support the interdisciplinary spread of research across technology, management, energy, and economics. This structure shows that

the field is highly interdisciplinary, with research dispersed across sustainability science, energy policy, digital transformation, and business management outlets. Such diversity reflects the complex and cross-cutting nature of carbon accounting and trade policy in the digital era.

Conclusion

This study provides a comprehensive bibliometric analysis of the evolving research landscape at the intersection of carbon accounting, trade policy, and digitalization. By systematically examining 10,185 publications from 2015 to 26th August-2025, the analysis reveals a significant acceleration in scholarly attention to this field. The study attributes this surge to global policy milestones, such as the Paris

Agreement, and the increasing integration of digital technologies in trade and business practices. The research highlights sharp increases in publication output in 2020 and 2023, underscoring how global events like the COVID-19 pandemic and the growing urgency of climate commitments have catalysed interest in digital solutions for sustainability. The analysis maps the intellectual structure of the field, identifying key authors, institutions, and journals that are shaping the discourse. The study reveals a dual dynamic of influence among authors: some, like Simone Abram, have made seminal contributions with highly cited work, while others, such as Fu Jia and Soumyadeb Chowdhary, have advanced the field through sustained productivity and strong collaborative networks. At the institutional level, the analysis shows that Durham University and Heriot-Watt University have achieved high impact through selective publications, while institutions like ETH Zurich, Cambridge, and Johannesburg have emerged as globally networked leaders. The study also identifies the most influential journals, with the Journal of Cleaner Production and Sustainability serving as central hubs for dissemination, complemented by high-impact outlets like Renewable and Sustainable Energy Reviews. Furthermore, the study's country-level mapping emphasizes the global scope of this research. The United Kingdom and China are identified as leaders in both research productivity and citations, reflecting their significant contributions to the field. Additionally, the analysis highlights the growing visibility of emerging economies like India and Malaysia, which are strengthening their presence through increasing contributions and collaborative linkages. Overall, the findings confirm that research in this domain is characterized by rapid growth, strong interdisciplinarity, and robust transnational collaboration. The evolution of this field not only reflects academic interest but also a global imperative to integrate carbon accountability into trade and business systems in the face of climate change and digital transformation.

The findings of this study have several important policy implications. First, the rapid expansion of research post-Paris Agreement highlights the necessity for a closer alignment between international climate commitments and trade policy frameworks. Policymakers should utilize this growing body of knowledge to design effective trade mechanisms—such as carbon border adjustment measures and emissions trading schemes—that promote accountability without undermining competitiveness. Second, the prominent role of digitalization in the literature underscores the need for strategic investment in digital monitoring, reporting, and verification (MRV) systems. These systems can significantly lower compliance costs and improve transparency in cross-border trade. Third, the evidence of robust transnational collaboration suggests that international knowledge-sharing platforms and data-exchange protocols are crucial for harmonizing standards across countries, thereby reducing fragmentation in global carbon governance. Finally, the increasing contributions from emerging economies such as India and Malaysia call for targeted capacity-building initiatives. These efforts are essential to ensure that developing countries can actively participate in shaping digital carbon accounting norms, thereby promoting inclusivity and equity in the global transition toward sustainable trade.

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