Research Article

Governance Dynamics in Carbon Taxes and Sustainability: A Global Review of Scientific Literature

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Abstract.

This study aims to explore the governance dynamics surrounding carbon taxes and their integration with sustainability goals, examining the evolution of scientific literature over the last two decades. Carbon taxes, as a policy tool for mitigating climate change, have gained prominence globally, with numerous countries adopting or planning to implement them as a strategy for reducing carbon emissions. This research employs a bibliometric approach, analyzing 156 peer-reviewed articles published between 2005 and 2025, sourced from the Scopus database. Using advanced bibliometric software, VOS-viewer and Biblio-metrics, the study map's key themes, such as the economic implications of carbon taxes, emission reductions, and the intersection between carbon tax policies and sustainability frameworks. The findings reveal an increasing academic interest in carbon taxation, particularly post-2017, with significant contributions from nations such as China, the United States, and several European countries. These studies have identified both the potential and the challenges of carbon taxes, especially in the context of institutional capacity, policy coherence, and stakeholder engagement. Despite the growing body of literature, research gaps remain regarding the interaction between governance structures and sustainable development objectives. This review highlights the need for interdisciplinary approaches combining environmental economics, political science, and public policy to address these challenges effectively. Additionally, this article provides insights that can guide policymakers and researchers in designing and evaluating carbon tax systems that not only mitigate climate change, but also align with broader sustainable development goals. This review serves as a foundation for future research on optimizing carbon tax systems to contribute to long-term environmental and economic sustainability.

Keywords: governance dynamic, carbon-taxation, sustainability, bibliometric analysis

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1. Introduction

Climate change is a global challenge that affects many aspects of life, including ecosystems, human health, and the economy. In an effort to mitigate climate change, many countries are implementing carbon tax policies as one of the instruments to reduce greenhouse gas emissions. Carbon taxes aim to trigger emission reductions through market mechanisms, by imposing a fee on carbon emissions generated by the industrial and consumption sectors [1]. Although implemented in many countries, the effectiveness

of carbon tax policies depends on governance dynamics, including factors such as institutional capacity, policy alignment, and stakeholder participation. It is important to understand how carbon tax governance interacts with sustainability goals and identify factors that influence the success of these policies [2]. Governance dynamics refer to the processes of change, interactions and mechanisms that occur in the structure and practice of policy management, especially how various actors, institutions and decision-making mechanisms interact and adapt in an evolving political, institutional and sustainability context.

The relevant theory to underpin this research is environmental economics theory that considers carbon tax as a market instrument that can internalize sustainable governance theory. Multi-level governance theory explains the importance of coordination between different levels of government (local, regional, national, international) in complex policies. In the context of carbon tax, many countries face challenges in coordinating policies between central and local governments, as well as in international relations related to climate change policies. In addition, governance theory is also critical to understanding how carbon tax policies can be effectively implemented, taking into account the various elements that influence their successful implementation. A good governance approach relies heavily on coordination between the government, private sector, and society, as well as on institutional capabilities to manage this complex policy [3].

The research focus expands from technical and economic aspects to more complex and multidimensional dimensions of governance. Bibliometric analyses reveal prominent thematic patterns, such as inter-actor collaboration, policy adaptation, and integration of sustainability in carbon tax design. Strong international collaboration networks show how carbon tax governance research and practice is not limited to the national level, but extends to the global level with the involvement of various institutions and countries [4]. These patterns reflect the reality that the success of carbon tax policy is strongly influenced by governance dynamics involving multi-level coordination, cross-sector collaboration, and adaptability to changing social, economic, and technological conditions [5].

In the context of sustainable carbon tax policy, the variability of structure and organization can take the form of centralized governance where policy decisions and implementation are controlled by a central authority with little involvement of other actors [6]. Effective for policies that require uniformity, but less flexible in the face of diverse local conditions. Decentralized governance, where local governments or local institutions have autonomy in decision-making and policy implementation. Increases

flexibility and responsiveness to local needs, but can lead to fragmentation and inconsistency. Multi-level governance combines local, regional, national and international levels of government and changes and adjusts structures as political and social conditions change. The combination of different levels of government and non-government actors working together accommodates the complexity of environmental issues such as carbon taxes that require coordination between levels and sectors [7].

Governance theories relevant to carbon tax policy implementation and sustainability goals explain how carbon taxes can be effectively implemented and adapt to social, political and economic changes. One key theory is multi-level governance, which emphasizes coordination between different levels of government-local, regional, national and international-in addressing complex issues such as carbon taxes. For example, countries such as Canada and Germany demonstrate how carbon tax policies require close cooperation between central and local governments to achieve policy alignment [8]. In addition, theory highlights the importance of collaboration between public, private sector and civil society actors in the decision-making process, which is crucial in designing and implementing effective carbon tax policies [9], as seen in renewable energy investments in Europe. Furthermore, adaptive governance provides a framework for policies that are flexible and able to learn from experience, allowing carbon tax policies to be adapted to technological developments and market dynamics, for example the adaptation of policies in Scandinavia in favor of technologies [10]. Equally important, collaborative governance theory emphasizes the active participation of the public and various stakeholders to enhance the legitimacy and fairness of policies, such as the collaborative approach in Australia that promoted the energy transition [11]. Based on these theories, this study's conceptual framework integrates the concepts of multi-level governance, collaboration networks between actors, policy adaptability, and public participation and transparency as key factors for successful carbon tax implementation. The model emphasizes effective coordination between local, regional and international levels of government, as well as close collaboration between the government, private sector and civil society. Policy flexibility is important for carbon taxes to adapt to changing socio-economic and technological conditions, while public engagement and transparency strengthen policy accountability and legitimacy.

Interactions and relationships between actors involve related to changes in power relations, levels of participation, and coordination mechanisms between actors where government, private, and civil society actors interact, negotiate, and influence policy implementation [12]. Policies and governance also adapt to changes in the political

climate such as changes in government, changes in policy priorities, pressure from interest groups, and international pressure, dynamic governance also adjusts policies to remain effective. The decision-making process and policy implementation, the dynamics of governance include changes in the participation of various stakeholders such as government, private sector, and civil society [13]. In addition, dynamic governance mechanisms demand strong transparency and accountability to strengthen public trust and encourage compliance. The process of adaptation and learning through monitoring, evaluation, and feedback allows policies to be improved continuously to adjust to changing social, economic, and environmental conditions. Inter-agency coordination and policy integration across sectors and levels of government are also important to avoid overlaps and conflicts that can hinder implementation. Finally, conflict management and negotiation between actors with diverse interests are crucial aspects of governance, ensuring consensus and broad support for policies. This whole process reflects governance as a flexible, responsive and participatory system to ensure policy success in a changing context [14].

Determining governance variables such as transparency, institutional trust and coordination mechanisms is crucial in analyzing the effectiveness of carbon tax policy implementation [15]. Transparency refers to the extent to which information about the decision-making process and policy implementation is openly available to the public, which can improve policy accountability and legitimacy. Institutional trust describes the level of confidence of the public and relevant actors in the ability and integrity of government institutions to implement the policy, which plays an important role in supporting compliance and reducing resistance. Coordination mechanisms are processes and structures that enable various actors at different levels of government and sectors to work together synergistically to design and implement policies effectively, prevent inconsistencies, and strengthen synergies between sustainability programmers. These three variables are interrelated and can be measured through both quantitative and qualitative indicators, providing a clear and comprehensive focus for understanding good governance as a key foundation for carbon tax success and sustainability.

Multi-level governance theory emphasizes the importance of coordination between levels of government - from local to international - to create coherent and effective policies. Meanwhile, governance network theory highlights the role of collaboration networks between public, private and civil society actors in ensuring engagement and transparency in carbon tax policies [16]. On the other hand, the concept of adaptive governance emphasizes that effective governance must be able to adapt and learn

from experience, dynamically adjusting policies to challenges and changes that occur. Through the integration of these approaches, an inclusive, adaptive and collaborative governance framework emerges as an essential foundation for the successful implementation of a sustainable carbon tax.

Thus, understanding governance dynamics as an interconnected and evolving system allows us to more effectively design and manage carbon tax policies. This approach not only foregrounds technical and economic aspects, but also pays attention to institutional and political contexts that are crucial in bridging theory and practice. Therefore, the integration of bibliometric data with governance theory not only provides a descriptive overview of research trends, but also provides conceptual guidance that policymakers can use to improve the effectiveness and sustainability of carbon tax policies in various national and international contexts [17].

2. Material and Methods

This study employs a bibliometric analysis approach to systematically review the scientific literature on governance dynamics in carbon taxes and sustainability. The dataset was retrieved from the Scopus database, covering publications from 2005 to 2025. To ensure the relevance and quality of the dataset, explicit inclusion and exclusion criteria were applied: only peer-reviewed articles published in English were included, while conference papers, book chapters, and non-English publications were excluded. Furthermore, publications unrelated to the core themes of carbon taxation, governance, or sustainability were filtered out through manual screening by a panel of subject matter experts [18].

Prior to the bibliometric analysis, a rigorous keyword normalization process was undertaken to address variations such as synonyms, plural and singular forms, and abbreviations. This normalization was essential to avoid fragmentation and redundancy in keyword co-occurrence analysis, thereby enhancing the accuracy of thematic mapping. The selection and validation of keywords were conducted in consultation with domain experts to refine the search terms and improve the robustness of the data. The bibliometric mapping and visualization were performed using VOS-viewer and Biblioshiny (an RStudio package). In VOS-viewer, specific thresholds were set to refine the network maps: keywords appearing fewer than five times were excluded to focus on the most significant terms and reduce noise. Additionally, clustering resolution and minimum cluster size parameters were adjusted to balance detail and interpretability

in thematic clusters. These methodological choices were transparently documented to ensure reproducibility and to clarify how data processing decisions impact the resulting bibliometric networks. By explicitly outlining the inclusion/exclusion criteria, keyword normalization steps, and VOS-viewer parameter settings, this study enhances methodological transparency, allowing readers and future researchers to understand, evaluate, and replicate the analysis with confidence.

2.1. Database and Research Strategy

Bibliometric analysis introduced by has emerged as a valuable scientific method for comprehending the temporal evolution of a research field from a multidisciplinary standpoint [19]. This method enables a thorough understanding of a research field, mapping its boundaries, identifying influential authors, and highlighting new directions for future research. This research employs a bibliometric analysis approach to examine the governance dynamics in carbon taxes and their intersection with sustainability across the global scientific literature. The bibliometric analysis will use two primary tools: VOS-viewer and R Studio [20]. These tools will be used for mapping and analyzing the literature, identifying key themes, and uncovering relationships within the data. The analysis will focus on scientific articles published between 2005 and 2025, using Scopus as the primary source of bibliographic data.

Keyword selection was based on an initial review of the existing literature. A search was conducted on Scopus using the keywords 'Carbon AND Tax' and 'Governance AND Approach'. The 156 research documents retrieved were then analyzed in VOS-viewer to identify additional terms commonly used in the literature. As a result of this initial search, terms such as 'carbon tax', 'carbon emissions', 'environmental governance' and 'environmental tax' were also considered as valid keywords. To further validate the selected keywords, we convened a panel of three experts from academia with extensive publications in the field of Climate Change, following the methodology outlined by [21]. These experts stated that the successful implementation of a carbon tax is strongly influenced by governance dynamics that include transparency, accountability, and collaboration between countries. While carbon taxes are recognized as an important instrument for promoting sustainable development, challenges such as distributional equity and public acceptance often pose barriers to implementation. Therefore, the effectiveness of this policy relies heavily on responsive and adaptive governance design, including

synergies with incentives for green technology diffusion. These findings emphasize the importance of a comprehensive governance approach in supporting carbon taxes as part of a global strategy towards sustainability [22].

To ensure data relevance and quality, strict inclusion and exclusion criteria were applied. Documents included in the analysis were only peer-reviewed journal articles that addressed aspects of carbon tax, governance and sustainability, documents in languages other than English, as well as other types of documents such as books, editorials and conference proceedings, were excluded from the analysis. In addition, articles that did not focus on the main theme were also screened through title and abstract checks. Prior to analysis, the data obtained was further cleaned of duplicates and incomplete data, the data was aggregated and normalized using keywords. The normalization process includes merging the keywords entered in the Scopus database search, the keywords used such as 'carbon tax' and 'carbon taxation', 'carbon tax' and 'governance approach', 'carbon tax' and 'public governance', 'carbon tax' and 'sustainability' are combined into one uniform entity, this normalization is important so that the keyword co-occurrence analysis can be done accurately and the thematic map results become meaningful. The search process is carried out by filtering the time range and type of document according to predetermined criteria (Table 1 and Figure 1).

TABLE 1: Main Information about Data.

Description	Result	Description	Result
Timespan	2008:2025	AUTHORS COLLABORATION	
Sources (Journals, Books, etc)	86	Single-authored docs	42
Documents	156	Co-Authors per Doc	3.13
Annual Growth Rate %	10.55	International co-authorships %	19.23
Document Average Age	5.6	DOCUMENT TYPES	
Average citations per doc	25.92	article	140
References	8941	book	1
DOCUMENT CONTENTS		book chapter	4
Keywords Plus (ID)	1103	conference paper	3
Author's Keywords (DE)	621	erratum	1
AUTHORS		retracted	1
Authors	455	review	4
Authors of single-authored docs	40	short survey	2

Figure 1: Main Information about Data.

2.2. Analysis and finding

This article uses the journal impact factor (IF) to assess the impact of journals. As an essential tool in bibliometrics, the impact factor has played an important roles in the evaluation of academic quality of journals, providing references regarding journal selection and evaluation of scientific research results [23]. In 1995, Dr Garfield, the founder of Science Citation Index (SCI), first suggested the concepts of impact factors on scientific journals, since when the impact factors have been increasingly used to describe the influence of journals and authors. The journal impact factors used in this paper are derived from the journal citation report (JCR).

Moreover, this paper uses the h-index to measure author influence. The h-index was proposed by Hirsch, an American physicist, in 2005 to evaluate individual academic achievements. Hirsch proposed that: 'A scientist has an h-index if one of his papers has at least one citation and the other paper has less than one citation' [24]. The H-index can more accurately reflect an individual's academic achievement; a higher H-index indicates that the paper has greater influence.

Keywords are an important part of a document that reflects the core content; through co-occurrence analysis of keywords, we can understand the development and trend of a discipline. In this paper, we use keyword co-occurrence analysis to discuss the highly popular issues in the field of carbon tax. Keyword occurrence analysis comes from the bibliometric idea of citation coupling and the idea of co-citation, that is, when two keywords that can express a research topic or direction in a certain subject appear in the same paper, it indicates that there is a certain internal relationship between the two words, and the greater the number of occurrences, the closer the relationship and distance [25]. Co-occurrence analysis is the use of vocabulary or noun phrases that appear simultaneously in a literature collection to determine the relationship between various research themes among the different disciplines represented by the literature

collection [26]. In this paper, we choose keyword co-occurrence as the carrier of co-occurrence analysis, using the high-frequency keyword co-occurrence cluster analysis method to explore the current research in the field of carbon tax based on Vos-viewer software and R Studio visualization software. Publications by years the total number of studies in the Scopus Advanced query database (TITLE-ABS-KEY (carbon AND tax) AND TITLE-ABS-KEY (governance AND approach)) with keywords from 1103 selected with the 10 highest words.

The analysis conducted in this study included several key bibliometric approaches. Firstly, keyword co-occurrence analysis was used to map the main themes emerging in the literature related to carbon taxes and governance, thereby identifying the research focus and relationships between the most frequently discussed concepts. Second, co-authorship analysis aims to uncover patterns of collaboration between authors and institutions, providing insights into networks of academic co-operation and the distribution of research contributions in this field. Third, citation analysis was conducted to assess the influence of specific scholarly works on overall research development, helping to identify the most influential publications, authors and journals in shaping the direction of carbon tax and governance studies. Fourth, Network analysis of countries, to analyses collaborations and contributions by institution or country. This provides insights into global leadership, patterns of international collaboration, and geographic distribution of research. Fifth, thematic mapping/cluster analysis, grouping the main themes in the research into large, highly related clusters, to provide a clearer picture of the research focus and relationships between themes in the literature [27].

2.3. Keyword co-occurrence analysis

The aim of this keyword co-occurrence analysis is to identify, map and understand the conceptual structure in the global scientific literature that addresses the interplay between governance, carbon taxes and sustainability. This visualization helps reveal how key topics such as emission control, taxation, environmental protection and economic instruments are interconnected and grouped in specific thematic clusters. As such, the map serves as a bibliometric analysis tool to pinpoint trends, foci, and research gaps in the existing literature-which is highly relevant for strengthening theoretical foundations, developing conceptual frameworks, and mapping the dissertation's contribution to the global scholarly discourse in the field of environmental policy and green economy.

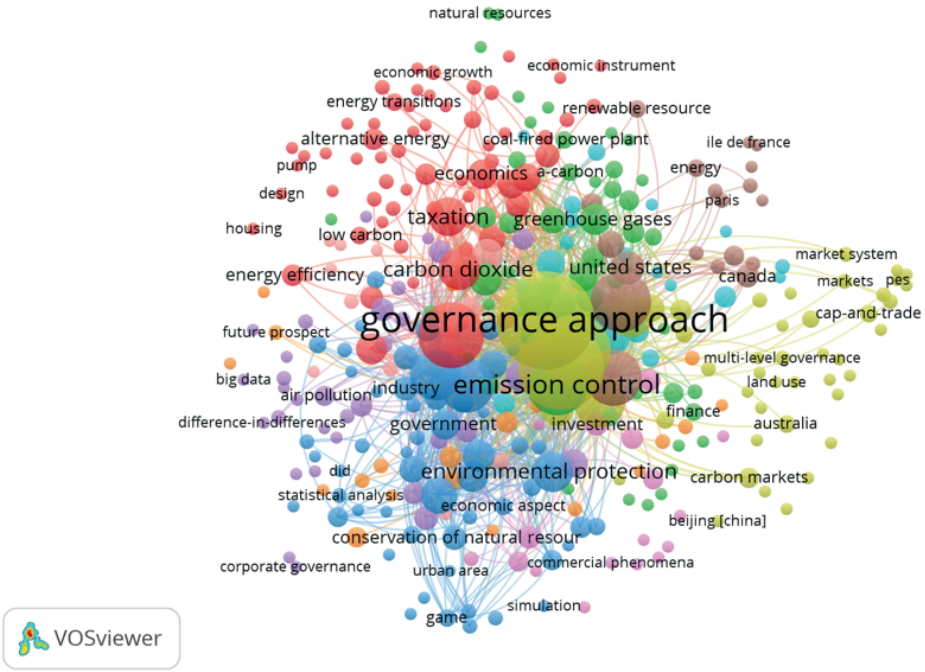

Figure 2: Keyword Co-occurrence Analysis.

Image Analysis Keyword Co-occurrence Visualization (VOS-viewer) The keyword 'governance approach' emerged as the largest and most central node in the network, suggesting that governance approach is a core concept in the global literature on carbon taxes and sustainability (Figure 1). This confirms that the success of carbon policies depends largely on how governance strategies are designed and executed at different levels of government. In relation to carbon taxes, keywords such as 'taxation', 'carbon dioxide' and 'economic instrument' cluster with 'governance approach', suggesting that governance in the context of policy - particularly carbon taxes - is a highly connected topic in the literature. This indicates that carbon tax is not only an economic issue, but also an institutional and public policy issue. From the sustainability and environmental dimensions nodes such as 'emission control', 'environmental protection', and 'conservation of natural resources' form a cluster that is also very close to the center, suggesting that sustainability orientation is a direct result of good governance arrangements and effective instruments. This supports the assumption that environmental sustainability is the result of synergies between policy, science and market mechanisms. Within the thematic clusters there are 6 clusters with different colors. Red: Focuses on economic, tax and energy transition aspects. Blue: Relates to environmental protection, resource conservation, and policy analysis. Yellow: Emphasizes market mechanisms such as cap-and-trade, carbon markets, and incentive systems (PES). Green: Contains technical

and geographical keywords such as greenhouse gases, carbon dioxide, united states. Brown/Dark Red: Represents spatial dimensions such as Canada, Australia, Paris, indicating a region-based approach. Purple & Orange: Contains analysis methods such as difference-in-differences, simulation, big data, indicating a quantitative approach to research. The high density of inter-node lines indicates the strength of semantic relationships between topics such as governance, carbon taxation, and sustainability. This means that scientifically, these issues often co-occur in the context of policy, legal and economic analyses.

2.4. Co-authorship analysis

Co-authorship analysis aims to visualize the development and interconnectedness of key concepts in the global scientific literature on governance, carbon tax and climate change based on author keywords over time. Through co-occurrence analysis and color grading by publication year, this figure shows how the research focus has evolved from classic market instruments such as cap-and-trade and market failure to more recent issues such as energy transition, environmental taxes and corporate governance [28]. The purpose of this visualization is to identify scholarly trends, map key thematic relationships, and reveal epistemological shifts that place governance at the center of climate and sustainability policy strategies, thus reinforcing the urgency of studies on governance dynamics in carbon tax implementation.

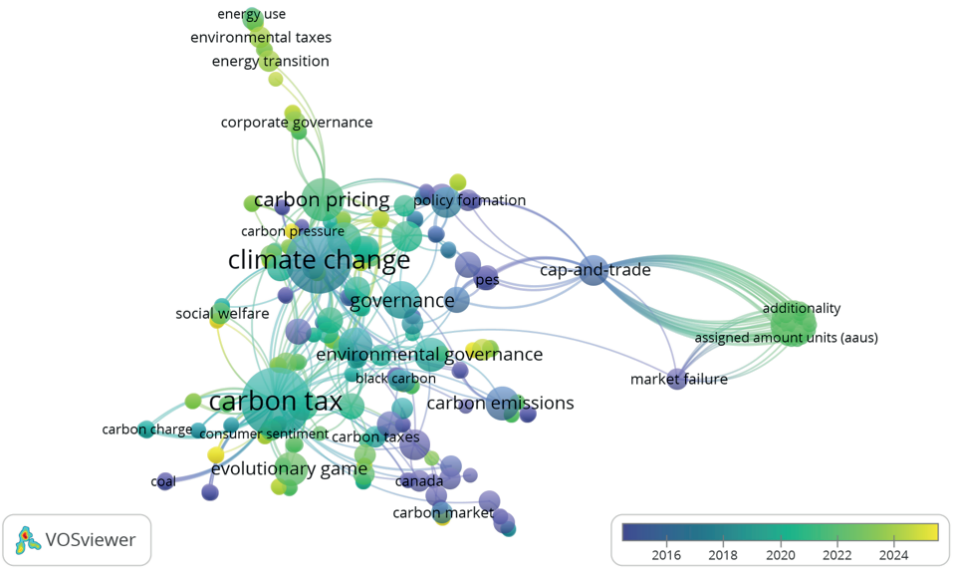

Figure 3: Co-authorship Analysis.

Visualization of Co-occurrence Author Keywords (VOS-viewer) analysis, the first analysis on the dominant keyword Node with the largest size is 'climate change', followed by 'carbon tax', 'carbon pricing', and 'governance' (Figure 2). This indicates that the issue of climate change remains at the centre of scientific studies, with carbon tax and governance as important instruments to respond to it. The close relationship between these nodes suggests that carbon tax policy governance is a central strategy in climate change mitigation. The color of the nodes indicates the average occurrence year of the keywords, based on a color spectrum from dark blue (old topic, circa 2016) to bright yellow (new topic, 2024). For example: Classic topics such as cap-and-trade, market failure, and carbon tax appear early (blue to green). Contemporary and new topics such as energy transition, environmental taxes, consumer sentiment, and corporate governance appear in greenish yellow, indicating increased attention in the last 2-3 years. This signals a shift in scientific discourse away from classical economic frameworks (cap-and-trade, market failure) towards more social, institutional and systemic topics (governance, energy transition, public perception) [29]. On thematic clusters and semantic relationships, several clusters are connected to form a network; Policy and institutions cluster: governance, policy formation, environmental governance, corporate governance. Economic instruments cluster: carbon pricing, carbon tax, environmental taxes, cap-and-trade[30]. Environmental impact cluster: climate change, carbon emissions, black carbon. Carbon market mechanisms cluster: carbon markets, assigned amount units (AAUs), additionality, showing the quantitative and technocratic aspects of carbon policy. It demonstrates the existence of a complex conceptual structure, where the governance approach becomes the bridge between economic instruments and environmental sustainability goals. The relevance of this research integrates instruments/carbon tax, carbon pricing and cap and trade with governance, policy formulation and long-term sustainability goals (climate change mitigation, energy transition) [31] .

This visualization maps the evolution and semantic structure of author keywords in the global literature on governance, carbon tax and sustainability, with 'climate change', 'carbon tax' and 'governance' being the main, tightly connected nodes. Colors indicate time trends, with topics such as 'carbon pricing' and 'cap-and-trade' appearing earlier, while newer issues such as 'energy transition', 'corporate governance' and 'consumer sentiment' appear later, signaling a shift in focus towards institutional and social approaches. Thematic clusters indicate that carbon policy dynamics are influenced not only by economic aspects, but also by governance factors and public perceptions. This visualization strongly supports the relevance of examining governance dynamics as a

key element in the effectiveness of carbon taxes to support sustainability and mitigate climate change.

2.5. Citation analysis

The document citation analysis in this study aims to identify the scholarly works that are the main references and have the most significant influence in the global discourse on the dynamics of carbon tax governance and sustainability. By mapping the documents with the highest number of citations, this research not only highlights the references most frequently used by the international scientific community, but also illustrates the direction in which theory, policy and practice in carbon emissions management are evolving. This is important in the context of the title 'Governance Dynamics in Carbon Taxes and Sustainability', as it reveals how instruments such as carbon taxes have been analyzed within various environmental and social governance frameworks, as well as how their effectiveness is measured in relation to long-term sustainability goals. As such, this analysis strengthens the conceptual basis of the research and provides academic justification for its importance as part of the ongoing scholarly dialogue globally, while ensuring that it stands on a foundation of credible, tested and influential literature.

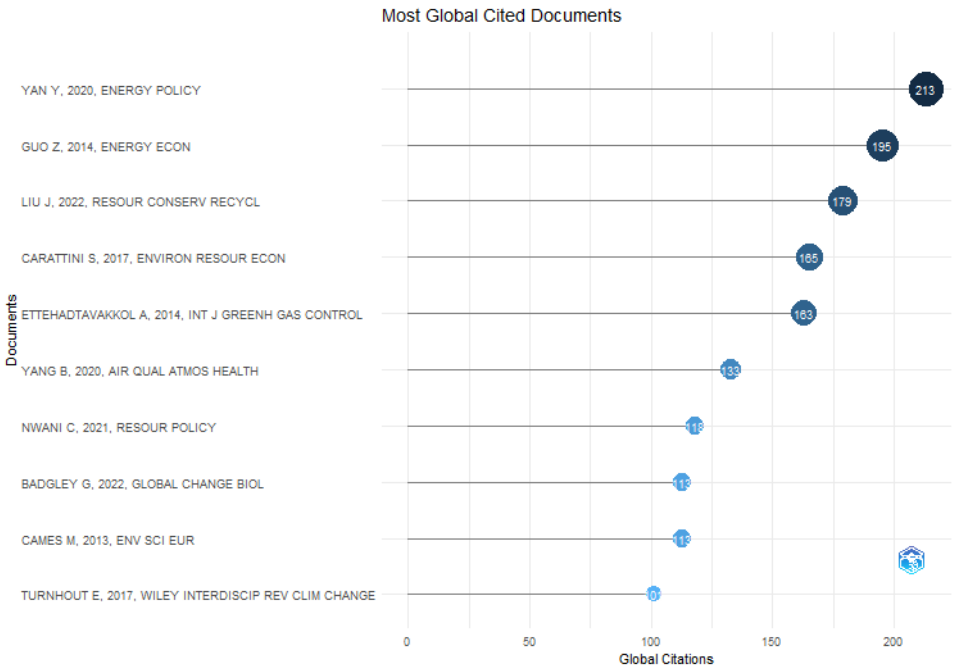

Figure 4: Citations Analysis.

This Figure 3 is a visualization of the Global Citation Score (GCS) of 156 documents, which displays the total number of global citations received by each document. The

figure above shows that the larger the size of the circle, the higher the number of citations received, signifying the influence or significance of the scientific work at the global level. From the total number of documents, the top 10 citation counts were analyses.

Table 2: Main Information about Citations.

Paper	Total Citations	TC per Year	Normalized TC
Yan Y, 2020, Energy Policy	213	35,5	4,44
Guo Z, 2014, Energy Econ	195	16,25	3,14
Liu J, 2022, Resour Conserv Recycl	179	44,75	5,9
Carattini S, 2017, Environ Resour Econ	165	18,3	4,13
Ettehadtavakkol A, 2014, Int J Greenh Gas Control	163	13,58	2,62
Yang B, 2020, Air Qual Atmos Health	133	22,17	2,77
Nwani C, 2021, Resour Policy	118	23,6	3,26
Badgley G, 2022, Global Change Biol	113	28,25	3,72
Cames M, 2013, Env Sci Eur	113	8,69	2,49
Turnhout E, 2017, Wiley Interdiscip Rev Clim Change	101	11,22	2,53

The data Table 2 shows 10 scientific articles with the highest number of citations in studies related to carbon tax and governance sustainability measured by total citations, citations per year (TC per year), and normalised total citation (TC), which come from highly reputable journals, namely Energy Policy and Energy Economics. The article by Yan Y. (2020) in Energy Policy recorded a total of 213 citations, with an average of 35.5 citations per year, and a normalised total citation (TC) of 4.4375, indicating a very high level of influence and strong topic relevance in the contemporary academic literature. Meanwhile, the article by Guo Z. (2014) in Energy Economics received 195 citations, with a TC per year of 16.25 and a normalised TC of 3.14, reflecting a stable, long-term contribution to the development of this study. This comparison indicates that although Guo Z.s article has been published longer, Yan Y.'s article has experienced faster citation growth, which is likely due to its more sophisticated approach to governance issues in energy policy and carbon taxes. The article by Liu J. (2022) stands out with the highest normalised TC of 5.90 and TC per year of 44.75, indicating that despite being a recent publication, it has a very high and rapid rate of academic adoption, reflecting the contemporary relevance of its contribution in the context of resource recycling and sustainability policies [32]. On the other hand, the articles of Yan Y. (2020) and Carattini S. (2017) also showed significant influence, with normalised TC of 4.44 and 4.13,

respectively, signalling strong contributions in the energy governance and climate policy literature [33]. Meanwhile, the articles of Guo Z. (2014) and Ettehadtaavakkol A. (2014), despite being published much later, still show fairly stable influence values, indicating that their works are long-term references in the development of carbon tax concepts. These articles reflect the main focus on the integration between policy, environmental sustainability, and governance models adaptive to climate change dynamics.

Yang B, 2020 (Air Qual Atmos Health) has a TC per year of 22.17 and its focus is likely on the relationship between carbon taxes and air quality. This expands the insight that carbon tax policies not only impact the economy and energy, but also on public health - an important aspect in the sustainability framework. Nwani C, 2021 (Resour Policy) with a normalised TC of 3.26, reflecting the increasing influence on the topic of natural resource policy and developing countries' adaptation to climate policy. This is important when looking at governance dynamics in Global South countries, such as Indonesia. Badgley G, 2022 (Global Change Biol) addresses global change and biophysical issues in relation to climate policy [34]. This article has a TC per year of 28.25, showing the importance of an interdisciplinary approach to governance and sustainability. Cames M, 2013 (Env Sci Eur) is an older article, with a normalised TC of 2.49. He could have highlighted carbon policy issues in Europe, including carbon markets and cap-and-trade systems, which provide an important comparison for policies in developing countries. Turnhout E, 2017 (Wiley Interdiscip Rev) has a normalised TC of 2.53 and most likely examines governance approaches from an interdisciplinary perspective. This is particularly relevant as it shows that carbon tax governance is not only technocratic, but also involves social, political and institutional factors.

These ten articles form an important foundation of literature in the global understanding of carbon tax governance and sustainability. Each contributes from different aspects ranging from public policy, economic effectiveness, public response, environmental impact, to interconnections between the energy and health sectors. These analyses not only help to identify academic trends and important findings, but also to fill theoretical and practical gaps in carbon tax implementation, particularly in the context of developing countries such as Indonesia.

2.6. Network analysis of countries

The aim of the network analysis of countries is to identify and map patterns of international collaboration between countries in scientific publications addressing carbon taxes

and sustainability. The analysis provides an overview of the most active and influential countries in research on the topic, as well as how cooperative relationships between developed and developing countries are formed in the context of environmental policy development and implementation. By knowing who is at the centre of knowledge production and exchange, researchers can understand the global dynamics of carbon tax governance, including Indonesia's place in the knowledge network. The analysis also helps identify potential collaborative partners, research gaps across regions, and the geographical distribution of policy focus and best practices that can be learnt from in the national context.

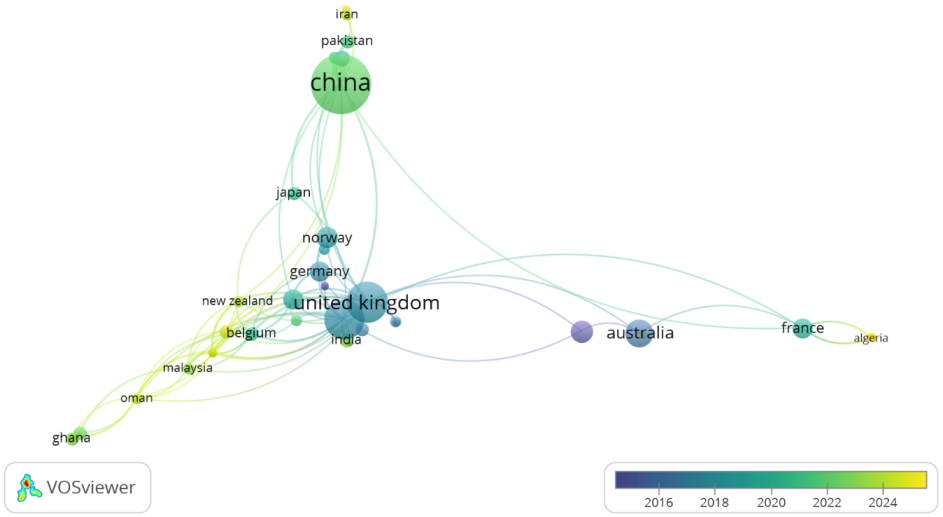

Figure 5: Network Analysis of Countries.

The Figure 4 above is the result of a network analysis of countries visualized using VOS-viewer based on the authors' collaboration between countries on the topic of "carbon tax" and environmental governance. The analysis shows that the United Kingdom (UK) and China are the two most central and dominant countries in this research network, as evidenced by their large node sizes and many lines of connection to other countries. The UK is a major centre of collaboration with many connections to countries such as India, Australia, France, Germany and Malaysia. China also plays an important role, actively collaborating with Pakistan, Iran, Japan and the UK. Countries such as France, Australia and Malaysia have a significant but more limited collaborative role. The colours of the nodes and connection lines represent the development of collaboration over time, with newer collaborations appearing in yellow and older ones in blue. This indicates that cross-country collaboration in carbon tax and environmental

governance research is evolving, with increasing participation of developing countries such as Malaysia, Ghana and Oman in recent years. This analysis demonstrates the importance of the international dimension in understanding and implementing carbon tax policies globally, and provides a strategic basis for Indonesia to expand scientific cooperation to strengthen evidence-based domestic policy capacity.

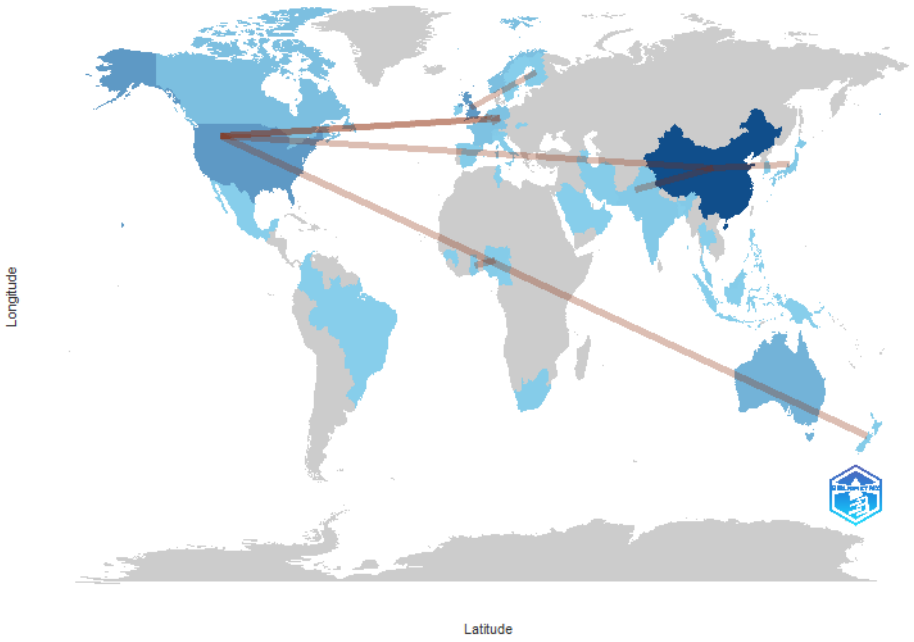

Figure 6: Network of Countries.

The Figure 5 above is a visualisation of the cross-country scientific collaboration map generated from the bibliometric analysis, showing the collaborative relationships between authors or institutions in publications on topics related to carbon tax or environmental governance. The map shows that dark blue countries such as China, the United States, and Australia are the most intense centres of scientific collaboration activity, indicated by thick connection lines to other countries. While light blue countries participate to a lesser extent in these collaboration networks. The lines connecting these countries signify the flow of collaboration in joint publications, and seem to show the main axis of cooperation between China-United States, China-Australia, as well as connections from China and the US to other countries in Asia and Africa.

This analysis is important in the context of research on carbon tax policy implementation, as it points to centres of knowledge production and dominant directions of global collaboration. It indicates that evidence-based policy development in developing countries such as Indonesia will be greatly helped by learning from and collaborating with countries that have high research capacity in this field, especially China and

the US. Therefore, strengthening international academic and collaborative networks is an important strategy in improving the effectiveness and legitimacy of carbon tax implementation at the national level.

2.7. Thematic mapping/ cluster analysis

Thematic mapping or cluster analysis in the research entitled 'Governance Dynamics in Carbon Taxes and Sustainability: A Global Review of Scientific Literature' aims to identify, category and map the main themes emerging in the scientific literature related to governance dynamics in carbon tax policy and sustainability. This analysis allows researchers to see the structure of knowledge, the interrelationships between concepts, and the evolution of research topics over time, so as to identify which themes are central (motor themes), emerging, established (basic themes), or niche themes. The benefits of this approach are that it provides a comprehensive understanding of the intellectual landscape of the field of study, directs the focus of research to be more relevant to global trends, and assists policymakers and academics in designing adaptive and evidence-based research and policy strategies, especially in the context of the multidisciplinary and cross-sectoral complexity of carbon tax governance.

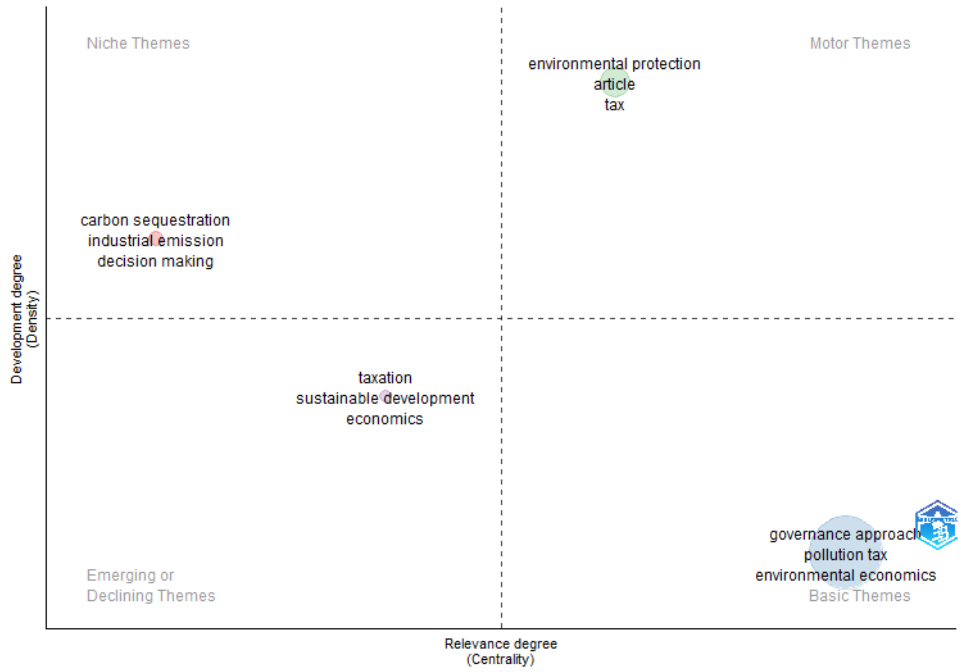

Figure 7: Thematic mapping – Cluster analysis.

The Figure 6 is a thematic map used in bibliometric analysis to map research topics along two dimensions: centrality on the X-axis and density on the Y-axis. The map is

divided into four quadrants: The top-right quadrant (Motor Themes) includes themes such as environmental protection, articles, and taxes that indicate important and well-developed topics - the centre of attention in the field of study. The upper left quadrant (Niche Themes) such as carbon sequestration, industrial emissions, and decision making represent themes that are internally developed but less central, generally specific and technical in nature. The lower left quadrant (Emerging or Declining Themes) contains themes such as taxation, sustainable development, and economics that are currently underdeveloped and less central, either new emerging topics or themes that are starting to be abandoned. Meanwhile, the bottom right quadrant (Basic Themes) such as governance approach, pollution tax, and environmental economics are themes that are highly relevant but still underdeveloped-usually providing the theoretical foundation or general framework for many studies.

The thematic map directly reflects the main elements of the research title, where the themes of carbon taxation and governance approaches appear in the “Basic Themes” quadrant—indicating that both are very central concepts in the global scientific literature but still need further development, making them an appropriate foundation for a more in-depth study such as that conducted in this study. In addition, the theme of sustainable development, which is in the “Emerging or Declining Themes” quadrant, indicates that despite its important potential, this issue is still in its infancy or needs to be strengthened in the context of policy and governance. By focusing on governance dynamics, this study plays an important role in filling the axis literature by connecting the central but immature basic themes, and contributing to further development on the topic of carbon taxation and drought globally.

3. Result and Discussion

The results of this study indicate that governance dynamics are a crucial element in the effectiveness of carbon tax policy implementation that supports sustainability. Through a bibliometric approach to 156 international scientific articles, it was found that themes such as governance approach and carbon taxation occupy a very central position but still require further development, as reflected in the Basic Themes quadrant on the thematic map. This shows that governance has become a central topic in global literature, but still requires strengthening in theoretical and operational aspects, especially in building more systematic cross-sector integration and contextual approaches to various levels of governance. The database used in this research paper comes from articles on

Scopus containing titles, abstracts and keywords, used to create queries (TITLE-ABS-KEY (carbon AND tax) AND TITLE-ABS-KEY (governance AND approach)) retrieved in May 2025, and the retrieval records contain titles, authors, keywords, abstracts, and citation information There are 156 documents in this research referring to China, the UK and India.

China and the UK are the main hubs in the global carbon tax collaboration network, indicated by the large circle size and the large number of connections. Countries such as Germany, India, Australia, and France also play an important role in this network, albeit with a slightly lower level of involvement. The bright yellow color in some countries such as Algeria, Iran, and Ghana indicates that research from these countries is becoming more prominent. Countries such as China and the UK emerged as dominant actors, characterized by large node sizes and high levels of collaborative relationships with other countries. International collaborations are seen involving countries such as Germany, India, Australia and France, which also have significant contributions to the production of scientific literature in this field. The color pattern indicating the year of publication shows that some countries such as Algeria, Iran and Ghana have started to show an increase in publication activity in recent years, indicating widespread global attention to carbon taxation and sustainability issues. These findings reflect the importance of a collective approach across countries in promoting adaptive and evidence-based carbon tax policies.

This discussion reinforces the understanding that the success of carbon tax policies depends not only on their economic design, but also on the extent to which they are managed in an inclusive, adaptive, and collaborative manner. Visualizations of international collaboration show that countries such as China and the UK are global knowledge production hubs, with extensive collaboration networks. A comparison of these collaboration patterns shows how developed and developing countries have different approaches to managing green policies [35]. Developed countries generally have well-established institutional capacities, sophisticated environmental information systems, and structured inter-agency coordination mechanisms. For example, Canada and Germany promote a multilevel governance approach with active participation from local governments, the private sector, and civil society, which makes their carbon tax policies more contextual and responsive to local needs.

In contrast, many developing countries still face challenges in aligning environmental policies with effective governance. Limited human resources, technology, and institutions are major obstacles to designing adaptive carbon tax systems. However,

countries such as Malaysia have shown progressive policy initiatives by integrating and environmental policy approaches into national development planning documents [36]. In Africa, Nigeria has begun implementing a carbon tax as part of its climate commitments, although it is still limited to the energy sector and requires international support. In Latin America, countries such as Chile have developed carbon tax systems that are integrated with incentives for clean energy investment, and involve non-state actors in the policy process. This comparison shows that success depends not only on a country's economic status, but also on its political capacity and willingness to innovate in public governance.

Comparisons between countries such as China and Ghana reveal stark differences in institutional capacity and resources. China has successfully developed a carbon tax governance system integrated with clean energy and technology policies through a strong but flexible centralized approach [37]. In contrast, Ghana faces challenges in terms of institutional capacity, cross-sector coordination, and limited data and public participation. Nevertheless, Ghana has made progress in building international partnerships and raising public awareness of environmental policies (Table 3). This underscores the importance of local context in governance design and implementation, where success is measured not only by the existence of policies but also by the adaptive capacity and inclusiveness of decision-making processes.

Keyword analysis in the literature on carbon tax and sustainability governance shows a significant shift in the focus of research and policy discourse from a technocratic approach to a more social and institutional-oriented approach. Initially, the discourse focused heavily on market mechanisms such as the cap-and-trade system and market failure issues that emphasized the technical and economic aspects of controlling carbon emissions. However, as research and policy practice developed, attention began to shift to issues related to, transparency, and collaborative governance between stakeholders. This shift indicates a growing recognition that the success of market-based policies is not only determined by their technical design, but also depends heavily on a solid institutional foundation.

The institutional foundation includes legal frameworks, regulations, oversight mechanisms, and the involvement of diverse stakeholders such as governments at various levels, the private sector, civil society, and the scientific community. Transparency in decision-making processes and policy implementation plays a critical role in building public trust and legitimacy, which are key prerequisites for acceptance and support of carbon taxes. In addition, collaborative governance facilitates effective coordination

Table 3: Main Information about Comparison of Developed and Developing Countries Regarding Carbon Tax Governance.

Countries	Economy Status	Governance Approach	Key Strengths	Challenges/Issues
China	Advanced Country	Centralized and Adaptive Approach	Integration of policy and green technology	Base transparency and limited public transparency
UK	Advanced Country	Multi-level and Participatory Approach	Intergovernmental coordination & community engagement	Consistency traversal of time policy
German	Advanced Country	Decentralized and Collaborative Approach	Active participation and local government	Harmonisation local-decentralization policy
Canada	Advanced Country	Multi-level and Federal Approach	Local Integration on national policy design	Comparation inter-regional capacity
Malaysia	Developing Country	Centralized but starting to be inclusive	Integration national with development plans	limitation of capacity implementation and infrastructure evaluation
Nigeria	Developing Country	Planning Implementation Stage	Political commitment for climate	Technical and infrastructure policy are weak
Ghana	Developing Country	Collaborative with support International	Increased public awareness, active partnerships	Limitation of base, institution, and resource
Chili	Developing Country	Inclusive and Incentive Based	Integration investment with clean energy	Coordination of challenge public and private sector

across institutions and actors, enabling alignment of objectives and resources in complex policy implementation.

Furthermore, the importance of understanding the socio-political context is key to ensuring that carbon tax policies can be properly adapted to local characteristics and changing political dynamics. Policies that do not take these factors into account tend to face social resistance and difficulties in long-term implementation [38]. Therefore, policy designers need to integrate dynamic and inclusive governance principles that can strengthen institutional trust and build adaptive coordination mechanisms between the central government, local governments, and other stakeholders. This focus underlines that the sustainability and effectiveness of carbon tax policies depend on a comprehensive governance approach, where social, political, and institutional aspects are no less important than technical and economic aspects. This approach allows for the creation of a carbon tax system that is not only economically efficient, but also socially acceptable and institutionally sustainable.

4. Conclusion

This study reveals that governance dynamics in carbon tax policies are a key element in supporting the transition to sustainable development. Through a bibliometric approach with the help of VOS-viewer and Biblioshiny (R-based), the development of global scientific literature related to the topic of carbon tax and sustainability has been analyzed. The results of the analysis show that there has been a significant increase in the number of publications since 2015, reflecting the global urgency of the issue of climate change and the need for appropriate economic instruments to respond to it.

In addition, the visualization of the collaboration network between countries shows that countries such as China, the UK, and Germany have a central role in knowledge production and actively collaborate with other countries. This pattern indicates a collective awareness and shared interest in formulating adaptive and effective carbon tax policies. Furthermore, this study highlights that an inclusive, adaptive, and evidence-based governance approach is a determining factor for the success of carbon tax implementation, especially in diverse political, social, and economic contexts across countries.

Based on the findings of this study, several key policy recommendations are proposed to enhance the effectiveness and sustainability of carbon tax implementation through robust governance: Enhance Transparency in Policy Processes; Governments should ensure that all stages of carbon tax policy development, implementation, and evaluation are conducted transparently and that relevant information is easily accessible to the public. Such transparency fosters accountability and builds public trust in carbon tax policies. Strengthen Institutional Trust; Building and maintaining trust among the public and stakeholders towards the institutions managing carbon taxes is essential. This can be achieved through consistent policy enforcement, institutional integrity, and inclusive decision-making processes. Strengthening institutional capacities is critical for the effective and sustainable administration of carbon tax policies. Develop Multi-level and Multi-sector Coordination Mechanisms; Carbon tax policies often involve multiple levels of government and various sectors. Effective and sustained coordination mechanisms are necessary to harmonize policies and optimize resource utilization [39]. Establishing collaborative forums among agencies and stakeholders is recommended to facilitate this coordination. Adopt Adaptive and Collaborative Governance Approaches; Carbon tax policies should be designed to be flexible and capable of adapting to social-political dynamics and technological advancements. Collaborative governance involving

government, private sector, civil society, and academia can enhance the legitimacy and sustainability of carbon tax initiatives [40]. Tailor Policies to Local Contexts and Developing Country Conditions; Developing countries require governance approaches that address institutional capacity limitations and balance economic development with sustainability goals. Technical assistance and international support are vital to strengthen governance frameworks and carbon tax implementation in these contexts.

This study offers several important implications for academic research and policy practice: Scientific Contribution**;** By integrating bibliometric analysis with governance theory, this study provides a comprehensive overview of global research trends and policy dynamics related to carbon tax governance. Practical Guidance for Policymakers; The findings present a conceptual framework and key governance variables that can serve as a guide for designing and evaluating effective and sustainable carbon tax policies. Directions for Future Research; The study highlights the need for in-depth investigations into carbon tax policy implementation in developing countries and the integration of social equity considerations within governance frameworks. Strengthening Global Collaboration; The results emphasize the importance of enhancing international research and policy collaboration to develop inclusive and context-sensitive carbon tax governance systems. Overall, this study provides conceptual and empirical contributions to the understanding of how governance influences the effectiveness of carbon tax policies. The implication is that policy makers need to consider collaborative aspects, transparency, and local context in designing instruments that are oriented towards environmental sustainability.

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