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# Exploring the diffusion of anthropocene concept across interdisciplinary research fields

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**This study examines the exponential growth and interdisciplinary diffusion of the Anthropocene concept, highlighting its significance for global sustainability research and policy. Using a quantitative bibliometric approach, 10,552 Scopus-indexed publications from 2001–2023 were analyzed through cumulative counts and correlation metrics to track publication growth, subject-domain adoption, and shifts in core and multidisciplinary journal dynamics. Results show a dramatic rise in output—from a single paper in 2001 to 1,648 in 2023—and expansion across 27 subject areas. Environmental Science emerged as the dominant field, while Agricultural Sciences declined and Social Sciences gained influence, indicating evolving priorities and greater attention to societal dimensions. Correlation among top subject domains weakened over time, signalling diversification and the emergence of new interdisciplinary linkages. Policy implications include the need for integrated climate governance, cross-disciplinary funding mechanisms, and inclusive, participatory strategies that reflect the Anthropocene's socio-ecological complexity. The study's value lies in mapping two decades of scholarly evolution to guide evidence-based sustainability policies and strengthen science–policy interfaces. Its originality lies in combining growth trends with subject-dynamic correlations, providing actionable insights into how shifts in academic focus inform adaptive climate strategies and the development of equitable, knowledge-driven responses to planetary change.**

***Keywords:*** *Anthropocene, Publication trends, Interdisciplinary research, Subject domain analysis, Scholarly growth.*

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## 1. Introduction

The Anthropocene, a term signifying humanity's profound impact on Earth's systems, has become central to scientific and policy debates over the last two decades. The increasing urgency of climate change, biodiversity loss, and planetary boundary transgressions has placed the Anthropocene framework at the core of interdisciplinary research. Recent Intergovernmental Panel on Climate Change (IPCC) reports, particularly the Sixth Assessment Report (AR6), emphasize that human activities have unequivocally warmed the atmosphere, ocean, and land, leading to widespread and rapid changes in the Earth system. The IPCC highlights the need for integrated, cross-disciplinary approaches to understand and address these complex socio-ecological challenges. Against this backdrop, the exponential growth of Anthropocene-related scholarship provides critical insights into how research is responding to global sustainability imperatives. This paper examines the diffusion of the Anthropocene concept across subject domains between 2001 and 2023, analyzing publication growth, disciplinary adoption, and shifting journal dynamics. By situating this diffusion within the broader context of IPCC recommendations, the study underscores the Anthropocene's importance in advancing scientific knowledge and informing sustainability policy agendas.

## 2. Literature review

The Anthropocene concept has garnered significant academic interest, prompting extensive research across various disciplines. This literature review examines key studies exploring the Anthropocene's influence on anthropology, sustainability, and interdisciplinary research. By analyzing bibliometric trends, co-citation patterns, and thematic clusters, the review highlights the evolving scholarly discourse and identifies critical contributions shaping the understanding of human-environment interactions in the Anthropocene era. Latour [1] highlights the Anthropocene's impact on anthropology, redefining 'anthropos' as a natural force, bridging physical and cultural studies, and influencing sustainability discourse. Belli [2] uses bibliometric analysis to reveal disciplinary clusters in Anthropocene research. Brauch [3] examines the concept's influence across sciences and humanities, focusing on Paul J. Crutzen. Garai, Roy, and Pramanick [4] analyze the Anthropocene's impact on Sustainable Development Goals (SDGs), identifying research trends, gaps, and key countries from 1992 to 2022.

Interdisciplinary research thrives on robust methodologies for evaluating and connecting scientific knowledge. Garfield emphasized citation analysis as a tool for ranking journals, providing valuable insights for science policy [5]. Earlier, Garfield [6] introduced citation indexing to map relationships between ideas. Price explored networks of scientific papers, laying the groundwork for understanding interdisciplinary linkages [7]. Small extended this with co-citation analysis, a method for identifying relationships across diverse fields [8]. Rogers highlighted the diffusion of innovations, offering a framework for

studying how interdisciplinary ideas spread [9]. Together, these works form the foundation for analyzing and fostering cross-disciplinary integration.

White and Griffith pioneered author co-citation analysis, introducing a method to assess intellectual structures within academic literature [10]. Their study mapped key relationships, enhancing the understanding of research dynamics and scholarly influence. King examined the geographic distribution of research publications and citations, uncovering disparities in research productivity across countries and institutions [11]. Porter and Rafols investigated the interdisciplinary impact of research using bibliometric methods, tracing its influence across various scientific fields and emerging research areas [12]. Eysenbach analyzed the effects of open-access policies on research dissemination, noting higher citation rates for open-access publications [13]. Barabási and Albert studied network dynamics in research collaborations, identifying key networks that boosted scientific productivity and innovation [14]. Van Leeuwen and Tijssen conducted a longitudinal analysis of research trends, pinpointing prolific authors, influential journals, and pivotal research topics over time [15].

Amjad and Ali traced knowledge diffusion between computer science and physics journals using entropy, citations outside category (COC), and research keywords, finding that computer science frequently cited physics journals, while physics journals primarily cited within their field [16]. Zhu and Yan analyzed dynamic impact and diffusion patterns in computer science using a 15-year citation dataset, revealing high scientific trading impact in subfields like AI and rapid growth in Human-Computer Interaction [17]. Yan studied disciplinary knowledge production and diffusion using Scopus-indexed data, finding rapid growth in Chemical Engineering, Energy, and Environmental Science, linked to global R&D expenditures [18]. Wu, Hill, and Yan discussed Business research across six disciplines, showing knowledge diffusion was discipline-dependent and influenced by journal quality [19]. Wang and Zhang explored the impact of geographic proximity on knowledge diffusion through citations, finding that codified knowledge spread faster within closer regions, especially in early dissemination stages [20]. Liu and Rousseau examined diffusion by publications and citations, introducing measures of diffusion breadth and intensity [21]. Rinia et al. analyzed cross-disciplinary citations, highlighting a central role for Basic Life Sciences and Physics and proposing indicators for measuring interdisciplinary impact [22].

Collectively, these studies reveal how the Anthropocene serves as a bridge among natural sciences, social sciences, and humanities, reinforcing the need for integrated responses to planetary challenges. Complementing this scholarly discourse, the Intergovernmental Panel on Climate Change (IPCC) provides critical scientific evidence underscoring the urgency of Anthropocene research [23]. The IPCC Sixth Assessment Report confirms that climate change is widespread, rapid, and intensifying, with Working Group II highlighting escalating ecosystem, food-security, and health risks, and Working Group III outlining mitigation pathways such as carbon neutrality, renewable energy transitions, and systemic policy interventions [24-26]. Together, these findings align with

and validate Anthropocene research, emphasizing the necessity of cross-sectoral, interdisciplinary approaches to address global environmental crises.

## 3. Objectives of the Study

- To analyze publication growth in the field of the Anthropocene from 2001 to 2023, highlighting trends and exponential increases in scholarly output.
- To investigate the diffusion of the Anthropocene concept across diverse subject domains and its interdisciplinary adoption over time.
- To assess the relative impact of core subject areas, such as Environmental Science and Agricultural Sciences, in Anthropocene research.
- To examine journal dynamics, including variations in publication counts and subject focus in core and multidisciplinary journals.
- To evaluate correlation trends among top subject domains and identify shifts in academic focus.
- To provide insights into the evolving significance of the Anthropocene concept in addressing global sustainability challenges.

## 4. Methodology

The methodology of the study employed quantitative bibliometric analysis to examine publication trends related to the Anthropocene from 2001 to 2023. Data were collected from the Scopus database using the keyword 'Anthropocene', covering publications from 2001 (the year the term first appeared in Scopus) through 2023. The analysis focused on annual publication counts, subject domain classifications, and journal contributions. Key metrics included cumulative values (CV), growth rates, and correlation values to assess interdisciplinary diffusion and shifting research priorities. The study identified prominent subject areas and journal dynamics by employing statistical tools such as trendlines and correlation analyses. A total of 10552 publications were analyzed using a spreadsheet application to track patterns in the diffusion and interdisciplinary application of the Anthropocene concept. This comprehensive methodology provided insights into the scholarly expansion of the Anthropocene and its evolving relevance across diverse academic fields.

## 5. Data Analysis

This data analysis explores publication trends in Anthropocene research from 2001 to 2023. By examining annual publication counts, subject classifications, and journal contributions, the study identifies key patterns and shifts in research focus. Statistical tools

reveal interdisciplinary diffusion, highlighting the Anthropocene's growing prominence across diverse academic fields.

### 5.1 *Publication Growth Analysis*

Table 1 presents the distribution of Anthropocene-related publications grouped into five-year intervals from 2001 to 2023, revealing clear phases of growth and disciplinary diffusion. During 2001–2005, the concept was in its formative stage, with only 15 publications indicating limited scholarly engagement. The following period, 2006–2010, showed moderate progress with 115 publications, suggesting growing interdisciplinary recognition and early integration into environmental and social research domains. A major surge occurred between 2011 and 2015, when publication output rose sharply to 1,242, marking the widespread adoption of the Anthropocene as a key research framework.

**Table 1**

**Distribution of Growth of Publications in Anthropocene**

| Period | No. of Publications | Cumulative Publications | % Share of Total Publications |
|---|---|---|---|
| 2001–2005 | 15 | 15 | 0.14 |
| 2006–2010 | 115 | 130 | 1.23 |
| 2011–2015 | 1,242 | 1,372 | 13.00 |
| 2016–2020 | 5,918 | 7,290 | 69.07 |
| 2021–2023 | 4,634 | 10,552 | 16.56 |

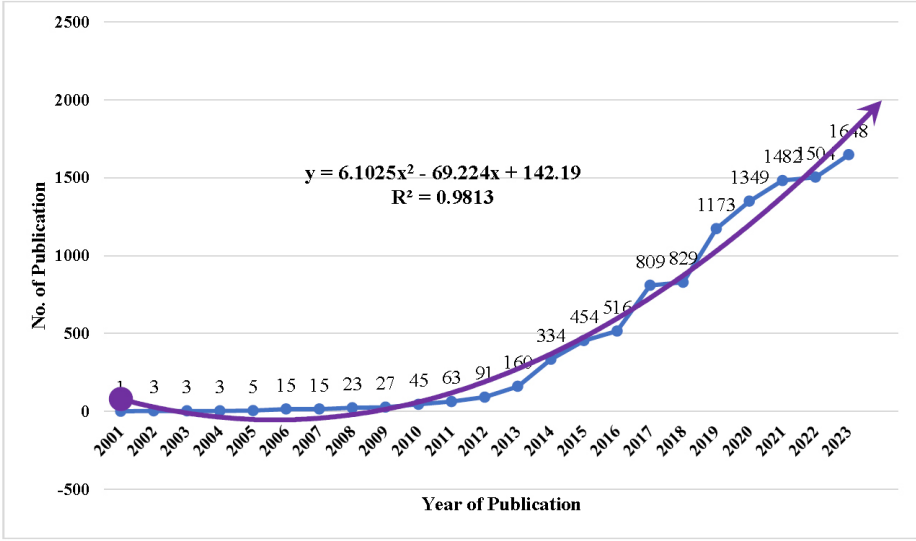


**Figure 1**

**Trend Analysis Curve Showing Year-wise Growth of Publications**

The period 2016–2020 witnessed exponential expansion, reaching 5,918 publications, driven by increased attention to sustainability, climate change, and planetary systems. Continued growth during 2021–2023, with 4,634 publications, confirms the Anthropocene's consolidation as a mainstream research area. This upward trajectory reflects the transition from conceptual development to institutionalization, sustained by international collaboration and policy-driven research initiatives addressing global environmental challenges.

The polynomial trendline for the year-wise growth of publications, represented by $y = 6.1025x2 - 69.224x + 142.19$, with $R^2=0.9813$, confirms the exponential trajectory of growth. The sharp increase after 2015 likely reflects enhanced scientific collaboration, funding opportunities, and policy attention toward issues such as climate change, biodiversity loss, and the Anthropocene's impact on ecosystems in Figure 1. The most productive years, 2021-2023, accounted for approximately 44% of the total publications, underlining the recent surge in scholarly attention. This acceleration underscores the Anthropocene's growing importance as a field of study critical to understanding and addressing humanity's impacts on Earth's systems. The sustained and accelerating growth in Anthropocene publications highlights the urgency and relevance of this field in addressing global challenges and shaping a sustainable future. Continued growth in this area is expected as research intensifies.

### 5.2 *Diffusion of Anthropocene over Different Subject Domains over the Years*

Table 2 illustrates the growing diffusion of the Anthropocene concept across diverse subject domains over time. In 2001, the term appeared in only two subject domains, reflecting its initial and limited use. However, its adoption steadily increased, reaching 17 domains by 2007, signalling a growing interdisciplinary interest. This upward trend continued gradually, with the term being used in 26 domains by 2015. From 2016 to 2021, the Anthropocene maintained a consistent presence across 26 subject domains, indicating its sustained relevance within established areas of study. In 2021, there was a slight expansion as the term was noted in 27 domains, suggesting continued integration into new academic fields. The steady growth in the adoption of the term highlights its significance in addressing contemporary global challenges, such as climate change, biodiversity loss, and human-environment interactions. The widespread use of the Anthropocene across a broad spectrum of disciplines underscores its critical role in understanding and responding to the impact of human activities on Earth's systems. The data demonstrates the increasing recognition and integration of the Anthropocene concept into diverse areas of research and scholarship, reflecting its importance as a framework for examining the complexities of the human-nature relationship over the past two decades.

### 5.3 *Variation of Core and Allied Facets*

Table 3 illustrates the percentage changes in cumulative value (CV) across various subjects over three-year periods. For Earth and Planetary Sciences, a decreasing trend in

**Table 2**

**Anthropocene Diffused in Different Subject Domains (1-27) during 2001-23**

| Year | No. of Subjects Included | Year | No. of Subjects Included |
|---|---|---|---|
| 2001 | 2 | 2013 | 25 |
| 2002 | 7 | 2014 | 25 |
| 2003 | 8 | 2015 | 26 |
| 2004 | 8 | 2016 | 26 |
| 2005 | 12 | 2017 | 26 |
| 2006 | 11 | 2018 | 26 |
| 2007 | 17 | 2019 | 26 |
| 2008 | 19 | 2020 | 26 |
| 2009 | 23 | 2021 | 27 |
| 2010 | 22 | 2022 | 27 |
| 2011 | 23 | 2023 | 27 |
| 2012 | 25 | | |

percentage changes in CV is evident, declining significantly from 29.03% in 2008–2010 to 13.10% in 2020–2022. This indicates a relative reduction in its impact compared to other fields during the analyzed periods. Agricultural and Biological Sciences also exhibit a declining trend in percentage changes in CV, with values decreasing from 20.16% in 2008–2010 to 15.80% in 2020–2022. This suggests a relative decline in its impact over time. Environmental Science, on the other hand, shows a fluctuating pattern. The percentage change increased notably from 25.81% in 2008–2010 to 31.04% in 2011–2013, followed by some variations but remaining relatively stable in recent years. Engineering demonstrates a modest but steady growth in percentage changes in CV, rising gradually from 3.23% in

**Table 3**

**Changes of Percentage Top 5 Subject cover 3 Year Cumulative Value in Anthropocene**

| Subject | 2008-10 % of 3YR CV | 2011-13 % of 3YR CV | 2014-16 % of 3YR CV | 2017-19 % of 3YR CV | 2020-22 % of 3YR CV |
|---|---|---|---|---|---|
| Earth and Planetary Sciences | 29.03 | 24.17 | 20.75 | 12.78 | 13.1 |
| Agricultural and Biological Sciences | 20.16 | 14.93 | 13.24 | 14.75 | 15.8 |
| Environmental Science | 25.81 | 31.04 | 29.81 | 28.79 | 27.92 |
| Engineering | 3.23 | 4.51 | 4.65 | 4.21 | 4.6 |
| Social Sciences | 21.77 | 25.35 | 31.55 | 39.47 | 38.58 |

2008–2010 to 4.60% in 2020–2022. This indicates a slight increase in its relative impact over time. Social Sciences exhibit a consistently increasing trend, with the percentage change in CV rising significantly from 21.77% in 2008–2010 to 38.58% in 2020–2022. This reflects substantial growth in its relative impact compared to other fields during the analyzed periods. These trends highlight variations in the relative impact of different disciplines, with some experiencing growth while others show a decline, reflecting evolving research priorities and interdisciplinary integration over time.

5.4 *Variance of Core Journals: Low Publication Analysis*

To provide a clear picture of the publishing pattern, Table 4 presents the number of journals by publication frequency in 5-year intervals. During 2001–2005, Anthropocene research appeared sporadically, with the majority of journals publishing only a single article—termed Onesies. From 2006–2010, the number of such Onesies journals increased, accompanied by the gradual emergence of journals publishing two (Twicies) and three (Thricies) articles, reflecting growing awareness and academic interest in the subject domain. The period 2011–2015 saw the highest diversity of outlets, but later years (2016–2023) witnessed a consolidation of publications within fewer, more active journals publishing multiple articles annually. This consolidation illustrates the institutionalization of the Anthropocene field, where dedicated journals increasingly serve as the primary vehicles for scholarly exchange.

**Table 4**

**Low Publication Analysis of Core Journals**

| Period | Onesies | Twicies | Thricies | >3 but ≤5 Articles | >5 Articles |
|---|---|---|---|---|---|
| 2001–2005 | 14 | 0 | 0 | 0 | 0 |
| 2006–2010 | 80 | 3 | 0 | 0 | 0 |
| 2011–2015 | 323 | 54 | 22 | 14 | 19 |
| 2016–2020 | 198 | 226 | 112 | 74 | 93 |
| 2021–2023 | 0 | 91 | 132 | 99 | 89 |

5.5 *Variance of Core Subject Domains: Correlation Analysis*

Figure 2 presents the correlation values for the top 10 subject domains over different years, using 2013 as the base year. A general declining trend in correlation values over the analyzed period suggests a weakening relationship among these domains from 2013 to 2023. In the base year, 2013, the correlation value was relatively high at 0.892, indicating a strong positive relationship among the top 10 subject domains. This value gradually decreased in subsequent years, dropping to 0.876 in 2014, with further reductions observed in the following years. A notable decline began in 2018, signalling a significant shift or divergence in the relationships between the subject domains. This decreasing trend could

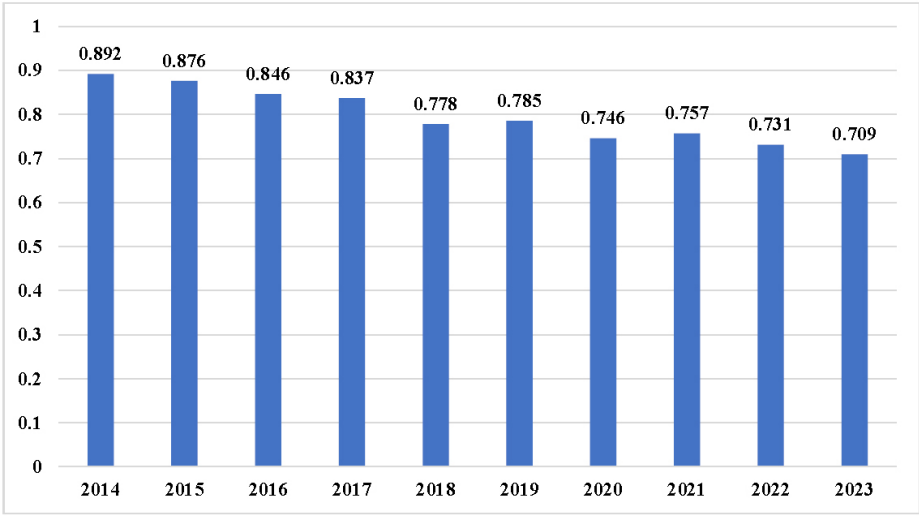


**Figure 2**

**Correlation Value of Core Journal Subject Ranking on the Base Year 2013 in Anthropocene**

be influenced by changes in curriculum design, evolving educational policies, or external factors impacting the integration of core subject domains. While the overall trend shows a decline, there are occasional fluctuations in the correlation values. For instance, a slight increase occurred between 2019 and 2020, temporarily interrupting the downward trend, before declining further in 2021. By 2022, the correlation value had dropped to 0.731, and in 2023, it further declined to 0.709. These values represent a substantial reduction compared to 2013, highlighting a continued weakening of the correlation among the top 10 subject domains over the past decade.

### 5.6 *Subject Analysis of Core Journals*

Table 5 provides an analysis of the subject areas of core journals in the Anthropocene, focusing on the top 15 journals by single-disciplinary and multidisciplinary subject areas across different years. Agricultural Journals dominated in 2008 and 2011, holding the top rank, but their prominence diminished in subsequent years. They became inactive in 2014, 2017, 2020, and 2022. Environmental Science Journals started at rank 5 in 2008 and steadily climbed to become the leading journal by 2022. Despite fluctuations in ranking over the years, they displayed a dynamic and growing presence in the field. Engineering Journals were ranked 1 in 2008, became inactive in 2011, returned in 2014 and 2017 with lower rankings, and were inactive again in 2020 and 2022. Multidisciplinary Journals began at rank 2 in 2008, experienced variations in ranking over the years, and eventually became inactive in 2022. However, they maintained a consistent presence in the top 10 for most of the analyzed period, reflecting their broad appeal. Behavioural Science Journals held the top rank in 2008 but became inactive in subsequent years, including 2011, 2014, 2017, 2020, and 2022. Geosciences Journals showed variability in rankings, ranging from 0 to 5, and

became inactive in 2022 after being ranked 4 in 2020. Chemical and Engineering Journals were ranked 1 in 2008 but displayed a fixed, less dynamic presence in subsequent years, including 2011, 2014, 2017, 2020, and 2022. Languages and Literature Journals showed a variable presence in the top 15, with their ranking improving steadily from 2008 to 2022.

**Table 5**

**Subject Area Analysis of Core Journal in Anthropocene**

| Core Journal by Single Disciplinary and Multidisciplinary Subject Area | | | | | | |
|---|---|---|---|---|---|---|
| Subject Areas | **2008** | **2011** | **2014** | **2017** | **2020** | **2022** |
| Agricultural | 1 | 1 | 0 | 0 | 0 | 0 |
| Environmental Science | 5 | 4 | 4 | 2 | 3 | 7 |
| Engineering | 1 | 0 | 0 | 2 | 0 | 0 |
| Multidisciplinary | 2 | 5 | 4 | 6 | 1 | 0 |
| Behavioural Science | 1 | 0 | 0 | 0 | 0 | 0 |
| Geosciences | 4 | 3 | 5 | 0 | 4 | 0 |
| Chemical And Engineering | 1 | 0 | 0 | 0 | 0 | 0 |
| Languages and Literatures | 0 | 1 | 0 | 2 | 3 | 1 |
| Anthropology | 0 | 1 | 2 | 2 | 2 | 1 |
| Law and Critical Theory | 0 | 0 | 0 | 1 | 2 | 1 |

Anthropology Journals began at rank 0 in 2008 but steadily improved their ranking over the years, maintaining a consistent presence in the top 10. Law and Critical Theory Journals became active in 2017 and continued to hold a presence in subsequent years, achieving the top rank in 2022. These findings highlight the dynamic nature of journal rankings across different subject areas, reflecting evolving research priorities and interdisciplinary integration over the years.

## 6. Findings of the Study

- Anthropocene-related publications grew exponentially, with annual output increasing from 1 in 2001 to 1,648 in 2023, and a cumulative total of 10,552 publications over the period.
- The concept expanded from 2 subject domains in 2001 to 27 by 2023, reflecting growing interdisciplinary integration and relevance across diverse research areas.
- Environmental Science emerged as the dominant field, steadily improving in prominence. Conversely, Agricultural Sciences experienced a decline in impact, indicating shifting research priorities.
- Single-article journals peaked in 2011 but declined to zero by 2020. Journals with more than five articles showed growth until 2015, followed by a decline, reflecting evolving publishing patterns.

- The correlation among top subject domains weakened over time, with values dropping from 0.892 in 2013 to 0.709 in 2023, suggesting diversification in research priorities.
- Findings highlight the Anthropocene's critical role in addressing global challenges, with its adoption reflecting increased academic focus on human-environment interactions and sustainability efforts.

## 7. Discussions

The findings demonstrate the exponential rise of Anthropocene-related publications, expanding from just two subject domains in 2001 to 27 by 2023. This trajectory mirrors the increasing urgency of global climate and sustainability discourses, as emphasized by the IPCC. Environmental Science has emerged as the leading field, reflecting alignment with IPCC calls for evidence-based approaches to biodiversity, carbon cycles, and planetary boundaries. The concurrent decline of Agricultural Sciences suggests shifting priorities toward broader sustainability frameworks, while the rise of Social Sciences underscores the growing recognition of societal dimensions in addressing Anthropocene challenges. The weakening correlation among top subject domains indicates diversification, with emerging disciplines increasingly shaping Anthropocene scholarship. This diversification aligns with IPCC's recommendation for integrated knowledge systems that combine natural, social, and technological perspectives.

## 8. Policy Implications

The findings carry significant policy implications. At first, the interdisciplinary expansion of Anthropocene research underscores the necessity for integrated climate governance frameworks that draw on multiple fields. Policymakers should prioritize funding mechanisms that foster cross-disciplinary collaboration, consistent with IPCC recommendations for systemic, rather than sectoral, approaches. Secondly, the rise of Social Sciences within Anthropocene research highlights the importance of inclusive, participatory policies that account for justice, equity, and human dimensions of climate change. Thirdly, the diffusion of research across 27 subject domains suggests that policymaking must be adaptive and informed by diverse streams of knowledge, from technological innovation to cultural perspectives. By aligning national and global policies with the evolving landscape of Anthropocene scholarship, decision-makers can more effectively address climate risks and advance sustainable futures.

## 9. Conclusions

This study highlights the exponential growth and interdisciplinary diffusion of Anthropocene research from 2001 to 2023, reflecting its centrality in global sustainability discourses. The findings reveal Environmental Science as the dominant field, with Social

Sciences gaining prominence, while Agricultural Sciences experience declining relevance. The weakening correlation among core subject domains signals diversification and the emergence of new priorities within Anthropocene scholarship.

For policymakers, these insights reinforce the need to embrace interdisciplinary collaboration in climate and sustainability governance. Consistent with IPCC recommendations, policies should integrate natural and social sciences, encourage transdisciplinary research, and support innovations that address the systemic nature of Anthropocene challenges. Investments in cross-sectoral research funding, inclusive policy design, and science–policy interfaces can ensure that Anthropocene scholarship informs effective and equitable climate action.

Future research should investigate regional patterns of Anthropocene scholarship, assess its influence on actual policy outcomes, and explore how emerging disciplines such as data science, artificial intelligence, and indigenous knowledge contribute to Anthropocene studies. Longitudinal analyses of thematic clusters—such as carbon neutrality, planetary health, and resilience—can further align scholarly research with the transformative pathways highlighted in IPCC assessments. By embedding Anthropocene scholarship into global sustainability policy, future research can foster actionable knowledge to navigate humanity's role in shaping Earth's future.

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