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The Transformation Paradox of Emerging Fields

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A Bourdieusian Approach to the Bibliometric Study of Sustainability Science

THE SWEDISH SCHOOL OF LIBRARY AND INFORMATION SCIENCE
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Cover image: Piet Mondrian, *Lozenge Composition with Yellow, Black, Blue, Red, and Gray* (1921). The Art Institute of Chicago. CC0 Public Domain (via Wikimedia Commons). The painting's rotated orthogonal grid—maintaining structural stability while shifting orientation—resonated with the themes explored in this thesis, particularly the tension between transformation and the persistence of underlying structures.

Abstract

How can a field that promotes transformation and interdisciplinarity simultaneously reproduce the academic hierarchies it seeks to transcend? This thesis examines sustainability science as an emerging interdisciplinary field, mobilising Pierre Bourdieu's field theory to analyse how symbolic capital, legitimacy, and recognition become structured as durable institutional forms during field formation.

Drawing on four complementary studies, the thesis traces three decades of intellectual and institutional development in sustainability science through an analytical framework combining bibliometric mapping, network analysis, and interpretive analysis of editorial discourse. It demonstrates how symbolic reward structures—such as journal hierarchies, editorial networks, and citation practices—do not function as neutral measures of scholarly contribution, but act as instruments in ongoing struggles over field boundaries and legitimate participation.

The thesis employs a reflexive multimethod design to map sustainability science across multiple analytical dimensions, integrating bibliometric analysis, social network analysis (SNA), geometric data analysis (GDA), and qualitative content analysis (QCA). Using citation and co-authorship patterns, published editorials, and the composition of editorial boards in a selected set of journals central to sustainability science, the thesis reconstructs the field's intellectual and social organisation, tracing how recognition structures crystallise into durable institutional forms. The analysis identifies three historical phases—Foundation (1993–2002), Introspection (2003–2012), and Diversification (2013–2022)—each marked by shifts in epistemic orientation and the redistribution of symbolic capital. Editorial discourse functions as a central site of symbolic struggle, where competing visions of sustainability science—and rival claims to definitional authority—are articulated and contested.

The thesis reframes the empirical analysis through field-theoretical concepts, foregrounding recognition, hierarchy, and symbolic power. By treating bibliometric indicators not merely as analytical tools but as socially embedded instruments of valuation, the study contributes to library and information science (LIS)—particularly scientometrics, bibliometrics, and scholarly communication—while engaging sociological perspectives on science. The findings provide

a critical account of how emerging interdisciplinary fields institutionalise authority while reproducing academic stratification—often in tension with their programmatic commitments to transdisciplinarity and post-normal science.

Svensk sammanfattning

Hur kan ett forskningsfält som främjar transformation och interdisciplinaritet samtidigt reproducera de akademiska hierarkier som det säger sig vilja överskrida?

Denna avhandling undersöker hållbarhetsvetenskap (*sustainability science*) som ett framväxande tvärvetenskapligt forskningsfält och använder Pierre Bourdieus fältteori för att analysera hur symboliskt kapital, legitimitet och erkännande struktureras i varaktiga institutionella former under fältets framväxt.

Med utgångspunkt i fyra kompletterande studier följer avhandlingen tre decennier av intellektuell och institutionell utveckling inom hållbarhetsvetenskapen genom ett multimetodiskt ramverk som integrerar bibliometrisk kartläggning, nätverksanalys och tolkande analys av editorials. Studien visar hur symboliska belöningsstrukturer, såsom tidskriftshierarkier, redaktionella nätverk och citeringspraktiker, inte fungerar som neutrala mått på vetenskapliga bidrag, utan verkar som instrument i pågående strider om fältets gränser och om vem som ses som legitim deltagare.

Med denna ram som utgångspunkt tillämpar avhandlingen ett reflexivt, multimetodiskt forskningsupplägg som integrerar bibliometrisk analys, social nätverksanalys (SNA), geometrisk dataanalys (GDA) och kvalitativ innehållsanalys (QCA) för att kartlägga hållbarhetsvetenskapen längs flera analytiska dimensioner. Genom analyser av citerings- och samförfattarmönster, publicerade editorials samt sammansättningen av redaktionella råd i ett urval av tidskrifter som är centrala för hållbarhetsvetenskapen rekonstruerar avhandlingen fältets intellektuella och sociala organisation och visar hur erkännandestrukturer stabiliseras till varaktiga institutionella former. Analysen identifierar tre historiska faser – grundande (1993–2002), introspektion (2003–2012) och diversifiering (2013–2022) – som var och en kännetecknas av förändringar i epistemisk orientering och en omfördelning av symboliskt kapital. Redaktionell diskurs framträder som en central arena för symbolisk kamp, där konkurrerande visioner av hållbarhetsvetenskap – och rivaliserande anspråk på definitionsmakt – artikuleras, ifrågasätts och selektivt legitimeras.

Avhandlingen omtolkar den empiriska analysen i fältteoretiska termer och synliggör därigenom erkännande, hierarki och symbolisk makt. Genom att betrakta bibliometriska indikatorer inte enbart som analytiska verktyg utan som socialt in-

bäddade värderingsinstrument bidrar studien till biblioteks- och informationsvetenskapen (B&I) – särskilt scientometri, bibliometri och forskning om vetenskaplig kommunikation – samtidigt som den anlägger sociologiska perspektiv på vetenskap. Resultaten bidrar med ett kritiskt perspektiv på hur framväxande tvärvetenskapliga forskningsfält institutionaliserar auktoritet samtidigt som de reproducerar akademisk stratifiering – ofta i spänning med sina programförklarade åtaganden om transdisciplinaritet och postnormal vetenskap.

Riassunto in italiano

Come può un ambito scientifico che promuove la trasformazione e l'interdisciplinarità riprodurre, al contempo, le gerarchie accademiche che aspira a trascendere? Questa tesi di dottorato esamina la scienza della sostenibilità in quanto area interdisciplinare emergente, avvalendosi della teoria dei campi di Pierre Bourdieu per analizzare come capitale simbolico, legittimità e riconoscimento scientifico si strutturino in forme istituzionali durevoli durante il processo di formazione del campo.

Attraverso quattro studi complementari, la tesi ripercorre tre decenni di sviluppo intellettuale e istituzionale della scienza della sostenibilità, impiegando un quadro analitico che integra mappatura bibliometrica, analisi reticolare e analisi interpretativa del discorso editoriale. Il presente studio dimostra come le strutture di ricompensa simbolica — quali le gerarchie tra riviste, le reti editoriali e le pratiche di citazione — non funzionino come misure neutrali del contributo scientifico, ma agiscano come strumenti nelle lotte in corso per la definizione dei confini del campo e della partecipazione legittima alle sue attività.

La tesi adotta un approccio multimetodologico riflessivo per rappresentare la scienza della sostenibilità attraverso molteplici dimensioni analitiche, integrando analisi bibliometrica, analisi delle reti sociali (SNA), analisi geometrica dei dati (GDA) e analisi qualitativa del contenuto (QCA). A partire da modelli di citazione e di collaborazione tra autori, il testo di articoli editoriali e la composizione dei comitati editoriali di un campione selezionato di riviste centrali per la scienza della sostenibilità, la tesi ricostruisce l'organizzazione intellettuale e sociale del campo, mostrando come le strutture di riconoscimento si cristallizzano in forme istituzionali durevoli. L'analisi identifica tre fasi storiche — Fondazione (1993–2002), Introspezione (2003–2012) e Diversificazione (2013–2022) — ciascuna caratterizzata da mutamenti nell'orientamento epistemico e dalla ridistribuzione del capitale simbolico. Attraverso queste fasi, il discorso editoriale costituisce un terreno centrale di lotta simbolica, in cui visioni contrapposte della scienza della sostenibilità — e rivendicazioni rivali sull'autorità di definire il campo — vengono articolate e contestate.

La tesi rilegge l'analisi empirica attraverso concetti di teoria dei campi, ponendo in primo piano riconoscimento scientifico, gerarchie e potere simbolico. Trattando gli indicatori bibliometrici non semplicemente come strumenti analitici, ma come mezzi di valutazione socialmente situati, questa ricerca contribuisce alla biblioteconomia e scienza dell'informazione — in particolare alla scientometria,

alla bibliometria e agli studi della comunicazione scientifica — dialogando al contempo con le prospettive derivate dalla sociologia della scienza. I risultati offrono un resoconto critico di come i campi interdisciplinari emergenti istituzionalizzino l'autorità, pur riproducendo la stratificazione accademica — spesso in tensione con le proprie dichiarazioni programmatiche di transdisciplinarità e postnormalità.

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Articles Included in This Thesis

Article I: Schirone, M. (2023). Field, capital, and habitus: The impact of Pierre Bourdieu on bibliometrics. *Quantitative Science Studies*, *4*(1), 186–208. https://doi.org/10.1162/qss_a_00232

Article II: Schirone, M. (2024). The formation of a field: Sustainability science and its leading journals. *Scientometrics*, *129*, 401–429. https://doi.org/10.1007/s11192-023-04877-1

Article III: Schirone, M. (2025). The emergence of sustainability science in the editorials of three scholarly journals. *Discover Sustainability, 6*, Article 688. https://doi.org/10.1007/s43621-025-01519-9

Article IV: Schirone, M. (2025). *Symbolic capital and inequality in scholarly communication: A bibliometric study of editorial boards* [Preprint]. https://doi.org/10.31235/osf.io/v8zmp_v3

Reviews & Reports

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List of Abbreviations

ANT – Actor–network theory

EVC – Eigenvector centrality

GDA – Geometric data analysis

HCKB – Highly cited knowledge base

JCI – Journal Citation Indicator

LIS – Library and information science

MCA – Multiple correspondence analysis

PCA – Principal component analysis

PNS – Post-normal science

QCA – Qualitative content analysis

SCI – Science Citation Index

SCIM – Symbolic capital institutionalisation model

SDGs – Sustainable Development Goals

SNA – Social network analysis

STS – Science and technology studies

1. Introduction

Sustainability science emerged in response to urgent global challenges—such as climate change, biodiversity loss, and social inequality—through integrative, interdisciplinary, and problem-oriented approaches. It builds on earlier traditions of sustainability-oriented, problem-focused research (Clark, 2007; Conrad, 2002). From its inception, the field has positioned itself as transformative (Kates et al., 2001), advancing an explicitly solution-oriented research agenda that foregrounds inclusivity and societal relevance as core commitments (Miller et al., 2014). Yet despite its rapid growth and increasing institutional visibility, the field remains in formation: its boundaries and internal coherence are "not completely settled or solidified" (Nagatsu et al., 2020, p. 1808), with ongoing debates over conceptual foundations, methodological approaches, and disciplinary positioning (Jerneck & Olsson, 2020; Schlüter et al., 2019).

This unsettled character raises a critical question: how does a field committed to transformation structure itself institutionally? When legitimacy is defined by the capacity to address urgent societal problems, institutional arrangements acquire particular significance—they become sites of scrutiny precisely because the field's authority depends on its ability to realise its stated commitments. While previous research has examined the conceptual development of sustainability science and traced the evolution of its core ideas (e.g., Kajikawa, 2008; Kates et al., 2001; Nagatsu et al., 2020), systematic analyses of its institutional organisation—particularly how authority is consolidated through journals, editorial structures, and scholarly networks—remain limited. Although bibliometric studies have mapped publication and citation patterns (e.g., Bettencourt & Kaur, 2011; Kajikawa et al., 2007), few have connected these patterns to broader questions of power, recognition, and field formation.

The institutional development of sustainability science has taken multiple forms, including the expansion of dedicated academic programmes, the establishment of research centres, and the emergence of professional societies and networks (Bettencourt & Kaur, 2011; Clark & Harley, 2020). As shown by large-scale analyses of the field's evolution and structure, sustainability science has undergone rapid growth, geographic expansion, and increasing institutional consolidation as a distinct research domain (Bettencourt & Kaur, 2011). While these institutional dimensions have been explored in previous research (Bettencourt & Kaur, 2011; Clark & Harley, 2020), comparatively less attention has been paid to the infrastructures of scholarly communication. This thesis therefore focuses on scholarly

communication structures—specifically publication, citation, and editorial gatekeeping—as key mechanisms through which academic recognition is structured and authority is consolidated.

Focusing on scholarly communication structures highlights how field formation involves not only conceptual development but also the organisation of legitimacy within the field. A persistent tension emerges: while sustainability science promotes ideals of interdisciplinarity, inclusivity, and transformative change, its authority is consolidated through conventional academic mechanisms—a relatively small number of prominent journals, interconnected editorial networks, and competitive publication systems. These dynamics tend to privilege established actors and reproduce institutional hierarchies within the field.

To understand these dynamics, I draw on Pierre Bourdieu's theoretical framework of fields and forms of capital (Bourdieu, 1975, 1986, 2004). From this perspective, scientific fields are structured social arenas in which actors compete for recognition by accumulating and converting different forms of capital: economic, cultural, social, and symbolic (Bourdieu, 1996). Symbolic capital, in particular, refers to the prestige and legitimacy conferred through recognition. It becomes institutionalised in durable structures such as journals, in relatively stable gatekeeping bodies like editorial boards, and in dynamic systems such as citation networks. Field theory thus provides a means for analysing how sustainability science articulates transformative ambitions while remaining embedded in institutional mechanisms that concentrate authority and reproduce academic hierarchies.

Within this framework, sustainability science provides a context for examining how legitimacy is negotiated through scholarly communication structures. The field articulates commitments to interdisciplinarity, inclusivity, and societal engagement—yet must secure recognition through conventional academic structures such as peer-reviewed journals, competitive publication systems, and editorial gatekeeping. I conceptualise this tension as a *transformation paradox*: to gain legitimacy, fields oriented towards transformation must accumulate symbolic capital through institutional mechanisms whose hierarchical and exclusionary logics they often critique. While similar contradictions might be present in other emerging fields, sustainability science's explicit normative engagement with global equity and systemic change renders this paradox especially visible—and analytically significant.

Article I establishes the theoretical and methodological conditions for this analysis by mapping how Bourdieu's field theory has been received and operationalised in bibliometric research. Articles II–IV then examine how the transformation paradox manifests across three interrelated dimensions of sustainability science's institutional organisation. Article II maps symbolic hierarchies among journals to reveal patterns of differentiation and stratification. Article III analyses how the conceptualisation of sustainability science evolves in published editorials, examining how journals articulate and negotiate the field's epistemic boundaries and normative commitments over time. Article IV examines editorial board composition as a gatekeeping structure, tracing how symbolic capital becomes concentrated through overlapping membership across editorial boards and patterns of institutional, geographic, and gender representation. These studies show how symbolic capital becomes embedded in organisational structures, consolidating authority in ways that both enable and constrain the field's transformative aspirations.

1.1 Disciplinary Positioning and Methodological Approach

This study is situated within the subfields of bibliometrics and scientometrics (see Leydesdorff, 2001), which are part of the broader discipline of library and information science (LIS). Bibliometrics focuses on measuring patterns of publication, citation, and collaboration, while scientometrics examines how these patterns reflect the structure and dynamics of scientific fields (De Bellis, 2009). Both subfields contribute to the study of scholarly communication—a core area within LIS concerned with how journals, editorial systems, citation networks, and metadata infrastructures shape the circulation, evaluation, and legitimation of knowledge (Åström, 2007). Building on this tradition, the thesis investigates how sustainability science becomes institutionalised through scholarly communication mechanisms that mediate recognition and authority. This positioning grounds the research within LIS while also supporting a Bourdieusian analysis of how symbolic capital becomes embedded in scientific communication infrastructures (Cronin, 2005; Wouters, 2014).

I treat bibliometric indicators as both analytical instruments and objects of inquiry in their own right. Journals, indicators, and citation networks are representations of scientific activity, but also institutional devices that actively shape authority, visibility, and recognition (Hammarfelt & Rushforth, 2017). Field theory thus

provides a lens for analysing how bibliometric tools, such as citation networks and indicators, reflect and reinforce hierarchies of symbolic capital. This study contributes to a growing body of scientometric research that integrates Bourdieu's field theory by combining quantitative bibliometric analyses with qualitative and theoretically informed interpretations of inequality, symbolic capital, and field dynamics (e.g., Boshoff et al., 2024; Koch et al., 2025).

The integration of Bourdieu's field theory with reflexive bibliometrics results in the Symbolic Capital Institutionalisation Model (SCIM). Developed inductively from the empirical analyses in Articles II–IV, the model's constituent concepts and mechanisms emerge across distinct empirical domains. SCIM provides a framework for understanding how emerging fields establish legitimacy by accumulating, converting, and stabilising different forms of capital across multiple institutional sites and symbolic systems—including journals, editorial boards, and citation structures. By synthesising Bourdieu's field theory with insights from research on scientific and intellectual movements (Frickel & Gross, 2005), SCIM helps explain how emerging interdisciplinary fields negotiate tensions between normative aspirations and the structural constraints of the academic system. These components are integrated in Chapter 4, where SCIM is presented as the framework constituting the theoretical core of the thesis.

1.2 Aim and Research Questions

This investigation focuses on the institutional consolidation of sustainability science over the past three decades, as reflected in publication patterns, journal structures, and editorial discourse. The analysis does not evaluate the quality or societal impact of individual research contributions, nor assess whether the field has succeeded in realising its stated commitments. Instead, the purpose of this study is to provide a systematic account of how scholarly communication structures shape the institutionalisation of sustainability science, thereby contributing to a deeper understanding of how academic authority is constructed and maintained in the field.

The study is primarily intended to contribute to research in library and information science, particularly in scientometrics, bibliometrics, and scholarly communication. By examining how recognition and authority are structured through these processes, the findings are also relevant for actors involved in academic publishing, research evaluation, and editorial governance, as well as for scholars seeking to understand the institutional dynamics of sustainability science.

To examine these structural processes, I adopt a relational and reflexive methodological framework that integrates bibliometric mapping, social network analysis, and qualitative content analysis, enabling the examination of both field-level structural patterns and their institutional and discursive articulation. The analysis is guided by four interrelated research questions:

RQ1. How can Bourdieu's theories on capital and field be applied to the publication, collaboration, and citation patterns of sustainability science?

RQ2. How can bibliometric methods, informed by a Bourdieusian perspective, be developed to describe the social and intellectual organisation of sustainability science, and how can qualitative insights complement these analyses?

RQ3. How can the process of institutionalisation in sustainability science be described through patterns revealed by quantitative and qualitative analyses of its publication output?

RQ4. How do editorial board structures in sustainability science journals reflect broader power relations in the social and intellectual organisation of the field?

The four articles included in the thesis address these questions empirically through distinct analytical lenses. The organisation of the thesis and the relationship between the summary essay and the four articles are outlined below.

1.3 Structure of the Thesis

This thesis consists of a summary essay and four journal articles. The summary essay is organised into eight chapters.

Chapter 2 traces the conceptual evolution of bibliometrics, from its early instrumental role in information management to its contemporary reflexive and field-theoretical interpretations. Chapter 3 examines sustainability science as an emerging interdisciplinary field, outlining its epistemic foundations, institutional development, and key bibliometric studies that have mapped its evolution. Chapter 4 presents the theoretical framework, integrating Bourdieu's field theory to analyse how symbolic capital, recognition, and authority are produced and contested within scientific fields. Chapter 5 details the methodological design, describing the integration of bibliometric mapping, network analysis, and qualitative content analysis, and specifying data sources, analytical techniques, and the rationale for combining quantitative and qualitative approaches.

Chapter 6 provides an overview of the four constituent articles, explaining how each addresses distinct empirical dimensions while remaining unified by the overarching field-theoretical framework. Chapter 7 integrates the main findings across the articles in relation to the research questions, showing how the institutionalisation of sustainability science can be understood in relation to broader dynamics of field formation. Chapter 8 synthesises the theoretical, empirical, and methodological contributions of the thesis, discusses implications for research and for practices related to scholarly communication and research evaluation, acknowledges limitations, and outlines directions for future research in library and information science, particularly in scientometrics, bibliometrics, and scholarly communication.

As the chapters unfold, a central argument takes shape: the transformation paradox emerges not as an anomaly, but as a structural feature of field formation. By examining how sustainability science operates within established academic systems, the thesis reveals how emerging fields negotiate recognition and, in the process, reproduce, adapt, or reshape existing configurations of scientific authority.

2. Reflexive Bibliometrics

The theoretical assumptions and historical lineages shape how bibliometric indicators are designed, interpreted, and used—and therefore what they can and cannot reveal about emerging fields (Hammarfelt, 2011; Leydesdorff et al., 2018). This chapter, therefore, surveys major traditions in bibliometric thought, moving from instrumentalist origins in information management, through Mertonian and constructivist interpretations of citation, to reflexive approaches that treat indicators as performative devices in the governance of science. It also examines the ethical and governance-related consequences of indicator use, with particular attention to inequalities in recognition and visibility.

2.1 Theoretical Directions in Bibliometrics: From Information Management to Field Analysis

Originally developed as tools for information retrieval, bibliometric methods have evolved through sociological, constructivist, and reflexive approaches that now treat indicators as part of the governance of science. This section traces that trajectory across three interrelated dimensions (Guns, 2013): documentary (publications), social (agents and institutions), and epistemic (concepts and knowledge structures). The shift is from measuring science to participating in its construction, clarifying how knowledge is structured, valued, and governed.

2.1.1 Instrumentalist Foundations: Information Retrieval and Quantification

Bibliometrics has its intellectual origins in early twentieth-century work on statistical bibliography and documentation, and emerged in response to the rapid growth of scientific publishing, which John Desmond Bernal characterised as an "enormous and chaotic structure" (1939, p. 117). Derek John de Solla Price captured this challenge as the "explosion of science" in his book *Little science, big science* (De Solla Price, 1963, p. 14). This exponential growth in scientific publications demanded new methods for navigating and making sense of the scholarly literature.

While bibliometrics was formally institutionalised in the post-war decades, its intellectual roots go back to the early twentieth century. Foundational ideas

emerged from Edward Wyndham Hulme's work on statistical bibliography and Paul Otlet's theories on documentation systems (Nelhans, 2022). The introduction of Lotka's law of scientific productivity and Bradford's law of scattering complemented these developments, establishing key epistemic reference points for the field (Rousseau et al., 2018).

Bernal's *The social function of science* further promoted the empirical study of science as a structured social activity (1939). The Soviet term *naukometriya* (scientometrics), proposed in 1969, marked an effort to formalise the quantitative analysis of science (Rousseau et al., 2018). These intellectual developments reflected a growing conviction that science itself could be studied systematically and rendered visible through measurement.

Eugene Garfield's interventions were pivotal in turning these scattered insights into an operational infrastructure for the measurement and understanding of scientific output. His Science Citation Index (SCI) reimagined citations as machine-readable links within the scientific record (Garfield, 1955, 1964). This tool, along with innovations like bibliographic coupling (Kessler, 1963), journal impact metrics (Garfield & Sher, 1963), and co-citation analysis (Small, 1973), shared a core positivist assumption: that citation frequency could serve as a quasi-objective proxy for intellectual influence.

Despite early ambivalence from practising scientists (Wouters, 1999), this emerging bibliometric infrastructure enabled the mapping and quantification of science itself. De Solla Price's exponential-growth curves and network analyses provided an empirical vocabulary that resonated with Kuhn's account of paradigms and scientific revolutions (De Solla Price, 1963, 1965; Kuhn, 1970). Small's clustering algorithms, meanwhile, offered a method for identifying evolving research fronts (Small, 1973). These developments positioned bibliometrics both as a "science of science" and as a practical infrastructure for the governance of science (De Solla Price, 1963; Garfield, 2009).

2.1.2 The Mertonian Turn: Citations as Symbolic Credit

A theoretical shift occurred when bibliometricians began to draw on Robert K. Merton's sociology of science (Merton, 1973, 1979). Merton's theories provided the interpretive break that transformed citations from tools for information retrieval into a form of symbolic currency within the scientific reward system. He argued that science operates through a moral economy of recognition, built on the CUDOS norms: Communalism, Universalism, Disinterestedness, and Organised

Scepticism. In this system, discoveries are shared publicly (communalism), but reputation accrues to the individual, provided their claims are judged by universal criteria and vetted critically. Citations, therefore, function as formal acknowledgements of intellectual debt and, consequently, as tokens of credit.

Merton (1968) introduced the "Matthew effect", drawing on multiple empirical sources—including Harriet Zuckerman's interviews with Nobel laureates (Zuckerman, 1967) and documentary evidence from scientists' diaries, letters, notebooks, publications, and biographies. Merton synthesised these observations into a sociological model in which the prior recognition and prestige of eminent scientists produce further recognition and credit, reinforcing status hierarchies over time within the moral economy of science.

Later, Merton revisited the Matthew effect to examine its broader implications, particularly the institutional logic through which credit and recognition accumulate in science (Merton, 1988). Merton emphasised that the allocation of recognition is not merely descriptive but actively shapes scientific careers and institutional advancement. He further acknowledged that his long collaboration with Zuckerman over two decades had deepened and refined the concept (Merton, 1988). In this revised account, Merton underscored that recognition systems operate through institutional processes governed by scientific norms.

However, subsequent scholarship has demonstrated that cumulative advantage is structured by more than eminence alone; social position profoundly shapes recognition patterns. As Rossiter (1993) argued, Merton's formulation focused on how the already prominent accumulate credit at accelerating rates (the "rich get richer" dynamic), while neglecting how marginalised groups are systematically denied recognition (the complementary "poor get poorer" pattern). Rossiter termed this the "Matilda effect", after the nineteenth-century feminist writer and suffrage activist Matilda Joslyn Gage, whose work exemplified this pattern of historical erasure. The Matilda effect dynamic reveals why women scientists are systematically denied recognition even for substantive contributions.

Together, the Matthew and Matilda effects show that the scientific reward system not only amplifies advantage but actively reproduces structural inequality along lines of academic status and gender. Later quantified in empirical studies (Kozlowski et al., 2024; Langfeldt et al., 2015; Tol, 2013), these dynamics create a system in which established researchers—disproportionately male and Western—gain resources and visibility at an accelerating rate, while newcomers and historically marginalised groups face systematic barriers to recognition.

These structural patterns complicate any straightforward use of citations as impact indicators—a concern identified early in bibliometric scholarship. Kaplan (1965) argued that citation practices are embedded in tacit academic norms and serve multiple social functions. Rather than neutral acknowledgements, Kaplan saw citations as strategic signals used to confer legitimacy, assert intellectual property, or even deflect responsibility. His work was an early warning against treating citation counts as objective measures of impact or quality. This concern was later validated by Cano (1989), whose study of elite scientists found that over a third of citations were perfunctory—used mainly to "set the stage" rather than engage substantively with the cited work.

As Wouters (1999) argued, Merton's reframing of citations as reward tokens—with all the inequities that entails—ultimately gave citation counts a powerful evaluative authority. They were transformed from factual footnotes into "rating" devices capable of legitimising decisions about hiring, funding, and research evaluation (Moed, 2005).

Yet Merton's normative sociology, despite its sophistication, rested on an assumption that would prove contentious: that citations generally operate within shared norms and values in science. From the late 1970s onwards, constructivist and Science and Technology Studies (STS) scholars challenged this view, arguing that citation practices cannot be reduced to norms or intellectual merit alone but are also shaped by contestation, rhetoric, and power. This shift redirected bibliometric inquiry from normative accounts of citation to more critical analyses of how scientific authority is constructed, negotiated, and contested.

2.1.3 Constructivist and STS Critiques

Scholars who emphasised power, conflict, and field dynamics later contested the Mertonian view of citations as normative acknowledgements. Bourdieu (1988), in particular, offered a structurally distinct alternative to Merton's normative account by conceptualising scientific recognition as a form of symbolic capital accumulated within fields structured by inequality and struggle. Bourdieu's perspective shifts attention towards the relational and competitive conditions under which recognition is produced: in his account, science constitutes a social field—a structured space in which agents compete for legitimacy and symbolic capital (Bourdieu, 1975, 2004). From this standpoint, citations can be understood as instruments in struggles over dominance, and scientific authority as produced through continuous contestation over resources, prestige, and recognition.

Bibliometric scholarship has drawn on Bourdieu's field-theoretical framework to reinterpret citations as indicators of, and resources in the accumulation of, symbolic capital. The value of citations depends not only on the act of referencing itself but also on the reputational status of the authors involved, the prestige of the journal, and the alignment of the work with dominant intellectual positions (Cronin, 2005; Gingras, 2016). Citations can function as active "position-taking" practices that signal allegiance, reinforce hierarchies, and help structure the distribution of symbolic authority. Article I in this thesis examines the reception and operationalisation of Bourdieu's (1989) structuralist constructivism in bibliometrics. Chapter 4 then systematically develops the Bourdieusian theoretical framework employed throughout the thesis.

In parallel, from the late 1970s into the early 1980s, constructivist critiques in STS challenged the foundational assumptions of citation theory. Collins, for instance, contributed to consolidating this broader shift by showing that scientific knowledge comes to count as such through processes of negotiation, interpretive flexibility, and community-based judgements of credibility rather than through norms and methods alone (Collins, 1983). These perspectives questioned whether citations reflect intellectual influence directly, arguing instead that they serve rhetorical, strategic, and perfunctory functions.

Nigel Gilbert (1977) highlighted the persuasive role of citations in scientific arguments, while Bruno Latour (1987) framed them as "inscription devices" that mobilise alliances and help scientific claims circulate. These scholars recast citations as rhetorical tools rather than transparent attributions of credit, revealing them as embedded in the production of scientific authority itself. Yet their emphases differ: Gilbert focuses on how citations function rhetorically within scientific texts to build arguments and convince audiences, while Latour emphasises the material and social work that citations perform in mobilising networks and circulating claims across time and space. Both challenge the assumption that citations transparently reflect intellectual merit.

Terttu Luukkonen (1997, p. 31) asked why Latour's theory was "largely ignored" by mainstream scholarship in the field. She argued that Latour's rhetorical interpretation reveals citations not just as markers of recognition, but as strategic tools used to legitimise contested knowledge claims (Latour, 1987; Latour & Woolgar, 2013). From a Latourian standpoint, citation counts cannot be treated as neutral indicators of value. By emphasising the diverse and often strategic uses of citations, Luukkonen showed that such indicators are methodologically fragile. Accepting Latour's account, she argued, would therefore require the field to move away from purely quantitative measurement towards more interpretive modes of

analysis—a move she saw as largely resisted. This methodological critique was reinforced by her empirical research, which showed that scientists frequently interpreted evaluations as instruments of legitimation rather than as drivers of behavioural change (Luukkonen, 1995).

Against this background, alternative lines of inquiry sought to operationalise a more explicitly interpretive and constructivist understanding of scientific knowledge production. Co-word analysis, developed within a constructivist, actor-network framework, maps the discursive structure of science by tracing conceptual networks in texts (Callon et al., 1991; Callon et al., 1983; Callon et al., 1986). This method reveals how knowledge emerges through shared terminologies and semantic alignments, charting science through its conceptual formations rather than through citation links alone.

Alongside these approaches, a second-order turn reframed bibliometric indicators and infrastructures as observation devices through which science describes—and thereby reshapes—itself.

2.1.4 Second-Order Bibliometrics: Citations as Communication

Emerging from constructivist critiques, later developments in bibliometric theory examined how citation practices not only reflect but also shape scientific culture. Paul Wouters (1999) developed the concept of "citation culture", arguing that referencing is not a transparent reflection of intellectual structure, but a socially embedded act shaped by disciplinary traditions, institutional constraints, and evaluation systems. Wouters described the Science Citation Index as a second-order observation device—a system that allows science to observe itself through indicators that are themselves performative. In this framework, citations do not merely describe science; they actively shape it by creating new forms of visibility and evaluation.

This reflexive approach marks a shift: whereas constructivist critiques expose how power and rhetoric enter citation practices, reflexive bibliometrics turns that lens back on bibliometrics itself as an object of inquiry. It emphasises the meaning-making aspects of citation practices and their cultural embeddedness, revealing how different disciplinary communities develop distinct citing conventions and interpretive frameworks. Wouters (2018) later extended this analysis through the "responsible metrics" agenda.

Yuko Fujigaki also conceptualised citation networks as dynamic systems that continuously reconstruct scientific knowledge (Fujigaki, 1998a, 1998b). She argued that citations act as "compasses" that position new research and recursively reshape the meaning of past work. Her model bridged qualitative accounts of science dynamics with quantitative analysis, offering a more integrated understanding of scientific evaluation.

Similarly, Loet Leydesdorff used a cybernetic standpoint and Niklas Luhmann's systems theory to model science as a self-organising communication system (Leydesdorff, 2001; Luhmann, 1995). In his view, citations are codified selections that stabilise meaning within recursive knowledge networks. His Triple Helix model captured the interactions between university, industry, and government. Although Wouters and Leydesdorff did collaborate (Leydesdorff & Wouters, 1999), their approaches differ: Leydesdorff used information-theoretic tools to formalise the dynamics of scientific communication, while Wouters focused on their policy implications and historical context.

Leydesdorff's (1989) assertion that co-word analysis offers a complementary method reflects this openness towards "qualitative scientometrics" (Callon et al., 1986). Unlike citation analysis, which primarily maps relational linkages between publications, co-word analysis traces patterns of term co-occurrence that may indicate underlying conceptual relationships and research themes (Callon et al., 1991; Callon et al., 1983). However, as Leydesdorff (2001) later demonstrates, such patterns do not provide a direct representation of cognitive structures, but instead reflect a combination of conceptual, linguistic, and rhetorical dimensions of scientific texts, and therefore require careful interpretation and multivariate analysis to disentangle these dimensions, rather than being read as direct mappings of knowledge structures.

The work of Wouters, Fujigaki, and Leydesdorff reflects a shift from instrumental to reflexive bibliometrics—a field capable of analysing its own effects and recognising the cultural dimensions of scholarly communication.

2.1.5 Synthesis: From Information to Performance

The evolution from Garfield's (1955) information-retrieval rationale to Wouters's (1999) reflexive paradigm marks a transformation in bibliometrics, from a descriptive method into a performative instrument of science governance. This entails a shift from viewing citations as objective traces of influence to seeing them

as tools that shape the structures they aim to map. In the wake of this shift, bibliometrics is understood as an arena in which scientific visibility is contested, negotiated, and reproduced. Contemporary research increasingly recognises the performative nature of indicators—their capacity to reshape the very phenomena they measure (Nelhans, 2022). In this sense, bibliometric indicators no longer merely describe science; they co-construct it by shaping—and being shaped by—the allocation of resources, reputations, and legitimacy (Nelhans, 2013). Accordingly, performativity operates at multiple scales—in national funding systems, institutional evaluation regimes, and researchers' publishing strategies—functioning as incentives that shape where scholars publish, what they prioritise, and which work becomes visible (de Rijcke et al., 2016; Hammarfelt & Rushforth, 2017).

The heterogeneous landscape of bibliometric indicators allows the same research activities to be assessed differently across evaluation models. This plurality underscores how bibliometric infrastructures are embedded in the governance of science, producing feedback loops between measurement practices and research behaviours.

The tension between instrumental and interpretive accounts of citation practices remains unresolved. In his work on *citationology*, Garfield (1998) argued that references constitute a specialised symbolic language with a citation syntax and grammar, and that citation indexes map the linkages between document addresses—addresses that may be described as *references* or *citations* depending on the direction of the link. On this view, citations function both as indicators of influence and as devices for intellectual mapping. Although citation-based methods are sometimes presented as scalable proxies for peer review (Donner et al., 2025), peer review remains the benchmark for quality because the meaning and significance of a citation are inherently context-dependent. Contemporary bibliometrics consequently seeks approaches that accommodate both the cognitive–informational functions and the socially embedded reputational logics of citation. As bibliometric evaluation has become a central mechanism of science governance, attention has turned to how indicators shape not only knowledge production but also opportunity, visibility, and recognition.

2.2 Critical Dimensions: Inequality and the Ethics of Bibliometrics

Bibliometric indicators do not merely observe scientific recognition; they participate in its production. As these methods have moved from information management tools to instruments of science governance, they have acquired performative force, shaping which contributions become visible, which researchers gain credibility, and which venues accumulate authority. This performative dimension raises critical questions. If bibliometric infrastructures govern access to recognition and resources, then the structural biases embedded in citation networks, journal hierarchies, and evaluation protocols are not merely methodological limitations but mechanisms through which inequality is reproduced. Such inequities become institutionalised through systems intended to measure scientific achievement.

Bibliometric literature has revealed that structural inequalities—particularly gendered and geopolitical biases—systematically privilege male, Western scholars in global science (Demeter & Toth, 2020; Halevi, 2019; Larivière et al., 2013; Mendonça et al., 2018), consolidating their status as dominant "cognitive authorities" (Wilson, 1983). This critical scholarship draws on the constructivist turn in science studies, which challenges assumptions about the neutrality of scientific knowledge production.

A central critique is the problematic equation of citations with research quality (Dahler-Larsen, 2019). The widespread use of indicators in evaluation has generated concern about their misuse, catalysing a "professional reform movement" that advocates for responsible metrics (Rushforth & Hammarfelt, 2023). The literature reviewed by de Rijcke et al. (2016) shows that once citations become evaluation tools, they help produce the very prestige they claim to measure, introducing a reflexive dynamic that complicates their use as neutral indicators. Such reflexive concerns are not new to the field. As discussed in Section 2.1, long before the emergence of responsible metrics, bibliometricians had already grappled with these tensions by integrating qualitative methods and sociological theory.

The reflexive turn in bibliometrics parallels broader shifts in the organisation of science itself, illuminating changing modalities of knowledge production. These transformations are articulated in *The new production of knowledge* (Gibbons et al., 1994), which distinguishes between "Mode 1" and "Mode 2" research. Mode 1 science is characterised by discipline-based, hierarchical structures focused on foundational principles and insulated within established academic boundaries. In

contrast, Mode 2 research is context-driven, problem-focused, and methodologically pluralistic, emerging "in the context of application" (Gibbons et al., 1994, p. 4). Knowledge production increasingly involves heterogeneous teams that cross disciplinary and institutional boundaries, engaging not only scientists but also governmental bodies, industries, and civil-society actors. In this context, bibliometric approaches have been proposed as a means of tracing patterns associated with Mode 2 knowledge production, particularly in interdisciplinary and transdisciplinary research domains (Kajikawa, 2022).

Concepts such as scientific trading (Leydesdorff et al., 1994; Rafols et al., 2010) treat citations as symbolic exchanges among disciplines, making it possible to map interdisciplinary flows of influence and legitimation empirically. Similarly, the notion of symbolic capitalism (Cronin, 2005; Gingras, 2010) reframes bibliometric indicators as instruments through which prestige, credibility, and authority circulate within an economy of reputation. Alternative metrics, including social-media-based indicators, diversify the currencies of recognition by foregrounding visibility and forms of social engagement alongside citation-based impact (Costas et al., 2017; Desrochers et al., 2018; Priem, 2014). These concepts collectively reframe bibliometric indicators as infrastructures through which symbolic capital circulates, rather than as technical measurement devices. Bibliometric infrastructures have, in this sense, become constitutive of the knowledge systems they purport to measure, actively structuring which collaborations form, which contributions gain legitimacy, and which hierarchies stabilise across disciplines and institutions. Understanding how such dynamics are articulated and stabilised through scholarly communication requires examining a field in which they are especially visible. Sustainability science is such a field—not because these dynamics are unique to it, but because its explicit commitments to interdisciplinary collaboration, societal relevance, and epistemic pluralism render them analytically prominent.

3. Sustainability Science

Sustainability science emerged in response to urgent challenges of global environmental change, social inequality, and economic development (Clark, 2007). The Brundtland Commission's report *Our common future* established the conceptual basis for the field by defining sustainable development as the process of reconciling present-day needs with the long-term interests of future generations (World Commission on Environment and Development, 1987). This framing repositioned sustainability from a technocratic concern to a fundamental rearticulation of societal goals across economic, social, and ecological dimensions, thereby demanding new integrative approaches to scientific inquiry. Building on this agenda, sustainability science has been articulated as a problem-defined field concerned with understanding interactions between nature and society while also advancing knowledge that is usable in practice (Clark, 2007; Kates et al., 2001).

The formation of sustainability science reflects a broader epistemological commitment to transformative change through mutual learning and stakeholder engagement (Clark & Harley, 2020; Lang et al., 2012; Spangenberg, 2011). Unlike traditional disciplines, it is explicitly problem-defined and oriented towards generating actionable knowledge that bridges theory and practice (Cash et al., 2003). This applied, use-inspired orientation has shaped both the field's intellectual development and its strategies for establishing credibility within academic institutions. From a bibliometric perspective, the consolidation of sustainability science as a recognisable community is relatively recent, shaped by rapid growth in publication output and by increasing cohesion in collaboration (co-authorship) networks (Bettencourt & Kaur, 2011).

These dynamics make terminological choices consequential. While the literature sometimes uses *sustainability science*, *sustainability research*, and *sustainability studies* interchangeably, this thesis treats them as analytical labels with different scopes and uses the distinctions to clarify what is being mapped and compared. *Sustainability research* refers broadly to scholarly work addressing environmental, social, and economic aspects of sustainability across disciplines and institutional contexts. *Sustainability science*, by contrast, designates a more recent, self-organised epistemic project integrating these strands into a coherent, problem-oriented field with explicit commitments to transdisciplinarity and societal relevance (Bettencourt & Kaur, 2011; Kates et al., 2001). As Bautista-Puig et al. (2021) emphasised, it remains a field in formation, oriented towards bridging science and society through collaborative, solution-focused inquiry.

The term *sustainability studies* is sometimes used—most notably by Wood (2011)—to describe broader educational and intellectual spaces, often rooted in the humanities or liberal arts. While several universities have adopted this label for academic programmes, it appears less consistently in bibliometric research. A notable exception is Ellili (2024), whose large-scale analysis employs *sustainability studies* as a field label, underscoring the ongoing terminological ambiguity surrounding this domain.

In this thesis, *sustainability science* is adopted as the primary analytical category. Bibliometric analysis requires identifiable institutional structures—such as dedicated journals, research centres, and professional societies—through which recognition and authority circulate. As the most widely operationalised term in bibliometric research (discussed in Section 3.3), *sustainability science* provides the clearest boundaries for tracing epistemic commitments, publication patterns, and mechanisms of authority. This strategic choice enables field-theoretical analysis without implying intellectual superiority over alternative framings.

Rather than tracing a comprehensive intellectual history, this chapter reconstructs sustainability science by examining its epistemic self-descriptions, institutional trajectories, and bibliometric mapping. By analysing the field's self-understanding as a form of strategic positioning within academic and policy arenas, this chapter establishes the empirical basis for the field-theoretical framework developed in Chapter 4.

3.1 Epistemic Reorientation, Post-Normal Science, and Methodological Pluralism

The epistemological self-understanding of sustainability science rests on a fundamental reorientation of scientific practice. Conventional models of normal science—emphasising predictive certainty, objectivity, and disciplinary reductionism—are widely regarded as inadequate for addressing sustainability's "wicked problems", characterised by deep uncertainty, contested values, high stakes, and urgent decision-making (Gold et al., 2018; Kerekes, 2023; Ravetz, 2018). These conditions strain disciplinary specialisation and undermine the assumption that complex socio-ecological systems can be governed through linear prediction and technical optimisation alone.

Post-normal science (PNS), as developed by Funtowicz and Ravetz (1993), provides a widely used vocabulary for this reorientation. PNS designates situations

in which “facts are uncertain, values in dispute, stakes high, and decisions urgent” (Funtowicz & Ravetz, 1993, p. 744). Sustainability challenges in environmental governance often exemplify these conditions, and sustainability science is frequently situated in contexts where these post-normal conditions complicate conventional quality assurance (Ravetz, 1999). Building on this, Ravetz (2006) links PNS directly to sustainable development, suggesting that the complexity and value-laden character of sustainability problems call for alternative criteria of scientific quality and legitimacy.

One implication of post-normal science is a rethinking of how quality is secured. Rather than seeking definitive certainty, PNS emphasises robustness, reflexivity, and transparency—qualities that cannot be secured through conventional peer review alone, but require deliberation and scrutiny within extended peer communities (Ravetz, 2006). These communities incorporate practitioners, policymakers, civil society actors, and Indigenous groups alongside academic researchers, positioning participatory knowledge production as integral to scientific rigour rather than a departure from it. The precautionary principle—understood as a commitment to early action in the face of uncertainty and potential irreversibility—complements this orientation by emphasising resilience-building and adaptive governance rather than delaying intervention until definitive predictions are available (Clark & Harley, 2020; Ravetz, 2022).

At the same time, participation within extended peer communities is structured by unequal authority. Academic credentials, institutional affiliation, and access to technical language shape whose contributions are recognised as legitimate, revealing tensions between epistemic inclusion and entrenched hierarchies. As Ravetz (2006) himself acknowledged, many of the participatory and reflexive ideals associated with post-normal science remain aspirational rather than fully institutionalised—a gap that is particularly salient in sustainability science.

Post-normal science should therefore be understood not as a comprehensive framework but as one influential component of a broader epistemic repertoire. In programmatic texts and field-defining statements, sustainability science draws on multiple epistemic resources to articulate its distinctiveness: problem-driven inquiry, integration of diverse knowledge systems, commitment to transdisciplinarity, and the production of actionable knowledge (Clark & Harley, 2020; Lang et al., 2012). These resources do not merely describe scientific practice; they actively shape it by structuring which questions are prioritised, who is recognised as credible, and how expertise is evaluated. As Nagatsu et al. (2020) emphasised,

the justification of epistemic norms in sustainability science is inherently political, raising questions about who defines standards of credibility and on what grounds.

This plural epistemic orientation is reflected in sustainability science's methodological diversity. The field integrates quantitative modelling, scenario analysis, and network approaches with participatory and transdisciplinary methods that emphasise joint problem framing, collaborative knowledge production, and iterative learning (Cash et al., 2003; Lang et al., 2012). While such methodological pluralism enables engagement with complex socio-ecological systems, it also complicates efforts to establish unified standards of evaluation and quality assurance.

Beyond post-normal science, sustainability science incorporates normative and conceptual frameworks that further expand its epistemic range. Enduring debates over the meaning of sustainability itself—most notably the distinction between weak sustainability, which allows substitution between natural and other forms of capital, and strong sustainability, which emphasises the irreplaceability of critical natural capital—encapsulate deeper philosophical disagreements about human–nature relationships and obligations towards future generations (Neumayer, 2003; Wilson & Wu, 2016). These positions shape how sustainability problems are framed, which forms of knowledge are considered relevant, and what kinds of interventions are deemed legitimate.

Closely related conceptual frameworks, such as resilience and Anthropocene thinking, further structure sustainability science's epistemic orientation. Resilience conceptualises socio-ecological systems in terms of their capacity to absorb disturbance while maintaining core functions, foregrounding adaptability, nonlinearity, and transformation (Folke, 2006). Anthropocene thinking emphasises the scale, acceleration, and potential irreversibility of human impacts on Earth systems, reinforcing claims that contemporary sustainability challenges exceed the scope of conventional disciplinary science (Steffen et al., 2011). These are two prominent examples drawn from the conceptual repertoire through which sustainability science articulates the urgency of its agenda and the rationale for methodological pluralism. As Clark and Harley (2020) argue, questions of what counts as relevant knowledge, which societal goals should be prioritised, and how trade-offs are evaluated cannot be separated from scientific inquiry itself. Normative reflexivity thus becomes a constitutive feature of the field's epistemic identity, reinforcing a move towards plural standards of rigour and legitimacy.

3.2 Institutionalisation and the Formation of Field Identity

While sustainability science's epistemic orientation emphasises pluralism, reflexivity, and transdisciplinarity, its consolidation as a scholarly domain depends on institutional processes that stabilise, reward, and reproduce particular forms of knowledge. Sustainability science was established as a response to urgent and complex challenges—such as climate change mitigation, biodiversity conservation, and environmental justice—and underpinned by claims that participatory and adaptive approaches are necessary under conditions of uncertainty and contested values. These justifications support the field's claim to autonomous institutional space, including dedicated journals, research centres, degree programmes, and professional societies, rather than remaining subsumed within established disciplines such as environmental science or ecology (Yarime et al., 2012).

Institutionalisation is not merely a process of stabilisation but a process through which scientific authority and reputational control are selectively distributed (Whitley, 2000). The creation of journals, research centres, and professional associations establishes formal sites of recognition that privilege certain research agendas, methods, and problem framings while marginalising others. Understanding how sustainability science has achieved institutional standing therefore requires examining not only which intellectual programmes have succeeded, but also how recognition and resources become concentrated within particular organisational configurations.

In the literature, the rise of sustainability science is frequently interpreted as part of broader transformations in scientific practice and institutional organisation associated with changing societal expectations and modes of knowledge production (Cash et al., 2003; Gibbons et al., 1994). These transformations enable interdisciplinary and transdisciplinary work while simultaneously embedding such work within established academic evaluation structures.

This tension becomes particularly visible in sustainability science's institutional development. The field's integration of perspectives from the natural sciences, the social sciences, the humanities, and Indigenous knowledge systems reflects both intellectual ambition and strategic positioning, as institutional credibility depends on demonstrating the capacity to transcend disciplinary boundaries while remaining legible to evaluation regimes rooted in disciplinary standards.

Field identity is further shaped by internal differentiation. As Clark and Harley (2020) emphasised, sustainability science comprises multiple research programmes, schools of thought, and specialised domains, each characterised by distinct terminologies, conceptual frameworks, and methodological preferences. While interdisciplinary initiatives have driven much of the field's growth, integration remains partial. Fragmentation reflects not merely intellectual pluralism but, following Whitley (2000), struggles over influence within field formation: research programmes embedded in more powerful organisational and reputational structures are better positioned to shape discourse priorities, attract resources, and define what counts as legitimate sustainability science.

Sustainability science exhibits many characteristics associated with Mode 2 knowledge production—context-driven, transdisciplinary research conducted within established academic institutions (Gibbons et al., 1994; Wiek et al., 2012). This dual positioning generates persistent tensions between rigour and relevance, as well as between disciplinary depth and transdisciplinary breadth. These tensions are mediated through concrete institutional mechanisms (Whitley, 2000). Journal editorial boards, for instance, act as gatekeepers by privileging particular methods and problem framings. Funding agencies develop research agendas by issuing strategic calls designed to promote specific types of collaboration and measurable impact. Doctoral training programmes reproduce epistemic norms by socialising early-career researchers into methodological and theoretical traditions. University tenure and promotion criteria translate field-level dynamics into individual career incentives, rewarding specific forms of scholarship.

External actors, such as policymakers and funding bodies, exert significant influence over research priorities, often directing attention towards actionable, near-term solutions for urgent problems such as climate change mitigation (Guston, 2001; Leydesdorff, 1997). While such responsiveness enhances societal relevance, it also introduces risks to epistemic autonomy.

These institutional dynamics position sustainability science as a Mode 2–type field, in which epistemic pluralism, normative reflexivity, and transdisciplinarity are continuously negotiated within organisational and evaluative structures.

3.3 Mapping the Field: Bibliometric Perspectives on Sustainability Science

The emergence of sustainability science reflects how scientific fields consolidate intellectual authority. As Sugimoto and Weingart (2015) highlighted, accounts of field formation often rely on narrative histories that foreground pivotal figures, landmark conferences, foundational journals, and forms of institutional recognition. In sustainability science, for instance, one prominent origin story invokes the Brundtland Commission's *Our common future* as a foundational reference point (World Commission on Environment and Development, 1987). At the same time, the field's institutional consolidation occurred later and drew on multiple antecedents. Sustainability science also exemplifies what Sugimoto and Weingart (2015) term a Zeitgeist-born field, emerging in response to urgent global concerns such as climate change and social inequality (Burger et al., 2012). Yet its consolidation has involved complex processes of resource mobilisation and struggles over epistemic authority that extend beyond these founding narratives.

Bibliometric research has played a role in documenting—and in important respects helping to constitute—sustainability science's consolidation. By establishing categories, identifying core journals, and mapping citation networks, bibliometric studies do not merely observe the field's structure; they actively participate in defining its boundaries and hierarchies. Classification itself is constitutive of field formation. Deciding which journals count as "sustainability science", which citations indicate "field coherence", and which collaboration patterns signal "interdisciplinary integration" stabilises particular understandings of the field and renders them actionable. This reflexive dimension—that classifications may help construct the field they purport to analyse—often remains implicit, yet is central to how scientific authority becomes institutionalised. The following studies illustrate how such classificatory choices have been operationalised in empirical mappings of sustainability science.

Kajikawa and colleagues' series of studies mapped the field's thematic clusters and their fragmentation, proposed conceptual frameworks, tracked emerging thematic hubs (including socio-technical transitions), and examined how specific journals contributed to field coherence (Kajikawa, 2008; Kajikawa et al., 2007; Kajikawa et al., 2017; Kajikawa et al., 2014). This body of work highlights the role of editorial decisions, funding dynamics, and institutional affiliations in shaping cohesion within the field. Bettencourt and Kaur (2011) offer a complementary macro-scale perspective, arguing that sustainability science underwent a "phase transition" around 2000, when previously fragmented communities formed a

dense global collaboration network—interpreted as evidence of increasing interdisciplinary consolidation.

Subsequent studies have refined and extended these insights. For instance, Bautista-Puig et al. (2021) introduced a journal-level taxonomy based on citation flows, using the Green and Sustainable Science and Technology category of Web of Science. Their classification—dividing journals into specialised, importer, exporter, and interdisciplinary types—revealed that the field remains dominated by specialised and multidisciplinary outlets, while integrative venues, though fewer, show greater longitudinal stability.

In a complementary approach, Buter and Van Raan (2013) identified a Highly Cited Knowledge Base (HCKB)—that is, a set of highly cited publications taken to constitute sustainability science's core literature. This corpus showed a strong emphasis on environmental and economic themes, with comparatively limited representation of social dimensions. Such an imbalance complicates the field's claims to balanced interdisciplinarity and inclusivity.

Further studies have highlighted conceptual and geographical heterogeneity. Vanhulst and Zaccai (2016) demonstrated that Latin American traditions foreground social justice and Indigenous knowledge more than dominant Global North frameworks, while Geissdoerfer et al. (2017) identified tensions between sustainability and circular economy framings, especially in relation to economic efficiency narratives. These insights reveal that interdisciplinarity is not merely a technical achievement, but a contested and uneven process shaped by global knowledge hierarchies.

Adding a more contemporary, large-scale perspective, Ellili (2024) conducted a bibliometric analysis of over 20,000 Scopus-indexed documents from 2000 to 2022. The study confirmed continued growth in the field and the persistent dominance of environmental over social themes. Ellili also employed the label "sustainability studies" in the analysis, adding further terminological ambiguity to the evolving discourse.

Kassab et al. (2020) found little correlation between altmetrics and expert assessments of societal relevance, highlighting challenges in quantifying impact for mission-oriented fields, while Liu et al. (2021) used topic modelling to identify emerging research frontiers, exemplifying how bibliometric methods shape visibility of certain knowledge trajectories through their classificatory frameworks.

Across this literature, several patterns recur: (1) a persistent thematic imbalance favouring environmental and economic dimensions over social concerns (Buter

& Van Raan, 2013; Ellili, 2024); (2) geographic concentration in the Global North (Ellili, 2024; Vanhulst & Zaccai, 2016); (3) journal hierarchies dominated by specialised venues alongside fewer but more stable integrative outlets (Bautista-Puig et al., 2021); and (4) marked stratification in citation patterns (Bettencourt & Kaur, 2011; Kajikawa et al., 2017). Several of these patterns are examined empirically in the articles comprising this thesis, though through different datasets, analytical lenses, and levels of aggregation.

These bibliometric studies effectively document recurring structural patterns—such as thematic evolution, citation flows, collaborative networks, and journal hierarchies—yet bibliometric mappings are typically better suited to describing such regularities than to specifying the mechanisms that generate them. They render visible what is captured in publication records, but offer more limited leverage for explaining why certain research programmes accumulate disproportionate recognition, how journal hierarchies become naturalised, or through which processes epistemic authority is conferred and contested.

3.4 From Epistemic Dynamics to Symbolic Power

Bibliometric research is well suited to revealing stratification in publications, journals, and collaboration networks, but less well suited, on its own, to explaining how authority, credibility, and recognition become stabilised within a field. This requires examining not only which research programmes, venues, or actors achieve prominence, but how such prominence is produced and naturalised through institutional arrangements. From this perspective, patterns of recognition are not simply outcomes of intellectual merit, but are shaped by structured processes of evaluation, gatekeeping, and resource allocation. Scientific fields are arenas of struggle in which actors compete over symbolic power, evaluative authority, and control over the criteria of legitimacy (Bourdieu, 2004). Hierarchies of recognition are therefore inseparable from the institutional conditions through which they are generated and reproduced.

Chapter 4 establishes a theoretical framework that integrates a reflexive approach to bibliometrics with field theory to address this gap. Where bibliometric methods identify patterned distributions of visibility and recognition, field theory provides conceptual tools for analysing how these distributions emerge, persist, and acquire legitimacy over time. Bringing these approaches together makes it possible

to understand the consolidation of sustainability science as a social process through which epistemic authority becomes institutionalised.

4. Theoretical Framework

Sustainability science is examined here as an emerging field—a contested social space in which authority, legitimacy, and evaluative criteria are continuously produced. I analyse this emergence through Pierre Bourdieu's theory of fields, which conceptualises science as a structured arena of struggle over the accumulation and conversion of capital, and over the power to define what counts as valid knowledge (Bourdieu, 2000). Rather than displacing cognitive accounts of disciplinary development, this approach operates at a different analytical level: it specifies how recognition is organised, how evaluation systems stabilise epistemic authority through means beyond intellectual content alone.

The present study traces how recognition and gatekeeping operate through journals, citation patterns, editorial discourse, and board-level governance. Such analysis requires an explicit account of how symbolic capital becomes recursively embedded (through self-reinforcing feedback) in institutions, rather than treating institutionalisation as an endpoint. For that purpose, I introduce the Symbolic Capital Institutionalisation Model (SCIM): a process-oriented synthesis that organises Bourdieusian concepts into an analytic sequence distinguishing pre-institutional emergence from post-institutional reproduction. SCIM was developed through the empirical investigations that inform this thesis.

I do not claim orthodoxy in my application of Bourdieu. As Seldén writes—referring to the different context of adapting Bourdieu's work to information-seeking research—there is "no intended heresy in the constructions, but there is no promise of orthodoxy either" (Seldén, 2004, p. 279). I proceed in that spirit, drawing on Bourdieu's relational sociology while integrating Frickel and Gross's (2005) theory of scientific/intellectual movements to better account for how heterodox fields emerge and institutionalise.

This chapter establishes a field-theoretical framework for analysing how epistemic authority and recognition are produced, stabilised, and reproduced in sustainability science. It first situates Bourdieu's theory of scientific fields in relation to systems theory and science and technology studies. It then establishes reflexivity as a methodological requirement for studying evaluative infrastructures—such as bibliometric indicators—that are themselves part of the field under analysis. Building on this foundation, the chapter reconstructs key Bourdieusian concepts as mechanisms of recognition, consecration, and reproduction, culminating in SCIM.

4.1 Field Theory and Its Distinctive Contribution

Bourdieu's (1975) field theory conceptualises science as a competitive, relational space structured by unequal distributions of capital—economic, cultural, social, and symbolic. In this view, scientific consensus is not a neutral starting point but an outcome of struggles over recognition and the authority to define legitimate knowledge. Scientists' roles are shaped by their access to resources, with recognition centralised through journals, citation networks, and affiliations. The field is thus not a neutral backdrop but a generative structure that shapes which contributions are recognised, which methods are legitimated, and which venues are treated as authoritative (Bourdieu, 2000). Field theory provides tools for analysing how such fields negotiate legitimacy through the accumulation and conversion of capital, and through struggles over who holds the authority to define valid research. These dynamics are central to the empirical studies in this thesis, which examine how sustainability science's authority is mediated through journal hierarchies, citation-based recognition, editorial discourse, and the gatekeeping practices of editorial boards.

The term *gatekeeping* is used throughout this thesis in a structural sense derived from Bourdieu's field theory, referring to the positional authority through which access to recognition and legitimate field membership is regulated. Bourdieu himself employs the term *gatekeepers* to describe agents who guard the boundaries of fields of cultural production, controlling what is admitted and what is excluded (Bourdieu, 2020, p. 296). This structural–positional understanding differs from the processual model of gatekeeping developed within media and communication studies (Shoemaker & Vos, 2009), which focuses on how information is selected, rejected, or transformed as it passes through decision points in communication channels (for a discussion from an informetric perspective, see also Gunnarsson Lorentzen, 2016). Rather than analysing selection as a sequence of decisions, the present study examines how the capacity to perform such selections is itself unequally distributed and institutionally stabilised—focusing on the distribution and concentration of gatekeeping positions through which recognition and legitimacy are differentially allocated.

While field theory provides a structured account of scientific authority and hierarchy, it is one of several approaches to understanding how knowledge production is organised. Systems theory and science and technology studies (STS)—particularly Actor–Network Theory (ANT)—offer influential alternatives that illuminate important dimensions of scientific practice. However, they offer less explanatory leverage for understanding how hierarchies of credibility and

institutionalised authority are produced and reproduced over time—especially in fields whose epistemic and normative commitments unsettle established disciplinary criteria.

ANT, a dominant current within STS, focuses on how knowledge is assembled through networks of human and nonhuman actors (Callon et al., 1986; Latour, 2005). Its commitment to generalised symmetry and contingency provides valuable tools for tracing how facts are stabilised in practice (Sismondo, 2011). Yet this same orientation can make enduring structural differences harder to capture. ANT is therefore less well equipped to explain how credibility becomes concentrated, how institutional authority persists and consolidates over time, or how evaluative mechanisms become self-reproducing. Following actors through networks can illuminate local negotiations, while leaving the durability of the constraints that structure those negotiations comparatively underspecified.

Systems-theoretical approaches, especially Luhmann's formulation, conceptualise science as a functionally differentiated subsystem governed by the binary code of true/false (Luhmann, 1995). This approach provides rigorous models of the recursive nature of scientific communication and differentiation (Leydesdorff, 2021), but it offers a thinner account of stratification: why some actors and institutions can impose definitions of quality more effectively than others remains analytically secondary. The question of who defines what counts as true—and through what mechanisms such definitions become durable—falls outside the framework's explanatory scope.

Bourdieu's field theory views science as a structured arena of competition in which actors struggle over symbolic capital and access to consecrating institutions such as journals, editorial boards, and citation systems (Bourdieu, 2000). The theory acknowledges contingency and heterogeneity while specifying the processes through which hierarchies are produced and reproduced. It also provides analytical traction for a phenomenon central to this thesis: how fields that articulate heterodox commitments to transformation nonetheless reproduce orthodox structures of recognition—the transformation paradox that characterises sustainability science's institutionalisation.

At the same time, field theory's emphasis on structural reproduction can understate the role of collective action, innovation, and contestation in scientific change. Frickel and Gross (2005) propose a general theory of scientific/intellectual movements to account for the emergence of organised, purposive groups that challenge dominant paradigms and reshape field structures from within. This per-

spective complements rather than contradicts field theory by specifying the agentic mechanisms through which heterodox actors gain footholds, while field theory explains why such mobilisation tends to generate new hierarchies even as it challenges existing ones. SCIM, developed in Section 4.9, integrates these perspectives by distinguishing two phases of field development: it draws on the scientific/intellectual movements literature to theorise pre-institutional emergence and mobilisation, and applies field-theoretic mechanisms to explain how consecration becomes self-referential once institutionalisation thresholds are crossed. This process operates across multiple analytical levels. Micro-level decisions—such as where to submit, whom to cite, or whom to collaborate with—aggregate into meso-level patterns, including journal hierarchies, peer-review norms, and editorial gatekeeping, which in turn stabilise macro-level structures of recognition and inequality. The empirical studies in this thesis draw on such traces—citations, journals, editorial texts, and editorial board structures—to reconstruct how authority is organised in sustainability science.

4.2 Reflexivity as Epistemic Foundation

Bourdieu's (1988, 2004) reflexive sociology insists that scholarly analysis must systematically examine how its own categories, methods, and evaluative tools are shaped by the same power relations they seek to explain. Reflexivity is therefore an epistemic requirement for studying scientific fields. This requirement is particularly salient in research that relies on evaluative and classificatory instruments such as citations, journal rankings, and bibliometric indicators, which are themselves structured by hierarchical relations (Cronin, 2005; Hammarfelt & Rushforth, 2017; Wouters, 1999). A reflexive stance guards against the naturalisation of these hierarchies—particularly the distinctions stabilised through evaluative and classificatory infrastructures. Apparent merit-based differentiation may reflect accumulated structural advantages rather than intrinsic differences in epistemic contribution. Ostensibly neutral indicators, meanwhile, can embed historically contingent evaluative norms and institutional priorities rather than universal ones (Dahler-Larsen, 2019). Treating bibliometric indicators as objects of analysis rather than transparent measures makes it possible to examine how evaluative infrastructures actively shape the distribution of recognition within a field (de Rijcke et al., 2016).

In this thesis, reflexivity functions as a conceptual bridge between empirical mapping and theoretical explanation. It ensures that bibliometric patterns—such as

citation stratification, journal hierarchies, and concentration of visibility—are interpreted not as direct reflections of epistemic quality but as outcomes of social processes through which authority is produced and stabilised.

4.3 Capital, Conversion, and Hierarchy in Scientific Fields

Unequal distributions of capital organise scientific fields, influencing individuals' positions and their potential to gain recognition (Bourdieu, 1986). Economic capital refers to resources such as funding, infrastructure, and equipment. Cultural capital exists in embodied (methodological competencies, theoretical expertise), objectified (books, datasets, instruments), and institutionalised (credentials, titles) forms (Bourdieu, 2020). Social capital consists of networks that provide access to resources and recognition, with value dependent on the volume and composition of capital held by one's connections. Symbolic capital refers to resources such as prestige, which are perceived as inherent attributes of individuals or institutions, though they actually arise from relational social structures (Bourdieu, 1979).

Within scientific fields, symbolic capital occupies a privileged position (Bourdieu, 1975). It functions as the primary medium through which other forms of capital acquire efficacy. Economic resources enable research, but without symbolic recognition, findings may remain marginal. Cultural competencies equip scholars with skills and expertise, yet these do not necessarily translate into authority without recognition by established evaluative institutions. What distinguishes scientific fields from domains where economic or political power operates more directly is precisely this requirement that recognition be symbolically mediated.

Bourdieu (1975, 2004) uses the term *scientific capital* to designate the field-specific form of symbolic capital operating within science—the authority and credibility derived from peer recognition, citation visibility, editorial influence, and institutional prestige. This thesis, however, retains the broader term *symbolic capital* for two reasons. First, the concept of symbolic capital more directly captures the focus on recognition, consecration, and prestige that structures the empirical analyses presented here. Second, and more importantly, this thesis develops the concept of *objectified symbolic capital*—capital materialised in durable institutional forms such as journals and editorial structures (see Section 4.8).

The conversion of capital follows field-specific logics shaped by historical struggles over legitimate practice (Bourdieu, 1975). In relatively autonomous scientific fields, economic capital converts into symbolic capital only through extended processes of peer review, publication, and evaluation. In more heteronomous contexts, external resources may translate more directly into recognition. These exchange rates are not fixed: bibliometric evaluation has altered how publication volume converts into symbolic recognition (de Rijcke et al., 2016), while international collaboration has reshaped how social capital translates into research opportunities (Leydesdorff & Wagner, 2008).

4.4 Mechanisms of Consecration and Recognition

Consecration is a fundamental mechanism through which symbolic capital is generated and distributed within scientific fields (Bourdieu, 1993, pp. 55–61; 2008). It encompasses the ensemble of practices through which certain contributions are marked as valuable—peer-review judgements, citation decisions, editorial selections, awards, and academic appointments. Each act of consecration derives its efficacy not from intrinsic authority, but from the accumulated symbolic capital of the agents or institutions that perform it.

This reveals consecration's recursive structure: effective acts of consecration presuppose prior consecration. Prestigious journals confer value on manuscripts because they have themselves been consecrated through long histories of selective publication and citation accumulation. Established scholars consecrate junior researchers because they possess recognised authority that can be transferred. This circularity helps explain how hierarchies of recognition stabilise and reproduce themselves over time.

Processes of consecration unfold across distinct temporal cycles (Bourdieu, 1985; Bourdieu et al., 1991). Some forms of recognition are fleeting, whereas others accumulate over longer periods, becoming durable and, in some cases, canonical. These temporal dynamics vary across fields: rapidly evolving domains compress cycles of recognition, whereas more stable fields may require decades for consecration to take hold.

Central to consecration's effectiveness is *misrecognition*—the collective forgetting of the social conditions through which symbolic capital is produced (Bourdieu, 1991a). Prestige comes to appear as an intrinsic property of the work itself rather than as an effect of the journal's accumulated symbolic capital. Recognition is thus experienced as the outcome of individual merit rather than as the product

of structurally unequal positions within the field. This misrecognition is not a cognitive error but a practical belief embedded in *habitus*—the system of durable dispositions through which agents perceive, evaluate, and act within the field (Bourdieu, 2020). Through habitus, researchers genuinely experience consecrated work as valuable even as the social mechanisms producing that value remain obscured.

4.5 The Structures of Reproduction

Agents reproduce scientific fields through *illusio*—the embodied belief that the field's stakes are worth pursuing (Bourdieu, 1990, 1998). Publication, citation, and recognition come to matter not primarily through rational calculation but through prolonged immersion in academic practice. This investment varies systematically by position: dominant agents, whose careers have been shaped by existing rules, tend to exhibit strong illusio and a stake in preserving field structures; marginal agents may perceive the game's arbitrariness more clearly, yet remain bound by the practical necessity of playing it.

Beneath explicit rules and evaluative criteria lies *doxa*—the taken-for-granted assumptions that structure perception and practice within the field (Bourdieu, 1977, 2000). Doxa defines what is self-evident and beyond justification, including accepted standards of rigour, implicit hierarchies of worth, and naturalised disciplinary boundaries. Under conditions of doxa, what counts as "good science" is rarely debated at the level of first principles—evaluative criteria such as journal prestige or citation impact may function as self-evident measures of quality rather than as conventions open to contestation.

When fields undergo rapid transformation—through technological change, institutional reform, or shifts in evaluation regimes—a temporal mismatch can emerge between actors' dispositions and new conditions of practice. Bourdieu terms this *hysteresis* (Bourdieu, 1977, 2000). Such lags generate both tension and opportunity, as established actors may experience capital devaluation while newer entrants align more readily with emerging structures. Bourdieu's (1988) analysis of French higher education around May 1968 illustrates this dynamic, showing how established academics experienced a devaluation of their accumulated capital as the institutional conditions of the field shifted abruptly.

Field reproduction ultimately depends on *symbolic power*—a form of domination operating through the tacit consent of those subject to it (Bourdieu, 1989, 1991a).

Through repeated exposure to field hierarchies, actors acquire dispositions attuned to their positions, learning to recognise prestige as legitimate and excellence as naturally associated with dominant institutions. Symbolic power manifests in deference to elite venues, anticipatory self-censorship that discourages submission to high-status journals, and the tendency to interpret rejection as personal inadequacy rather than as an effect of structural asymmetries embedded in field positions.

4.6 Struggles for Transformation: Heterodoxy and Heresy

Even within reproductive dynamics, scientific fields retain space for transformation through the dialectic of *orthodoxy* and *heterodoxy* (Bourdieu, 1977; Bourdieu, 1993). Orthodoxy denotes the dominant vision of the field: established classifications, recognised methodologies, and accepted evaluative frameworks sustained through institutional power and doxic assumptions. Heterodoxy, by contrast, comprises positions and discourses that explicitly challenge these principles, rendering visible what orthodoxy treats as self-evident and proposing alternative definitions of legitimate knowledge and authority.

Such struggles are structured by the unequal distribution of capital. Agents with limited standing often perceive the field's arbitrariness more clearly but lack the symbolic capital required to make heterodox alternatives credible. Conversely, agents occupying dominant positions possess the authority to define legitimacy but are strongly invested in preserving existing arrangements. Dissenting challenges tend to be most effective when advanced by actors at the intersection of inclusion and marginality—those who have accumulated enough capital to be taken seriously, while remaining sufficiently distant from the centre of power to question its foundations (Bourdieu, 1988; Frickel & Gross, 2005).

These struggles are enacted through differentiated strategies that reflect agents' positions within the field. *Conservation strategies*, typically deployed by capital-rich agents, aim to preserve existing hierarchies by defending dominant methodologies, reinforcing disciplinary boundaries, and maintaining established journal and evaluation hierarchies. *Subversion strategies*, more often adopted by challengers seeking upward mobility or field redefinition, contest these hierarchies by promoting alternative methods, legitimating new objects of inquiry, founding new venues, or proposing novel evaluative criteria (Bourdieu, 1993). Such strategies

do not operate outside the field's logic but seek to transform it from within by reshaping the criteria through which legitimacy is allocated.

When heterodox strategies become coordinated and collectively sustained, they take on a movement-like character. From the perspective of *scientific/intellectual movements*, field transformation is understood less as a purely cognitive rupture than as an organised process of contestation and institutional construction (Frickel & Gross, 2005). Unlike Kuhnian paradigm shifts, which emphasise theoretical replacement within established disciplinary frameworks (Kuhn, 1970), this perspective foregrounds collective mobilisation, struggles over recognition, and the creation of alternative infrastructures of publication, evaluation, and training. New fields emerge not solely through epistemic innovation, but through sustained efforts to stabilise heterodox claims by translating them into durable institutional forms.

4.7 The Autonomy–Heteronomy Axis

Scientific fields exist in tension between *autonomous* and *heteronomous* principles of hierarchisation (Bourdieu, 2004). The autonomous principle derives from internal criteria of valuation—peer recognition, disciplinary standards, and theoretical or methodological sophistication (Bourdieu, 1993, 1996). The heteronomous principle reflects external forces, including political priorities, economic demands, policy relevance, and media visibility. Every scientific field occupies a position along this autonomy–heteronomy axis, which shapes how capital circulates and how recognition is allocated.

In relatively autonomous fields, symbolic capital accumulates primarily through peer-validated achievement. Whitley (2000) offers a complementary account, arguing that scientific work depends on relations of mutual dependency among scientists in the conduct and evaluation of research. Publication venues are hierarchised by disciplinary prestige, careers advance through recognition by colleagues, and research trajectories follow largely internal intellectual logics. In more heteronomous fields, symbolic capital is negotiated across multiple valuation regimes. External funding, demonstrable societal impact, or policy influence may function as sources of recognition, while media visibility or stakeholder relevance can partially substitute for peer consecration.

A field's position on the autonomy–heteronomy axis conditions the conversion of capital. Autonomous fields regulate conversion through peer-controlled mechanisms, whereas heteronomous fields allow a more direct translation of external

resources into symbolic recognition. This generates strategic dilemmas for researchers: publicly accessible or policy-oriented outputs may enhance heteronomous standing while diminishing autonomous prestige; theoretical sophistication may strengthen peer recognition while limiting funding opportunities; engagement with external stakeholders may increase visibility at the cost of disciplinary authority.

These dynamics also shape how symbolic capital becomes institutionalised. In autonomous fields, authority concentrates in peer-controlled structures such as editorial boards, learned societies, and professional associations. In heteronomous fields, external actors exert greater influence through funding priorities, evaluation frameworks, and governance regimes. Editorial boards constitute a central site where this gatekeeping function becomes visible, as symbolic authority is exercised and negotiated at the intersection of autonomous and heteronomous principles of valuation—a dynamic examined empirically in Article IV of this thesis.

4.8 Objectified Symbolic Capital

Symbolic capital attains its most durable form when it becomes objectified—that is, embedded in institutional infrastructures that outlast individual careers and short-term struggles for recognition (Bourdieu, 1986, 1988). Prestige sediments into relatively stable entities such as journals, departments, professional associations, ranking systems, and evaluation platforms. Once objectified, symbolic capital no longer depends on the continuous presence or performance of particular actors, but persists through institutional continuity.

Prestigious journals provide a paradigmatic example. Their authority is not reducible to the merit of any single publication; it derives instead from standing accumulated through editorial selectivity, citation density, and disciplinary centrality. This symbolic capital becomes available to subsequent contributors, who benefit from the journal's status even if they did not contribute to building it. Similar dynamics operate in elite departments and research centres, where reputational advantages are transmitted across cohorts through institutional affiliation rather than recreated anew by each generation.

Objectified symbolic capital exhibits strong path dependence. Institutions that already command recognition tend to attract submissions, citations, funding, and highly qualified researchers, reinforcing their position through cumulative and self-amplifying dynamics. These dynamics of cumulative advantage constitute

the Matthew effect, discussed in Section 2.1.2 (Merton, 1968, 1988). Conversely, newer journals and organisations face structural barriers to recognition: they must accumulate symbolic capital gradually through sustained selectivity and visibility, while competing against established actors whose advantages compound over time.

While scholars can often benefit relatively quickly from affiliation with consecrated institutions, the contribution of any single individual to an institution's overall symbolic capital is typically limited. Objectified symbolic capital therefore shapes researchers' strategic options—where to publish, whom to collaborate with, and which affiliations to pursue—by concentrating symbolic capital in already-consecrated institutions and venues. This orientation reflects practical adaptation to the field's structured distribution of recognition.

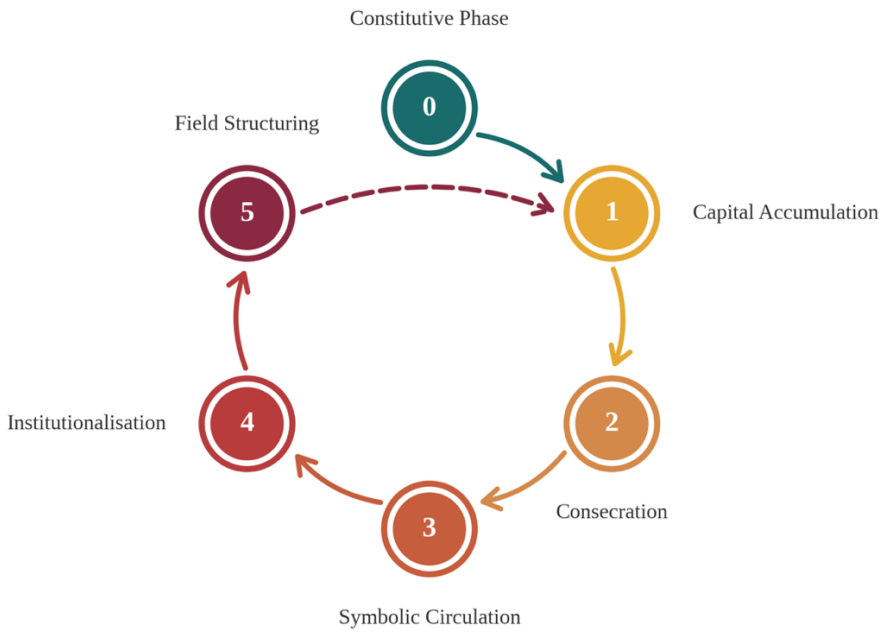
Gatekeeping positions—such as editors, editorial board members, and evaluative authorities—occupy a distinctive role within this structure. Their influence derives less from personal prestige alone than from their location within institutions endowed with accumulated symbolic capital (Bourdieu, 1990, 1991a). Through routine classificatory decisions—defining acceptable topics, methods, and standards—they participate in stabilising the evaluative categories through which recognition is allocated.

4.9 The Symbolic Capital Institutionalisation Model

SCIM unifies the concepts developed in the preceding sections within a process model that shows how symbolic capital becomes institutionalised and how recognition transforms into durable forms of authority. Institutionalisation is thus understood not as a fixed structural endpoint but as an ongoing process of symbolic accumulation and stabilisation, reproduced through practices of recognition and evaluation.

Figure 1

The Symbolic Capital Institutionalisation Model (SCIM)



Note. The model distinguishes a constitutive phase of field formation from five recursive mechanisms through which symbolic capital is reproduced and institutionalised.

SCIM is grounded in Bourdieu's field theory but draws selectively on Frickel and Gross's theory of scientific/intellectual movements (Frickel & Gross, 2005) to specify the collective mobilisation through which emerging domains secure initial recognition. This combination allows the model to distinguish two analytically distinct phases of field development.

The *Constitutive Phase* captures the period in which heterodox actors, operating under conditions of limited legitimacy, mobilise collectively to establish minimally shared arrangements of recognition. During this phase, authority remains provisional and externally dependent: emerging domains draw on imported symbolic capital, strategic alliances, and temporary evaluative arrangements rather than on fully autonomous mechanisms of consecration. As these arrangements stabilise, field dynamics shift. Recognition can increasingly be generated within

the emerging domain itself, as acts of consecration become self-referential and begin to reproduce authority internally. This marks a transition from emergence, where legitimacy is contested and partially borrowed, to reproduction, where authority is produced endogenously and sedimented institutionally. Transitions between these regimes are typically uneven and contested, with emergent domains often combining partial internal consecration with continued reliance on adjacent fields.

4.9.1 The Constitutive Phase

Intellectual novelty is rarely sufficient for field formation. This point is central to Bourdieu's sociology of science and corroborated by Bourdieu-informed studies of disciplinary emergence (Bourdieu, 2004; Gingras, 1991). New fields arise when actors positioned at the margins of established disciplines mobilise collectively to challenge prevailing classificatory schemes, articulate alternative research programmes, and secure recognition for problems and methods not fully accommodated by existing fields.

Heterodox mobilisation characterises this early stage, involving the collective contestation of dominant definitions. Because established journals, evaluative criteria, and reputational circuits are not yet fully available, early proponents must often rely on resources accumulated elsewhere. Symbolic authority is often imported from adjacent disciplines, from highly visible individuals, or from external audiences such as policy actors or funding bodies. Recognition remains fragile and contingent, with legitimacy negotiated across multiple evaluative arenas rather than secured internally. From the perspective of scientific/intellectual movements, this phase is best understood as a coordinated process of collective positioning rather than a purely cognitive rupture (Frickel & Gross, 2005). The constitutive phase concludes when such arrangements become sufficiently stabilised that recognition can be generated primarily within the emerging domain itself. This transition is typically gradual rather than abrupt, as emergent fields often combine provisional internal recognition with continued reliance on adjacent domains.

4.9.2 The Five Loops

In line with Figure 1, the Symbolic Capital Institutionalisation Model (SCIM) distinguishes a constitutive phase (Loop 0) from five recursive mechanisms—capital accumulation, consecration, symbolic circulation, institutionalisation, and

field structuring—through which symbolic capital is reproduced and stabilised once a field reaches a threshold of institutional coherence. These mechanisms operate simultaneously rather than sequentially: the output of each loop becomes an input for the others, forming a self-reinforcing structure (see Figure 1). Each loop is elaborated in the subsections that follow. While typical iterations reinforce existing hierarchies, the system also accommodates change. Heterodox actors may gain access to consecrating positions, and external disruptions can alter prevailing capital conversion rates. The pace of change, moreover, varies across levels: individual visibility can shift rapidly, whereas institutional classifications exhibit considerable inertia—a temporal asymmetry that helps account for the coexistence of stability and transformation within the same field.

Loop 1: Capital Accumulation

Capital accumulation refers to the uneven build-up of symbolic capital within the field. Actors enter with unequal volumes and compositions of economic, cultural, and social capital, which position them differentially with respect to opportunities for recognition. Economic resources enable sustained research activity; cultural capital facilitates conformity with dominant methodological and stylistic standards; and social capital provides access to prestigious collaborators and venues. Recognition therefore accumulates differentially: actors already endowed with advantageous positions are more likely to secure further recognition, while others face structural barriers regardless of the substantive merits of their work.

Loop 2: Consecration

Consecration is the mechanism through which symbolic capital is formally allocated within the field. It operates through institutionally authorised gatekeeping practices—peer review, editorial selection, invitations, prizes, and appointments—that mark certain contributions as legitimate and valuable. These acts derive their efficacy from the symbolic capital already held by the agents and institutions performing them. Consecration is therefore inherently recursive: only those already recognised can effectively confer recognition, a dynamic that contributes to the durability of hierarchical field structures.

Loop 3: Symbolic Circulation

Once recognition is conferred, symbolic capital circulates as recognised authority. It attaches to names, affiliations, journals, and research trajectories, travelling through citation practices, collaboration networks, reputational spillovers, and institutional mobility. This circulation depends on misrecognition: prestige appears

as deserved merit rather than as the outcome of accumulated structural advantages. Through symbolic circulation, authority extends beyond the original act of consecration, shaping aspirations, strategies, and perceptions of legitimacy across the field.

Loop 4: Institutionalisation

Institutionalisation refers to the stabilisation of symbolic capital in durable organisational forms. Through repeated acts of consecration and circulation, recognition becomes embedded in institutions such as journals, editorial boards, evaluation platforms, professional associations, and departmental hierarchies. Objectification is the dominant mechanism within this loop: symbolic capital is stored in institutional infrastructures that outlast individual careers and make accumulated prestige available for future appropriation. Institutionalisation standardises evaluative criteria, concentrates opportunities where prestige already resides, and generates path dependencies that constrain subsequent field development.

Loop 5: Field Structuring

Field structuring designates the feedback effect through which institutionalised symbolic capital reshapes the overall structure of the field. Prestigious institutions, venues, and positions define the classificatory schemes that organise future recognition, delimiting what counts as a legitimate contribution, appropriate methodology, and significant finding. Field structuring thus closes the recursive cycle: the conditions under which future accumulation, consecration, and circulation occur are themselves products of prior institutionalisation.

4.10 Multi-Level Structure of Field Formation

The SCIM operates across multiple analytical levels—macro-level structures, meso-level institutions, and micro-level practices—each with distinct temporalities. These dimensions are analytically distinct but empirically inseparable: field reproduction and transformation emerge from recursive feedback across all three levels. Nelhans's (2022) analysis of performance-based evaluation systems illustrates a comparable dynamic: macro-level funding models shape meso-level institutional strategies and micro-level scholarly practices, which in turn reinforce and recalibrate the evaluative regime itself.

The macro level captures the overall structure of positions shaped by how capital is distributed across a field. This includes zones of dominance and marginality, poles of autonomy and heteronomy, and boundaries with adjacent fields. Such structures become visible through aggregate patterns: citation-based networks that can be used to approximate "invisible colleges" (Crane, 1972; Zuccala, 2006), institutional hierarchies that channel resources, and geographical distributions that reflect centre–periphery relations (Kwiek, 2021). As these structures reflect the accumulation and objectification of symbolic capital over extended periods, they often change slowly, providing a relatively stable backdrop against which struggles over recognition unfold.

The meso level mediates between structural configurations and individual practices. Here, institutional arrangements—journals, editorial boards, professional associations, evaluation committees, and ranking agencies—process and distribute recognition. Meso-level mechanisms possess relative autonomy, operating according to internal logics irreducible to either macro-level capital distributions or micro-level intentions. Institutional change at this level typically unfolds over medium-term temporalities, allowing adjustment without constant instability.

At the micro level, attention turns to the practical dispositions, or habitus, through which actors navigate field structures (Bourdieu, 1977; Bourdieu, 1990). Habitus provides a "feel for the game"—an embodied sense of what is possible, legitimate, or strategically advisable—while illusio sustains investment in the field's stakes. Doxa, hysteresis, and symbolic power (Section 4.5) operate most directly at this level, shaping how actors perceive opportunities, internalise constraints, and adjust strategies. Micro-level dynamics unfold rapidly through repeated decisions about journal submissions, citation choices, and theoretical and methodological positioning.

These levels are linked through recursive feedback rather than hierarchical causation. Macro structures condition meso-level gatekeeping; meso-level decisions shape micro-level strategies; aggregated micro practices, in turn, reproduce or gradually reshape macro structures. The operation of journal prestige—an empirical focus of this thesis—illustrates this dynamic clearly: editorial decisions reshape hierarchies, submission patterns reinforce or challenge them, and the cycle repeats.

Temporal differentiation further structures these dynamics. Short-term temporalities govern immediate cycles of production and recognition, such as publication decisions, grant evaluations, and citation uptake. Medium-term temporalities op-

erate at the level of institutions, shaping the rise and decline of research programmes, shifts in editorial policies, and changing funding priorities over years or decades. Long-term temporalities structure the field more deeply, persisting across generations through durable classificatory schemes, institutional hierarchies, evaluative regimes, and habitus formed through academic socialisation and objectified in organisations. The interaction of these asynchronous dynamics generates both stability and transformation, allowing fields to change while remaining structurally recognisable over time.

Objectified symbolic capital introduces pronounced path dependency into this multi-level system. Accumulated advantages sediment into institutions, making early configurations especially influential for subsequent development. Founding journals, initial evaluation criteria, and early distributions of recognition constrain future possibilities without fully determining them. External shocks—technological change, policy interventions, funding reconfigurations—or internal contradictions can nevertheless disrupt established trajectories, particularly when heterodox actors gain access to consecrating positions.

SCIM distinguishes between a constitutive phase of pre-institutional mobilisation and a subsequent regime of institutional reproduction governed by five recursive mechanisms. Together, these explain how recognition becomes self-referential, as consecrated agents and institutions come to define the criteria through which authority is allocated. In the articles comprising this thesis, these processes are examined through complementary traces of field formation—publication and citation patterns, journal positioning, editorial discourse, and editorial board structures. Because SCIM's mechanisms are specified as field-generic processes rather than case-specific outcomes, the model's broader applicability is considered in the concluding chapter.

5. Methodology

In this thesis, I adopt a reflexive, relational, and multimethod approach to examine the formation of sustainability science as an academic field, grounded in Bourdieu's relational sociology (Bourdieu, 1991b). Scientific production is conceptualised not as an autonomous process of truth discovery but as a historically and socially embedded struggle over multiple forms of capital and their conversion into symbolic capital. I treat journal publications, editorial boards, and bibliometric data and indicators as traces of ongoing contests over legitimacy, recognition, and authority—empirical materials produced through field struggles and classificatory practices rather than transparent measures of scholarly achievement.

Epistemologically, I adopt a methodological constructivist stance while remaining agnostic about strong ontological claims. Bourdieu's concepts of field, capital, and symbolic power are used here as analytical tools for interpreting social practices rather than as descriptions of mind-independent structures. Field theory provides a relational framework for understanding academic practices as structured struggles over recognition and authority. Concepts such as capital accumulation and field structuration are therefore treated as interpretive categories, not as fixed entities existing independently of the practices through which they are produced and sustained. This epistemological orientation underpins the Symbolic Capital Institutionalisation Model (SCIM) developed in Chapter 4, where institutionalisation is conceptualised as an ongoing process of symbolic accumulation and stabilisation, rather than a settled structural endpoint.

The multimethod design of the thesis is grounded in these epistemological commitments. Following Bourdieu's argument that methods must be determined by the nature of the scientific object rather than by disciplinary convention (Bourdieu et al., 1991), I combine statistical techniques (Articles II and IV) with qualitative content analysis of bibliometrics scholarship (Article I) and journal editorials (Article III). Bibliometric and network-analytic methods map the distribution of recognition and the structure of hierarchies, while interpretive analysis reveals the discursive processes through which legitimacy is claimed and contested. This dialectical engagement between objectifying and interpretive approaches advocated by Bourdieu et al. (1991) is supported by recent work in quantitative science studies (Leydesdorff et al., 2020; Milojević, 2025).

5.1 An Integrated Research Design

The methodological framework integrates bibliometric analysis, implemented through social network analysis and geometric data analysis (SNA and GDA), and qualitative content analysis (QCA). These methods are complementary, each addressing distinct dimensions of field formation.

These three methodological families build on foundational bibliometric techniques that structure the empirical analyses. In Article II, the Journal Citation Indicator (JCI) is used as a proxy measure for symbolic capital to operationalise journal selection and hierarchisation. Descriptive bibliometric analyses of publication volumes, citation distributions, and keyword frequencies provide the baseline data from which relational and geometric analyses depart (Articles I and II). In Article IV, compositional analysis of editorial boards—examining the gender, geographical, and institutional distribution of board members—complements the network-analytic approach by mapping dimensions of inequality not captured by relational metrics alone. Co-authorship and keyword co-occurrence network visualisations generated in VOSviewer further support the mapping of intellectual and collaborative structures in Articles I and II (van Eck & Waltman, 2022). These techniques are not ancillary but constitutive: they produce the structured data on which SNA, GDA, and QCA operate.

SNA is applied across three relational domains. Co-authorship networks are used to reveal collaborative structures; co-citation networks trace thematic and intellectual alignments (Article II); and editorial networks uncover latent structures of institutional power and symbolic capital (Article IV) (Baccini & Barabesi, 2009, 2011; Baccini et al., 2020). The analysis employs centrality measures, specifically eigenvector centrality, as well as community detection techniques to map clusters and hierarchies within the field (Traag et al., 2019). These measures operationalise relational advantage as access to recognition and gatekeeping authority, conditioned by field position.

GDA enables the multidimensional mapping of sustainability science's intellectual and social organisation (Article II) (Le Roux & Rouanet, 2004). Multiple Correspondence Analysis (MCA) identifies underlying oppositions and symbolic distances between conceptual groupings based on their categorical associations (Le Roux & Rouanet, 2010). In Article II, MCA is used to implement co-word analysis—operationalised as keyword co-occurrence—to identify and position thematic clusters within a relational field. Complementing this, Principal Component Analysis (PCA) positions journals according to their volume and type of capital (Le Roux et al., 2019). Within this framework, Robust PCA is specifically

utilised to handle skewed bibliometric distributions and mitigate the influence of extreme outliers (Candès et al., 2011). Subsetting the Article II dataset into three historical periods enables diachronic comparison of shifts in symbolic positions and field structures over time (Lebaron, 2018).

QCA is used to investigate the reception of Bourdieu's work within bibliometrics (Article I) and the discursive constitution of sustainability science through editorial texts (Article III). Editorials are treated as "symbolic goods" through which agents assert authority and delineate field boundaries (Bourdieu, 1985). Methodologically, QCA combines the systematic orientation of classical content analysis with discourse-analytic sensitivity. Its abductive logic enables a flexible engagement with texts, bringing theoretically informed categories—such as symbolic capital, field autonomy, and heterodoxy—into dialogue with inductively emergent themes (Krippendorff, 2019).

5.2 Units of Analysis and Data Construction

The research treats journals as primary units of analysis—a choice driven by field-theoretical expectations rather than methodological convenience. From a field-theoretical perspective, journals function as institutional sites where symbolic capital becomes objectified through editorial governance, citation accumulation, and evaluative authority.

Focusing on journals entails a potential risk of methodological circularity: treating journals as units of analysis might appear to predetermine their centrality within the field. However, the analysis employs multiple methods—bibliometric mapping, network analysis, and qualitative content analysis—that could have revealed journals as peripheral rather than central to processes of field institutionalisation. Concretely, this would have been indicated by dispersed citation structures with no stable journal core, weakly centralised editorial-board networks lacking gatekeeping hubs, or editorials that rarely articulate field boundaries or legitimacy claims. The convergence of findings across these methods—demonstrating journal centrality in citation structures, editorial networks, and discursive framings—therefore supports, rather than presupposes, their institutional significance. Journals emerge as concentrated sites of symbolic power—a pattern established through multimethod investigation rather than assumed by the research design.

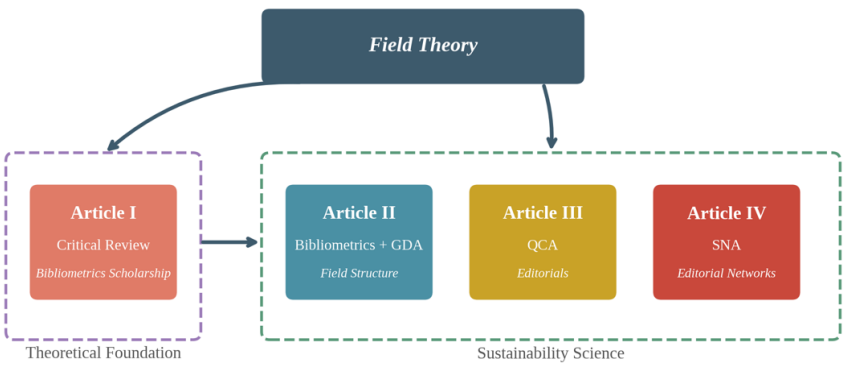
Throughout the project, data preparation—such as author disambiguation, affiliation standardisation, and periodisation—is treated as constitutive analytical work

rather than neutral technical preprocessing. Following Bourdieu, classificatory practices are understood as instruments of symbolic power (Bourdieu, 2018). Decisions concerning how historical periods are segmented, which journals are included, and how institutional affiliations are normalised directly shape the relational structures that emerge from the analysis. These choices are documented explicitly in Articles I–IV, in line with the reflexive commitment that underpins this research.

5.3 Operationalisation Across Articles and Integration into the Symbolic Capital Institutionalisation Model (SCIM)

The model serves as the integrative framework for the thesis as a whole, rather than featuring explicitly within each article. Figure 2 provides an overview of how the four articles relate to one another within this framework, distinguishing theoretical foundations from empirical analyses and highlighting the integrative role of field theory across the thesis.

Figure 2
Overview of the Thesis Structure: Field Theory as the Overarching Framework and the Articles' Empirical Focus and Methods



Each article translates field-theoretical constructs—such as symbolic capital, consecration, legitimacy, recognition, and hierarchy—into analytical categories appropriate to its specific data sources. Article I examined the reception of

Bourdieu's work within bibliometrics scholarship, tracing how field-theoretical concepts have been taken up and operationalised in this research tradition. In Article II, symbolic capital was operationalised through the JCI, publication and citation volumes, and keyword co-occurrence. Robust PCA positioned journals within a geometric space of symbolic differentiation, MCA mapped thematic structures across three historical periods, and co-citation and co-authorship networks traced intellectual and collaborative alignments within the field. Article III extended the analysis to the discursive domain by examining how editorials in core sustainability science journals articulated field boundaries and advanced normative claims. Through qualitative content analysis, constructs such as recognition and symbolic struggle were identified in the ways editorial discourse framed epistemic priorities and institutional legitimacy. Article IV shifted attention to the governance structures of scholarly communication, analysing the composition and network structure of editorial boards. Here, symbolic capital was operationalised through variables such as institutional affiliation, geographical diversity, and patterns of interlocking editorships, interpreted as mechanisms of gatekeeping and institutional reproduction.

These article-specific operationalisations provided the empirical basis for cross-article synthesis. While each article generated findings tied to its particular unit of analysis, the overarching research aim required synthesis across these empirical domains. SCIM was developed inductively in the summary essay to support this synthesis, rather than being advanced as an explicit model within each article. In this integrative effort, analytical categories developed in Articles II–IV are brought into relation through SCIM's core dimensions. Accumulation is reflected in citation-based indicators as well as in the discursive attribution of authority in editorials. Conversion processes are examined in terms of how discursive legitimacy is articulated in editorial texts (Article III) and how such claims relate to more durable positions of authority within editorial governance structures (Article IV). Institutionalisation becomes visible in the stabilisation of symbolic hierarchies, particularly through editorial governance and the stratification of journal prestige. Using SCIM as a synthesis framework supports a multi-scalar analysis linking micro-level practices—such as citation behaviour and editorial discourse—to macro-level patterns of recognition, hierarchy, and symbolic consolidation.

However, the application of SCIM highlights certain limitations. Some constructs, particularly recognition and legitimacy, displayed considerable contextual variability across data sources. Their meanings and operational expressions were

contingent on site-specific dynamics—discursive in editorials, quantitative in citation data, and institutional in governance structures. While this variability does not undermine SCIM's analytical coherence, it points to the need for further refinement when applying the model to other fields or empirical settings.

5.4 Methodological Contributions

The thesis reconceptualises empirical materials—often treated as peripheral or neutral—as central to field formation. In Article II, author keywords are reinterpreted as symbolic positioning devices, and keyword co-occurrence networks are analysed as historically contingent structures through which epistemic alignments and disciplinary boundaries are asserted. Similarly, Article III reframes editorials as central sites of symbolic struggle rather than mere commentary. Interpretive analysis shows how editorials articulate the field's collective self-understanding and project normative visions of sustainability science. A theory-informed coding framework maps editorial discourse onto field-theoretical constructs such as legitimacy, struggle, and consecration through abductive categorisation and iterative refinement—yielding a coding approach adaptable for analysing editorial discourse in other fields.

The thesis further operationalises field-theoretical constructs—specifically symbolic capital—through computational strategies. Article IV establishes a typology of journal governance by combining median eigenvector centrality (MEV) with the Gini coefficient. In this framework, MEV captures relational prestige derived from connections to other prestigious positions, while the Gini coefficient assesses the internal concentration of editorial authority. These metrics collectively constitute a relational framework for analysing how symbolic capital is institutionalised within editorial boards, distinguishing four configurations of governance: dispersed core, concentrated core, dispersed periphery, and concentrated periphery. The accompanying R toolkit, hosted on GitHub, provides a reproducible workflow—comprising modular code and synthetic data—to support replication and adaptation in other scholarly domains (Schirone, 2025).

Methodological contributions also centre on making temporal and relational dynamics analytically tractable. Article II applies Robust PCA to map the structural positions of journals within a geometric space of symbolic differentiation, addressing the highly skewed citation distributions characteristic of bibliometric data. MCA of author-assigned keywords, subsetted into three historical periods,

traces shifting thematic alignments over time. Article IV complements this temporal analysis by mapping interlocking editorships as networks of editorial authority.

5.5 Methodological Limitations

While methodological limitations are addressed in each individual article, several overarching considerations apply at the level of the project as a whole.

First, reliance on Web of Science in Article II introduces structural biases associated with the coverage of this database (Mongeon & Paul-Hus, 2016). It primarily indexes journals published in English, potentially underrepresenting epistemic contributions from the Global South and non-Anglophone contexts. Despite efforts to improve data quality through systematic curation—including document-type filtering, metadata cleaning and standardisation, and keyword harmonisation through exclusion and synonym lists—these structural limitations cannot be fully resolved within the scope of Article II.

Second, the proprietary and closed nature of the bibliometric databases used in Articles I and II affects reproducibility and transparency. While these platforms provide structured metadata and citation linkages useful for large-scale relational analysis, reliance on commercial infrastructures limits independent verification and restricts data access (Leonelli, 2023). To partially mitigate these limitations, Article IV makes analytical scripts and workflows openly available, enhancing transparency and reproducibility with respect to data processing and network construction (Schirone, 2025).

Third, the operationalisation of core concepts such as field and capital through bibliometric and network-based proxies involves inherent simplifications. Although such abstractions enable systematic mapping of symbolic structures, they risk reducing historically embedded social practices to formal regularities. This tension is partially addressed through interpretive contextualisation and cross-method comparison, though the risk of reducing relational processes to formal indicators cannot be entirely eliminated.

Fourth, the periodisation of field development into three discrete phases functions as an analytical device but may flatten the complexity of intellectual evolution. Field trajectories are often recursive, overlapping, and contested. While the segmentation adopted here is grounded in editorial discourse and dataset structure, it cannot fully capture the non-linear temporality of field dynamics. The thesis itself

reflects this contingency: Articles II and III employ different periodisation schemes, each calibrated to the temporal logic of its empirical material, demonstrating that phase boundaries are analytically constructed rather than naturally given.

Fifth, the interpretive framework developed in Article III—including the theory-informed coding scheme and the abductive categorisation of editorial discourse—was constructed from a purposive sample of 76 editorials drawn from three Anglophone journals. While this design enables sustained longitudinal analysis within a coherent discursive space, it constrains the range of editorial voices, epistemic traditions, and linguistic contexts from which the framework's categories were derived. The transferability of the coding scheme to other editorial corpora—particularly those from non-Anglophone or Global South journals—remains to be empirically tested.

5.6 Ethical Considerations

The thesis examines processes of scientific field formation within scholarly communication, focusing on how authority and recognition are structured at the level of institutions, networks, and discourses rather than individual actors. Nevertheless, because the underlying data involve identifiable scholars and their professional attributes, the project adheres to established principles of research integrity, including the *European code of conduct for research integrity* (All European Academies [ALLEA], 2023) and the guidelines of the Swedish Research Council (Vetenskapsrådet, 2024). As the research relies exclusively on publicly available bibliometric data and published texts, formal ethical review was not required under the relevant institutional guidelines.

Aggregating personal attributes such as editors' gender, institutional affiliations, and geographic location necessitates specific privacy safeguards. Although editors act as professional representatives of their institutions, care was taken to avoid identifying individuals through the aggregation of potentially identifying attributes. Aggregation therefore varies by data type. Gender data are reported only as aggregate percentages (e.g., "22.5% of interlocking editors are women") and are not cross-tabulated against other identifying variables. Geographic data are presented at the country, subregional, and continental levels to preserve interpretability while minimising re-identification risk. Institutional affiliations are analysed in aggregate form (e.g., "five institutions account for 103 of the 2,135 total

editorial positions"), enabling the examination of concentration patterns without constructing individual-level profiles. No cross-tabulations across gender, geography, and institutional affiliation are performed, and small-N categories are reported only at broad geographic levels.

Bibliometric and network-based analyses also carry the risk of stigmatising journals, institutions, or regions when highlighting disparities. To mitigate this risk, observed inequalities are interpreted cautiously as outcomes of structural dynamics—such as cumulative advantage, network effects, historical positioning, and mechanisms of prestige by association (Desposato, 2024). This interpretive approach draws on Bourdieusian field theory to contextualise observed inequalities as outcomes of structural dynamics rather than as evaluations of individual performance or institutional quality.

6. Overview of the Included Articles

This thesis comprises four interrelated articles examining the institutionalisation of sustainability science as an academic field. Taking journals as the primary site of analysis, the empirical articles examine the field's symbolic architecture through bibliometric mapping of citation patterns, keyword positioning, and co-authorship networks at country and institutional levels (Article II), qualitative analysis of editorial discourse (Article III), and network analysis of editorial board composition (Article IV). These empirical investigations build on Article I, which examines how Bourdieu's field theory has been operationalised within bibliometric research. In the context of this chapter, the notion of the field's "symbolic architecture" is used as a shorthand for the structured configuration of recognition and authority as it becomes stabilised over time. At the same time, this architecture is understood as continuously produced and negotiated through practices of citation, editorial selection, and scholarly positioning. In this sense, the analysis attends both to the relatively durable organisation of the field and to the ongoing processes through which its symbolic order is constructed.

6.1 Summary of Article I

The first article, *Field, capital, and habitus: The impact of Pierre Bourdieu on bibliometrics*, contributes to addressing **RQ1** by examining how Bourdieu's theoretical framework has been received and adapted in bibliometric research. By mapping the conceptual influence of Bourdieu's work, it establishes an analytical basis for assessing how his relational sociology can be further applied within bibliometrics.

Drawing on a corpus of 182 publications in the bibliometrics literature citing Bourdieu, the study combines structural mapping with content analysis. Co-authorship and co-word network analyses based on author-assigned keywords identify leading contributors and core thematic clusters. These mappings are complemented by a systematic content analysis that identifies the most frequently mobilised Bourdieusian concepts in the corpus, alongside a qualitative interpretation of how those concepts have been translated into bibliometric scholarship.

The analysis reveals that Bourdieu's reception in bibliometrics has been shaped by a small number of scholarly clusters. In the co-authorship network, the US-affiliated Blaise Cronin occupies a pioneering and structurally central position. A

prominent Canadian cluster, anchored by Yves Gingras and Vincent Larivière, is associated with early efforts to introduce Bourdieu's sociology of science into bibliometrics, with Gingras's (1991) study of Canadian physics identified as a pivotal contribution. Conceptually, "field" and "capital" (especially symbolic and social capital) are the most recurrent concepts, while "habitus" appears more sporadically, often in discussions of academic socialisation. The study also shows that while Bourdieu's conceptual vocabulary is widely adopted, his methodological tools—such as GDA—remain underutilised, highlighting a disjunction between theoretical borrowing and methodological implementation.

Beyond mapping influence patterns, the article identifies a selective translation process in which Bourdieu's ideas are integrated into bibliometrics largely through established quantitative proxies: symbolic capital is mapped onto citation structures, while social capital is inferred from co-authorship networks. This conceptual–methodological asymmetry points to gaps that the thesis addresses in subsequent articles.

This article has been published in *Quantitative Science Studies*.

6.2 Summary of Article II

The second article, *The formation of a field: Sustainability science and its leading journals*, contributes to addressing **RQ2** by examining the intellectual and institutional organisation of sustainability science, with journals as the core units of analysis, and field theory as a theoretical lens. Article II thereby reconstructs sustainability science as a structured symbolic space, making visible the distribution of symbolic capital and the hierarchies that underpin its institutional organisation.

The empirical dataset consists of 71,871 documents published between 2001 and 2021 across eighteen purposively selected journals associated with sustainability science. Journal selection was guided by the Journal Citation Indicator (JCI), criteria based on journal scope and Web of Science classification, and the analysis of relevant earlier literature. The study employs co-citation analysis to map intellectual structure, co-authorship analysis to trace collaborative patterns at country and institutional levels, keyword co-occurrence analysis to identify thematic clusters, and GDA (Robust PCA and MCA) to position journals and thematic groupings within a multidimensional symbolic space. The field's development is examined diachronically across three historical phases—2001–2007 (emergence), 2008–2014 (institutional consolidation), and 2015–2021 (thematic diversification)—to trace the shifts in intellectual and institutional alignments.

The analysis reveals a differentiated structure: some journals occupy central positions with high symbolic capital—operationalised through citation and co-citation prominence—while others remain specialised and peripheral. The article also proposes a three-part typology of journals linked to decreasing disciplinary autonomy: a field-building "room of its own" strategy exemplified by *Sustainability Science*; broad sustainability venues such as *Nature Sustainability*, *Journal of Cleaner Production*, and *Sustainable Development*; and specialised discipline-based journals (e.g., *ACS Sustainable Chemistry & Engineering* and *IEEE Transactions on Sustainable Energy*). The co-citation mappings indicate a shift from early dominance of chemistry- and energy-oriented clusters towards a broader configuration in which journals such as *Journal of Cleaner Production* become increasingly prominent, alongside more explicit attention to policy-oriented and transdisciplinary research.

Article II reconstructs sustainability science as a structured symbolic space. The symbolic hierarchies identified here are subsequently examined through their discursive legitimation (Article III) and reproduction through editorial governance (Article IV).

This article has been published in *Scientometrics*.

6.3 Summary of Article III

The third article, *The emergence of sustainability science in the editorials of three scholarly journals*, addresses **RQ3** by analysing editorial discourse as a site where symbolic boundaries are constructed, negotiated, and contested in the institutionalisation of sustainability science.

The empirical material consists of all editorial texts published between 1993 and 2022 in three journals selected for their longevity and continuous availability of editorials across the study period: *Environment, Development and Sustainability*, *Sustainable Development*, and *International Journal of Sustainable Development and World Ecology*. This corpus comprises 76 editorials, enabling comparison across different temporal stages of the field's development.

Editorial discourse functions as a medium for the symbolic construction of sustainability science. Editors use editorial texts to assert the field's autonomy, frame legitimate research agendas, and negotiate tensions between academic excellence and societal relevance. Three historical phases in the field's development are de-

lineated: a “Foundation Phase” (1993–2002) focusing on epistemological positioning; an “Introspection Phase” (2003–2012) characterised by internal critique and consolidation; and a “Diversification Phase” (2013–2022) marked by thematic expansion and an increasingly diverse set of institutional and stakeholder orientations articulated in editorial discourse. To capture shifts in this discourse, the article treats these phases as analytic categories rather than fixed historical breaks.

Sustainability science emerges from the analysis as a heterodox field, marked by a sustained critique of disciplinary orthodoxies and an openness to alternative epistemologies. In its foundational phase, the field foregrounded systems thinking, participatory methodologies, and openness to multiple knowledge systems—including references to Indigenous knowledge. The subsequent introspective period was characterised by a heightened reflexivity, with editorial discourse interrogating the field’s conceptual foundations and methodological commitments—particularly regarding interdisciplinarity and the limitations of ecological modernisation. In the diversification phase, sustainability science expanded its thematic scope to address emergent global crises, including climate change and other global disruptions, while advancing transdisciplinary frameworks that foster collaboration across academic, policy, private-sector, and community actors. Substantively, the editorials portray sustainability science as heterodox, with epistemic pluralism framed as central to its identity.

Article III complements the structural mapping of Article II by reconstructing the discursive processes through which field boundaries and evaluative norms are legitimised.

This article has been published in *Discover Sustainability*.

6.4 Summary of Article IV

The fourth article, *Symbolic capital and inequality in scholarly communication: A bibliometric study of editorial boards*, addresses **RQ4** by examining how symbolic capital accumulates and is distributed within the editorial governance structures of sustainability science. The article conceptualises editorial boards as sites where academic legitimacy is produced and reproduced.

This study analyses 2,135 editorial positions across 30 journals associated with sustainability science. The journal set was constructed by combining 18 leading journals identified in Article II, 3 historically significant titles examined in Article

III, and additional journals from Harley and Clark's (2020) curated list. This purposive selection strategy ensures coverage of the field's intellectual breadth, historical depth, and structural diversity (see Article IV, Section 2.4, for the complete selection rationale and list of journals). The analysis constructs editor–editor and journal–journal networks based on interlocking editorships (editors who hold positions on more than one editorial board). Eigenvector centrality (EVC) is operationalised as a relational measure of symbolic capital, while Gini coefficients quantify inequality in its distribution. This dual approach distinguishes not only which journals occupy structurally central positions, but also whether symbolic capital is concentrated or dispersed within individual editorial boards.

The findings reveal substantial inequality. Only 71 scholars (3.33%) serve on multiple boards, forming an elite group of interlocking editors. Women constitute 22.5% of this group, and the editors with the highest symbolic capital are predominantly located in Western and Northern Europe and Eastern Asia, with Latin America and Africa represented by only two interlocking editors each. The results indicate that the most prestigious editorial network positions are geographically and institutionally concentrated and gender-skewed, which sits in tension with sustainability science's stated commitments to global inclusivity and diverse knowledge systems.

Through the combination of median EVC and the Gini coefficient, the article develops a fourfold typology of editorial governance:

- Dispersed Core: high symbolic capital distributed broadly (e.g., *Journal of Cleaner Production*, *Sustainability Science*).
- Concentrated Core: high symbolic capital concentrated in a few editors (e.g., *Ecological Economics*).
- Dispersed Periphery: low symbolic capital yet relatively egalitarian internal distribution (e.g., *World Development*).
- Concentrated Periphery: low symbolic capital dominated by one or two influential editors (e.g., *Environmental Research Letters*).

This typology demonstrates that journals vary not only in their position within the interlocking network but also in how authority is organised internally.

Article IV shifts the focus from symbolic positioning to institutional power, showing how inequalities identified at the intellectual (Article II) and discursive (Article III) levels are stabilised and reproduced through editorial governance structures.

This article is currently under major revision at *the Journal of the Association for Information Science and Technology (JASIST)*, where revisions are in progress. A preprint is available on SocArXiv.

6.5 Comparative Overview of the Four Articles

Table 1 synthesises the theoretical, methodological, and empirical contributions of the four articles. While each article is designed to address one primary research question, it also contributes evidence relevant to adjacent questions; these connections are indicated in the table and developed fully in Chapter 7, where findings are integrated across studies. Article I establishes the theoretical foundations by examining how Bourdieu's concepts have been applied—and how they can be further mobilised—within bibliometric research. It identifies both existing applications and underexploited methodological tools such as GDA. Article II translates these insights into empirical analysis, mapping the symbolic capital structure of sustainability science as captured through a set of purposively selected journals and tracing thematic evolution across the field. Article III complements this structural mapping with qualitative analysis of editorial discourse, reconstructing how field identity and evaluative norms are symbolically constructed over time. Although Articles II and III adopt different periodisation logics—reflecting the distinct temporal dynamics of bibliometric structures and editorial discourse, respectively—their phases are broadly comparable and collectively trace the field's trajectory from emergence through consolidation to diversification. Article IV extends the analysis to editorial governance, examining how symbolic capital is concentrated through the networks that control knowledge validation and dissemination.

Articles II–IV each document a version of the same structural tension. Article II reveals thematic openness coexisting with structural hierarchy. Article III documents rhetorical commitments to inclusivity alongside boundary-maintenance practices. Article IV exposes governance structures that concentrate authority while articulating commitments to global representation. At each scale—structural, discursive, institutional—the field reproduces hierarchical patterns of recognition even as it advances heterodox claims.

Table 1

Main Contributions of the Articles in the Thesis

Article	Title	RQs	Theoretical	Methodological	Empirical
I	*Field, capital, and habitus*	**RQ1**	Establishes a foundation for applying Bourdieu's relational sociology in bibliometrics; identifies operationalisable concepts and underused methodological tools.	Develops a multimethod protocol for tracing theoretical reception, combining co-authorship/co-word mapping with systematic concept coding.	Maps and critically assesses Bourdieu's reception in bibliometrics.
II	*The formation of a field*	**RQ2, RQ1**	Conceptualises journals as symbolic goods that objectify the field's cultural, social, and symbolic capital; treats author-assigned keywords as proxies for the symbolic capital embedded in publications.	Integrates GDA (Robust PCA; MCA) with co-citation and co-authorship analyses to reconstruct field positions and symbolic distances.	Maps differentiated journal positions associated with symbolic capital, documents shifts in co-citation configurations from early chemistry/energy clusters towards a broader configuration, and proposes a journal typology—illustrated by *Sustainability Science* as a field-building venue—linked to decreasing degrees of autonomy from established disciplines within the journal set.
III	*The emergence of sustainability science*	**RQ3, RQ2**	Theorises editorials as strategic interventions in symbolic struggles over field identity and criteria of legitimacy.	Develops an abductive QCA workflow for longitudinal editorial corpora, combining theory-derived categories with inductively emerging themes.	Identifies three historical phases—Foundation (1993–2002), Introspection (2003–2012), and Diversification (2013–2022)—and documents an inter- and transdisciplinary epistemic self-understanding articulated in editorial discourse.
IV	*Symbolic capital and inequality in scholarly communication*	**RQ4, RQ3**	Conceptualises interlocking editorships as mechanisms of symbolic capital accumulation and institutional reproduction; distinguishes two dimensions of editorial governance: structural centrality within interlocking networks and internal concentration of board-level authority.	Introduces a network-analytical operationalisation of symbolic capital in editorial governance, combining MEV with Gini coefficients to profile boards along both dimensions.	Reveals a concentrated interlocking-editor elite; documents geographic and gender stratification; classifies journals into a fourfold governance typology (Dispersed/Concentrated × Core/Periphery).

Note. EVC = Eigenvector Centrality; GDA = Geometric Data Analysis; MCA = Multiple Correspondence Analysis; PCA = Principal Component Analysis; QCA = Qualitative Content Analysis. RQ1–RQ4 refer to the research questions presented in Chapter 1.

7. Discussion and Integration of the Findings

This chapter synthesises the empirical insights of the four constituent articles to address the thesis's research questions and to clarify what they jointly show about the institutionalisation of sustainability science. The Symbolic Capital Institutionalisation Model (SCIM) informs the cross-article synthesis throughout this chapter, and is applied more directly in Section 7.2 to trace conversion and feedback dynamics.

The articles reveal a persistent tension. Sustainability science articulates normative commitments to interdisciplinarity and transdisciplinarity, inclusivity, and societal engagement, while the empirical material reveals persistent hierarchies of academic authority—in journals, citation structures, and editorial governance. This tension is not reducible to individual inconsistency, but reflects how emerging fields secure legitimacy within established logics of academic evaluation. Sustainability science thus combines a transformative orientation towards complex socio-environmental challenges with reliance on orthodox mechanisms of consecration, including peer-reviewed publication, citation-based evaluation, and institutional prestige. In this chapter, the "transformation paradox" is treated not as a failure of the field's normative commitments but as a structurally generated feature of field development.

This chapter addresses each research question sequentially, integrating findings across the four studies into a coherent account of how recognition is accumulated, converted into authority, and embedded in durable institutional structures.

7.1 Answering the Research Questions

Each research question is addressed through the articles that most directly bear on it, integrating findings across studies to trace how recognition, authority, and legitimacy are produced and stabilised within sustainability science.

Research Question 1. How can Bourdieu's theories on capital and field be applied to the publication, collaboration, and citation patterns of sustainability science?

Research Question 1 is addressed primarily through Articles I and II: Article I establishes how Bourdieusian concepts of field and capital have been operationalised in bibliometrics, while Article II applies this Bourdieusian perspective to publication, collaboration, and citation patterns in sustainability science.

Article I provides the conceptual and methodological point of departure by examining how Bourdieu's relational sociology has been incorporated into bibliometrics. While concepts such as field and symbolic capital are increasingly mobilised, the article also shows that their more demanding relational and reflexive implications are often softened in practice. Article I therefore motivates a field-theoretical reading of bibliometric indicators, treating publication and citation patterns not as neutral measures of quality but as traces of symbolic capital accumulation within a structured space of recognition.

Article II translates this perspective into an empirical reconstruction of sustainability science through co-authorship and citation-based analyses across a purposively constructed set of journals associated with sustainability science, selected using citation-based indicators and scope-based inclusion criteria. The findings indicate a strongly stratified configuration in which a limited number of institutions—predominantly located in China and the Global North—occupy central positions in collaboration and citation networks. These positions are best interpreted as effects of historically accumulated symbolic resources and institutional prestige, rather than as direct reflections of intrinsic scholarly quality (Bourdieu, 1988, 1991b). In this sense, scientific capital appears as a relational asset: standing derives from location within networks of recognition and consecration, and these positions tend to attract further visibility over time.

Read together, Articles I and II demonstrate how Bourdieu's concepts can be applied to make the social architecture of sustainability science visible through bibliometric traces. Publication venues, collaboration patterns, and citation relations jointly constitute a hierarchy of legitimacy in which early advantages in visibility and institutional standing can be reinforced through cumulative recognition. The dynamics of conversion and recursive feedback are taken up more explicitly in Section 7.2.

Research Question 2. How can bibliometric methods, informed by a Bourdieusian perspective, be developed to describe the social and intellectual organisation of sustainability science? How might qualitative insights complement these analyses to capture field formation?

Research Question 2 is addressed primarily through Articles II and III, with Article I providing the conceptual foundation. Article II develops a Bourdieusian bibliometric framework that integrates bibliometric mapping with GDA to position journals, topics, and keywords within a relational field space. Journals are treated as positions defined by relative symbolic capital, operationalised through publication volume, citation patterns, and thematic orientation. The analysis identifies a differentiated hierarchy of journal positions in which a limited subset of venues commands disproportionate recognition and visibility. Article II also proposes a typology of three journal types linked to decreasing levels of disciplinary autonomy. Within this typology, *Sustainability Science* serves as the illustrative field-building case—an attempt to create a "room of its own" for sustainability science—alongside broad sustainability outlets and discipline-anchored specialised venues (Clark, 2007). The GDA and network-analytic maps reveal symbolic distances and oppositions.

Article III complements this quantitative mapping by analysing editorials as institutionally authorised sites of discursive boundary-setting and legitimation. Editorials, written by consecrated editors, speak with delegated authority and articulate field boundaries, epistemic priorities, and shared evaluative commitments. Through an abductive qualitative content analysis of 76 editorials, the article identifies three overlapping phases—Foundation (1993–2002), Introspection (2003–2012), and Diversification (2013–2022)—that capture shifts in how sustainability science narrates its epistemic identity, justifies its ambitions, and negotiates tensions between academic excellence and societal relevance.

Articles II and III thus illuminate different dimensions of field formation: hierarchies of visibility are traced in publication and citation structures, while boundary-setting and legitimation are articulated in editorial texts.

Research Question 3. How can the process of institutionalisation in sustainability science be described through patterns revealed by quantitative and qualitative analyses of its publication output?

Research Question 3 is addressed through Articles III and IV, building on the structural mapping developed in Article II. Articles III and IV examine how comparable hierarchising dynamics are stabilised through discursive and organisational infrastructures, using different empirical materials suited to each domain.

Article III analyses editorial discourse as a site of legitimation and boundary-setting through which field identity, evaluative norms, and lines of inclusion are articulated and stabilised over time. Across the three identified phases, editorials repeatedly frame sustainability science as a distinctive, problem-oriented domain, thereby stabilising shared categories of relevance and rigour even as internal tensions remain visible.

Article IV extends this account by examining editorial governance as an institutional infrastructure through which symbolic authority is allocated and reproduced. Network analysis of editorial boards across 30 journals reveals that gatekeeping authority is concentrated within a small, interconnected subset of the editorial community, predominantly affiliated with a limited set of institutions in the Global North. Editorial roles are both outcomes of accumulated recognition and positions from which future legitimacy can be conferred. They embed symbolic capital in durable organisational forms, shaping the field's criteria of inclusion.

Articles II–IV collectively demonstrate that institutionalisation in sustainability science involves the alignment of publication hierarchies with discursive legitimation and governance arrangements that stabilise symbolic hierarchies over time. Editorials provide a language of justification and boundary-setting, while editorial boards operate as sites of consecration and gatekeeping; their co-evolution helps explain why a field founded on heterodox ambitions can nonetheless reproduce orthodox hierarchies as it seeks legitimacy within established academic evaluation regimes.

Research Question 4. How do editorial board structures in sustainability science journals reflect broader power relations in the social and intellectual organisation of the field?

Research Question 4 is addressed directly by Article IV, which examines editorial governance as a site where gatekeeping authority is allocated and reproduced. Rather than treating editorial boards as neutral administrative arrangements, Article IV conceptualises them as institutional infrastructures through which symbolic power operates in scholarly communication: editorial positions confer the capacity to shape what counts as publishable, visible, and credible within the field.

Empirically, the analysis shows a concentration of editorial influence. A small subset of scholars holds multiple board appointments (an interlocking-editor core), linking influential venues and concentrating consecrating capacity in a limited set of actors. Editorial appointments can therefore be read as a conversion

point: accumulated scholarly recognition—built through publications, citations, and institutional standing—becomes translated into durable gatekeeping authority. Once established, this authority is self-reinforcing: interlocking editorial positions coordinate evaluative influence across venues, shaping the pathways through which reputational credit circulates. Moreover, the typology developed in Article IV reveals that journals with comparable levels of network prominence can nevertheless differ markedly in how authority is distributed internally, suggesting that editorial governance varies along two partially independent dimensions: a journal's position within the interlocking network and the internal concentration of influence within its board.

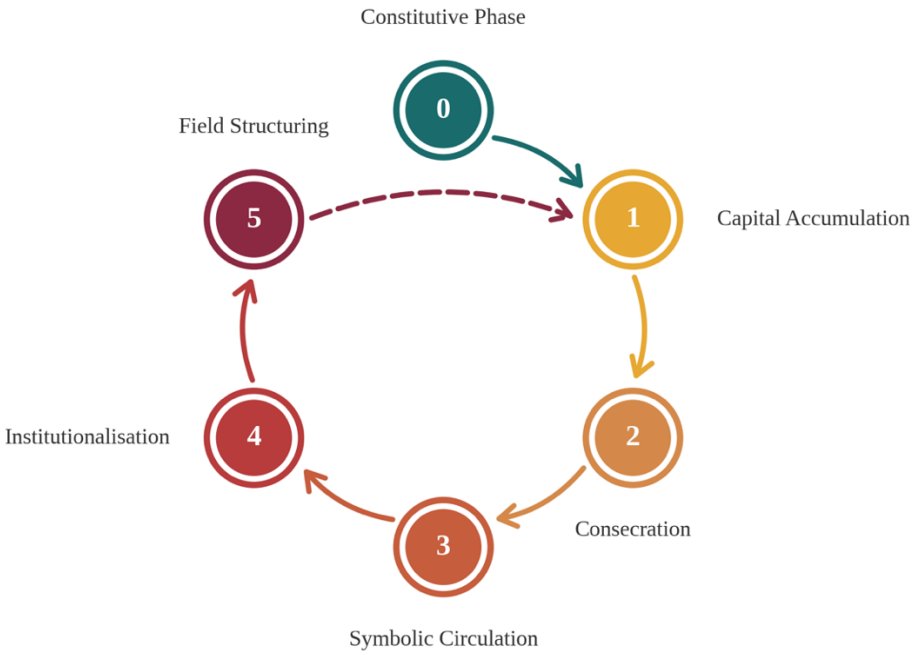
Article IV further indicates that these governance structures are patterned by broader geo-institutional and gendered inequalities. Representation is uneven across regions and institutions, and the distribution of central editorial positions is markedly more concentrated than the distribution of nominal board membership. In field-theoretical terms, this suggests that sustainability science's governance infrastructure does not merely mirror existing hierarchies in academic capital; it also provides a mechanism through which those hierarchies are reproduced within the field's own evaluative institutions.

7.2 Symbolic Capital Conversion and Recursive Dynamics

This section traces the recursive dynamics through which symbolic capital is converted, circulated, and stabilised within sustainability science, using SCIM as an integrative framework. The transformation paradox—introduced in Chapter 1 and traced across the research questions above—emerges from these recursive interactions: the same mechanisms that enable field consolidation also reproduce hierarchical distributions of authority. For ease of reference, Figure 3 reproduces the SCIM figure (Figure 1) introduced in Chapter 4.

Figure 3

The Symbolic Capital Institutionalisation Model (SCIM). Reproduced from Figure 1 (Chapter 4)



Note. The model distinguishes a constitutive phase of field formation from five recursive mechanisms through which symbolic capital is reproduced and institutionalised.

Symbolic capital conversion underpins this dynamic. Recognition accumulated through publication, citation, or institutional affiliation becomes effective authority only once it is ratified through consecrating positions and embedded in durable infrastructures. The analysis of Articles II–IV identifies a recurrent pathway. Publication visibility and journal standing support access to editorial roles—one category of consecrating position. Editorial appointments, in turn, enhance visibility and reputational standing, enabling symbolic capital to circulate across venues through reputational spillovers and interlocks. Over time, these processes transform symbolic capital into objectified authority (embedded in journals, governance structures, and evaluative routines), reshaping what counts as legitimate contribution. In SCIM terms, these dynamics span consecration and circulation,

their institutional embedding, and the resulting effects on field structuring (Loops 2–5, see Figure 3).

These processes are recursive rather than linear. Early advantages in recognition generate further opportunities for consecration, while institutionalised authority feeds back into subsequent patterns of accumulation. As demonstrated in Articles II and IV, prestigious journals and influential editors tend to co-occur within the same networks of recognition and governance, and editorial appointments, in turn, can consolidate journal standing through routine gatekeeping. This helps explain how unequal distributions of visibility and authority can be reproduced through ordinary evaluative practices, while continuing to appear as the outcome of neutral standards of excellence.

These recursive dynamics do not require intentional coordination by individual actors (Bourdieu, 2004). They unfold through the field's internal logic and routine practices—submission strategies, citation conventions, editorial selection, and institutional appointment—sustained by illusio, or shared investment in the field's stakes. Accordingly, even actors committed to epistemic pluralism and transformation may contribute in practice to the reproduction of existing structures.

At the same time, recursion does not imply closure. Because the loops are interdependent, interventions at specific points can alter the conditions under which symbolic capital circulates—for example, by diversifying editorial governance, adjusting evaluative criteria, or expanding the range of legitimate publication venues. However, the empirical patterns documented in the articles suggest that, under prevailing conditions, these dynamics tend to stabilise existing hierarchies more readily than they redistribute authority.

7.3 Mechanisms of Capital Concentration

The concentration of symbolic capital and institutional authority documented in Articles II–IV operates through four interrelated mechanisms: editorial governance concentration, citation stratification, discursive legitimation, and geo-demographic concentration. From the perspective of SCIM, this concentration is not a deviation from the field's normative commitments to inclusivity and epistemic pluralism but an outcome of recursive interactions among consecration, symbolic circulation, institutionalisation, and field structuring.

7.3.1 Editorial Governance Concentration

Editorial governance constitutes a central infrastructure of consecration within sustainability science. As shown in Article IV, editorial board positions are not evenly distributed but concentrated within a relatively small, densely interconnected group of scholars who occupy multiple roles across journals associated with sustainability science.

As discussed in Section 7.2, this concentration reflects recursive dynamics rather than intentional exclusion or coordinated gatekeeping. Scholars who have accrued recognition through publication records, citation visibility, and institutional affiliation are more likely to be appointed to editorial roles. Once appointed, these roles confer the capacity to shape journal scope, review standards, and thematic priorities, thereby augmenting the visibility and authority of those who hold them. Over time, editorial governance becomes a mechanism through which symbolic capital is objectified and stabilised, feeding back into the structuring of the field by shaping what becomes publishable and visible.

Article IV's governance typology further shows that this concentration is not uniform: journals vary independently in their structural centrality within the interlocking network and in the internal distribution of board-level authority. Some journals combine high network prominence with concentrated editorial control, while others with comparable prominence distribute authority more broadly. This variation suggests that editorial governance operates through partially independent dimensions. Interventions targeting one dimension—such as diversifying individual boards—may not address concentration at the network level, where interlocking structures concentrate consecrating capacity across journals.

Editorial concentration can coexist with genuine commitments to epistemic pluralism. From a Bourdieusian perspective, this reflects the relative autonomy of scientific fields. Actors operate under shared evaluative constraints that limit discretionary transformation even in the presence of reflexive awareness (Bourdieu, 2004). Editors may actively seek thematic diversity and methodological openness, yet operate within inherited evaluative frameworks that privilege established trajectories. As a result, governance structures tend to stabilise existing hierarchies even as the field expands substantively. In SCIM terms, editorial governance concentration spans consecration, institutional embedding, and field structuring (Loops 2, 4, and 5).

7.3.2 Citation Stratification

Citation patterns constitute a second mechanism through which symbolic capital is unevenly accumulated and reproduced (Larivière et al., 2013; Merton, 1968). Across sustainability science journals, citation distributions exhibit steep hierarchies consistent with cumulative advantage dynamics: early visibility and prior recognition increase the likelihood of subsequent citation, producing self-reinforcing patterns over time.

Within SCIM, citation stratification reflects the interaction between capital accumulation (Loop 1) and symbolic circulation (Loop 3). Citations record recognition and actively redistribute it, directing attention towards already visible actors, topics, and venues. Articles published in high-status venues benefit from heightened visibility, while highly cited authors gain further access to high-status collaborations and publication opportunities. These dynamics contribute to the stabilisation of field structure (Loop 5) by concentrating attention and authority around a limited set of actors and venues.

Citation hierarchies need not reflect deliberate preference or evaluative bias. They emerge through routine scholarly practices—literature review conventions, reputational heuristics, and disciplinary canons—that collectively reinforce existing distributions of symbolic capital.

7.3.3 Discursive Legitimation

Discursive legitimation operates as a third mechanism through which symbolic capital is stabilised. As demonstrated in Article III, editorials play a distinctive role in articulating shared evaluative commitments, epistemic priorities, and boundaries of legitimate contribution.

Within SCIM, discursive legitimation is closely linked to consecration and symbolic circulation. By framing sustainability science as a distinctive, socially indispensable, and internally aligned field, editorials contribute to the stabilisation of collective expectations regarding what counts as valuable research. This process supports institutionalisation (Loop 4) by anchoring normative claims—about relevance, rigour, and contribution—in established evaluative infrastructures such as journals and peer review, while the field's thematic agenda broadens.

This account of discursive legitimation does not rest on intent or persuasion on the part of individual editors. Instead, it reflects the position of editorials as institutionally authorised texts produced by consecrated actors, whose statements

carry symbolic weight because the editorial voice itself is legitimised through its institutional location, rather than through rhetorical force alone.

7.3.4 Geo-Demographic Concentration

A fourth mechanism concerns the uneven distribution of symbolic capital across geographic and institutional locations. Despite sustainability science's global orientation, editorial authority remains concentrated in a limited number of regions and institutions, predominantly in the Global North (Demeter & Toth, 2020). As shown in Article IV, editorial appointments are disproportionately held by universities and research organisations in North America, Western Europe, and East Asia, with pronounced institutional concentration among a small number of research-intensive universities.

From the perspective of SCIM, these patterns reflect inherited capital distributions that condition access to consecration and circulation. Geographic location, institutional resources, and linguistic positioning shape the initial conditions under which recognition can be accumulated (Loop 1). These advantages are subsequently reinforced through consecrating infrastructures—most visibly editorial governance—contributing to durable field structuring (Loop 5). The interlocking-editor subset intensifies this pattern: the editors occupying the most central network positions are disproportionately located in a small number of regions, reinforcing centre–periphery dynamics within the field's governance infrastructure. Symbolic capital circulates more readily within established centres, making redistribution unlikely in the absence of targeted intervention.

These four mechanisms demonstrate how symbolic capital becomes concentrated through ordinary field processes rather than exceptional practices.

7.4 Interdependence

Editorial governance, citation stratification, discursive legitimation, and geo-demographic concentration form an interdependent system, mutually reinforcing one another through SCIM's recursive loops. Consecration shapes which contributions become visible and citable; citation patterns inform assessments of merit that guide editorial recruitment; discursive legitimation translates these hierarchies into shared evaluative language; and geo-demographic privilege conditions

access to each of these processes. These loops establish a self-reinforcing dynamic, where symbolic capital accumulates, circulates, and stabilises through routine field practices.

This interdependence is sustained not only by institutional arrangements but also by actors' internalisation of the field's evaluative logics. Central to this process is illusio: the shared belief that the stakes of sustainability science are meaningful and worth pursuing (Bourdieu, 1990). Researchers invest in the field because they perceive it as uniquely positioned to address pressing socio-environmental challenges, while institutions and funders support sustainability initiatives as markers of relevance and responsibility. This collective investment sustains participation and reinforces the legitimacy of existing evaluative structures, even where their hierarchical effects are recognised.

Hysteresis further contributes to the durability of these patterns (Bourdieu, 1977). Discursive commitments to inclusivity, epistemic pluralism, and global engagement have outpaced the evaluative and organisational structures through which recognition is allocated. While internationalisation intensifies circulation across national contexts, its effects primarily reinforce the geo-demographic asymmetries described in Section 7.3.4. As a result, normative discourse may articulate transformative commitments while the governance arrangements, citation hierarchies, and institutional infrastructures that condition recognition tend to remain largely stable. This temporal mismatch allows the field to accommodate new themes and vocabularies without corresponding redistribution of symbolic capital.

Symbolic power operates through this combination of interdependence and internalisation. Classificatory schemes—such as notions of rigour, impact, and excellence—appear neutral and meritocratic, yet they are anchored in historically accumulated capital and institutionalised authority (Bourdieu, 1991b). Through repeated participation in evaluative routines, these classifications come to be experienced as natural features of academic life. Field participants contribute to the reproduction of hierarchies not through intent or acquiescence, but through practical adaptation to the structured conditions of recognition.

Understanding interdependence clarifies why the transformation paradox persists. The same mechanisms that sustain the field's coherence and legitimacy also constrain redistribution.

7.5 Institutionalisation and Field Structure

The transformation paradox reflects sustainability science's ongoing institutionalisation. Objectification stabilises symbolic capital by embedding it in durable structures, yet this same stabilisation provides an institutional foundation for continued field development.

The articles demonstrate that institutionalisation in sustainability science operates simultaneously across cognitive, normative, organisational, and regulatory dimensions. Article II's reconstruction of the field's journal-based hierarchy makes visible patterns of thematic orientation and boundary formation that distinguish sustainability science from adjacent domains. Article III's editorial analysis shows how evaluative criteria, epistemic priorities, and quality standards have been articulated through editorial discourse, embedding normative expectations about what counts as a legitimate contribution. Article IV demonstrates that the field has developed organisational infrastructures of editorial governance—boards, interlocking appointments, and hierarchies of gatekeeping authority—that allocate recognition and structure access to consecrating positions.

Institutionalisation enables field development in several ways. It provides stable platforms for knowledge production and facilitates resource mobilisation by establishing recognised channels through which funding and institutional support flow (Whitley, 2000). It also creates legitimate space for heterodox approaches, allowing sustainability science's interdisciplinary and problem-oriented commitments to receive academic recognition (Bourdieu, 1996). The existence of dedicated journals, editorial boards, and publication hierarchies—documented across Articles II–IV—signals a degree of autonomy sufficient to sustain a partially field-specific logic of evaluation, even if this autonomy remains uneven and contested.

At the same time, institutionalisation constrains transformation by generating path dependencies that make subsequent change increasingly difficult (Bourdieu, 1977). Conformity to established evaluative criteria tends to subordinate heterodox innovations to orthodox standards of legitimate scholarship (Hicks et al., 2015). Article IV's finding of a concentrated interlocking-editor core illustrates this constraint: these editors, disproportionately affiliated with a limited set of institutions in the Global North, occupy positions that shape publication decisions and, through them, field visibility.

Within institutionalised fields, change typically proceeds through regulated channels that preserve existing distributions of authority (Bourdieu, 1990). Article

III's identification of a Diversification phase (2013–2022) illustrates this pattern: editorials increasingly invoked justice, decolonisation, and Indigenous knowledge, yet these themes were integrated through conventional publication formats and peer review procedures rather than through fundamental restructuring of editorial governance. Thematic innovation expanded the field's scope without necessarily altering its basic organisation. Similarly, reflexive discussion—such as special issues, editorials, and methodological debates—is institutionally accommodated in ways that allow problems to be articulated without altering the underlying governance structures or evaluative criteria (Bourdieu & Wacquant, 1992). Article IV's governance typology reinforces this point: even journals with high network prominence and broad thematic scope can maintain concentrated internal authority, suggesting that discursive openness and structural concentration are not mutually exclusive.

This pattern of regulated change explains how sustainability science can simultaneously transform and reproduce itself. Within a relatively autonomous scientific field, transformation is pursued through field-internal criteria and institutions that also function to stabilise accumulated symbolic capital, making reproduction and change structurally interdependent rather than contradictory (Bourdieu, 2004). Innovation occurs at the level of discourse, topics, and problem framings, while deeper structures of recognition and authority often remain comparatively stable (Bourdieu, 1977). Change thus unfolds within boundaries that preserve fundamental power relations, rendering the transformation paradox a structurally intelligible feature of field institutionalisation.

7.6 Concluding Synthesis

The analysis developed across Chapter 7 specifies the transformation paradox as an empirically grounded outcome of sustainability science's institutionalisation under conditions of relative autonomy (Bourdieu, 1988; Whitley, 2000). One marker of this consolidation is the establishment of dedicated publication spaces—what Clark describes as sustainability science gaining "a room of its own" (Clark, 2007). Such spaces can support field-specific boundary work and evaluation, while still allowing hierarchical distributions of authority to persist. Using SCIM as an integrative reference point, the chapter has shown how symbolic capital is accumulated, converted, and stabilised through recursive interactions among publication practices, editorial governance, discursive legitimation,

and geo-demographic structuring. These processes jointly sustain the field's legitimacy while constraining the redistribution of authority.

The same infrastructures that enable sustainability science to function as a coherent and credible field—journals, editorial boards, evaluation criteria, and institutional affiliations—also serve as sites where symbolic capital is objectified and rendered durable. Discursive shifts, thematic diversification, and expanded problem framings are accommodated more readily than changes to consecrating institutions or criteria of recognition.

This does not imply that redistribution is impossible (Bourdieu, 1986). Rather, the analysis suggests that meaningful transformation is unlikely to emerge from discursive commitment alone. Because symbolic capital circulates through interdependent feedback loops, interventions that target only one dimension are likely to have limited effects—for example, publication diversity without changes in governance, or discursive inclusion without shifts in evaluative criteria. Redistribution would require coordinated changes across multiple sites of the field, including editorial governance, criteria of consecration, and the institutional conditions under which recognition is accumulated.

By treating the transformation paradox as a structural condition rather than a normative shortcoming, this chapter provides a reflexive basis for understanding both the achievements and the limits of sustainability science (Bourdieu & Wacquant, 1992). The field's continued evolution will likely depend less on resolving this paradox than on navigating it within the constraints and possibilities of relative autonomy.

8. Conclusions and Contributions

Drawing on four empirical studies, the thesis shows how sustainability science consolidates as a recognisable field through recursive processes of symbolic capital accumulation that organise recognition, authority, and legitimacy. These processes are theorised through field theory and examined empirically using bibliometric, network-analytic, and qualitative approaches (Bourdieu, 1988). The thesis clarifies how sustainability science develops both as a transformative knowledge project and as a stratified academic domain.

8.1 Theoretical Contributions

The primary theoretical contribution of this thesis is the Symbolic Capital Institutionalisation Model (SCIM). SCIM integrates a field-theoretical conception of bibliometrics with an account of symbolic capital as objectified in scientific journals and their editorial governance structures. Together, these elements provide an analytical framework for examining how evaluative infrastructures and mechanisms of scholarly recognition organise legitimacy, authority, and hierarchy in emerging scientific fields.

Bibliometric indicators—such as impact factors, citation counts, and journal rankings—are treated not as neutral descriptors, but as symbolic mechanisms that help constitute the hierarchies they appear to measure. They participate in the construction of academic value by codifying recognition and directing attention, thereby shaping publication strategies, reputational trajectories, and field boundaries. Indicators can be understood as evaluative devices (Hylmö et al., 2025) and, in related terms, as judgment devices (Hammarfelt & Rushforth, 2017); from a Bourdieusian perspective, such devices intervene in field organisation by shaping what is recognised and rewarded. As Article I demonstrates, this positions bibliometrics as a reflexive mode of field analysis rather than simply a technical instrument for science policy.

A second constitutive element of SCIM is the concept of objectified symbolic capital. This concept specifies how prestige and recognition become embedded in durable infrastructures of scholarly communication—journals, editorial boards, indexing systems, and ranking systems—that persist over time and exert structural influence beyond individual agents. Once institutionalised, symbolic capital

acquires inertia: it shapes research practices, reviewer expectations, and editorial decision-making. In this sense, SCIM develops Bourdieu's account of objectification by clarifying how symbolic capital is stored and reproduced through communicative infrastructures that stabilise hierarchies over time (Bourdieu, 1986).

SCIM also clarifies how interdisciplinary and heteronomous fields consolidate academic legitimacy. Fields grounded in heterodox ideals—such as transformation, inclusion, or transdisciplinarity—often depend on orthodox academic mechanisms to secure recognition. Early proponents may import symbolic capital from adjacent, more established domains, legitimising the emerging field while also transmitting external hierarchies. Over time, citation stratification, editorial concentration, and stabilised evaluative routines generate path dependencies that resist redistribution of symbolic resources.

Although SCIM is derived from the thesis's empirical analyses, it is proposed as a conditionally portable framework for examining symbolic capital accumulation in academic contexts characterised by comparable evaluative infrastructures and recognition mechanisms. Its applicability rests on structural similarity rather than empirical generalisation, and it does not claim explanatory reach beyond cases in which analogous configurations of editorial governance, citation practices, and evaluative routines can be demonstrated empirically.

8.2 Empirical Contributions

The thesis reconstructs sustainability science's symbolic economy, identifying a consistent pattern: despite expansion in publication volume, geography, and thematic diversity, symbolic capital remains concentrated within a limited set of journals, institutions, and actors.

The three empirical articles on sustainability science (Articles II–IV) substantiate this pattern of symbolic capital concentration from complementary angles. Article II reveals differentiated journal positions and stratified patterns of recognition that remain salient as the field expands. Article III analyses editorials as institutionally authorised sites of discursive legitimation and delineates three historical phases—Foundation (1993–2002), Introspection (2003–2012), and Diversification (2013–2022). Across these phases, editorials move from early field-definition and legitimation towards more explicit reflection on interdisciplinarity and evaluation, and later towards transdisciplinarity, equity and social justice, and the SDGs, while consistently returning to tensions between scientific rigour and policy relevance. Article IV shows that editorial governance is networked and unevenly distributed,

with central positions concentrated among a limited set of editors. Together, these findings illuminate the transformation paradox: sustainability science has expanded in scale and scope even as symbolic authority remains concentrated.

8.3 Methodological Contributions

The thesis employs a multimethod design to operationalise key concepts from field theory across three analytical dimensions: relational, positional, and discursive. Network analysis maps the relational distribution of symbolic capital through co-authorship, co-citation, and interlocking editorships. Geometric Data Analysis (GDA) visualises field positions and stratification patterns. Qualitative content analysis traces discursive processes of legitimation and boundary-setting in editorial discourse.

By conceptualising bibliometric data as socially produced traces rather than transparent indicators of quality, the analysis questions taken-for-granted assumptions about visibility, merit, and academic value (Wouters, 2014). The methodological workflow is designed to support transparency and reproducibility, though replication of the bibliometric analyses remains partly contingent on access to Web of Science.

As part of this methodological contribution, the thesis provides an open-access bibliometric toolkit hosted on GitHub (Schirone, 2025). The toolkit operationalises the analytical strategies developed in Article IV—including the combination of median eigenvector centrality with Gini coefficients to profile editorial governance—offering modular code, example data, and a reproducible workflow for investigating editorial networks and symbolic capital dynamics. This supports reuse of the approach in other domains where editorial governance and evaluative infrastructures are analytically relevant.

8.4 Practical Implications

The findings of this thesis have implications for journal editors, editorial boards, research evaluators, and institutions concerned with the organisation of scholarly communication and the promotion of epistemic diversity within sustainability science. More broadly, these findings are relevant for understanding how research evaluation systems operate through scholarly communication structures, shaping which contributions are recognised and legitimised.

Symbolic capital concentration is not simply an aberration that can be corrected through isolated measures, but a structural feature of how academic fields secure legitimacy within existing evaluative regimes. The transformation paradox shows how fields committed to inclusivity and interdisciplinarity may nonetheless reproduce hierarchies through routine practices of citation, editorial selection, and institutional affiliation. Recognising this dynamic is important in practice because it reframes diversity initiatives not as straightforward correctives, but as interventions operating against durable structural tendencies. This perspective may temper expectations of rapid change while focusing attention on where sustained efforts are most likely to have impact.

Within SCIM's recursive architecture, some points of intervention are more tractable than others. Editorial governance is one such point: as a mechanism of consecration, it has downstream effects on symbolic circulation and institutionalisation. The concentration of symbolic capital within interlocking editorial networks, as documented in Article IV, suggests that deliberate diversification of editorial boards—across geography, institutional location, career stage, and epistemic tradition—may contribute to moderating self-reinforcing patterns of recognition. Such efforts would not eliminate symbolic hierarchy, but they could pluralise the sources from which consecration flows, expanding whose contributions are rendered visible and authoritative.

A second set of implications concerns evaluation practices. The thesis shows that bibliometric indicators function not as neutral measures of quality, but as evaluative devices that shape the distribution of recognition. For research evaluators and funding bodies, this supports approaches that complement citation-based metrics with qualitative assessment, recognise diverse publication venues, and resist conflating journal prestige with scholarly merit (Hicks et al., 2015). Such shifts could alter the conversion rates through which different forms of contribution are recognised.

For sustainability science scholars, the thesis underscores a tension between explicit commitments and institutional positioning. Scholars seeking to advance transdisciplinary, solution-oriented, or Global South-centred research may find their work undervalued by evaluative systems calibrated to established academic standards. Institutional support for alternative dissemination venues, multilingual publishing, and non-traditional outputs could partially mitigate these disadvantages, though such efforts require sustained commitment and may carry reputational risks within prevailing reward structures.

8.5 Limitations

Several limitations shape the scope and interpretation of the thesis's findings. The citation and co-authorship data are sourced exclusively from the Web of Science Core Collection, a curated database whose coverage privileges English-language journals and publications from the Global North (Mongeon & Paul-Hus, 2016). This infrastructural selectivity introduces a visibility bias that likely underrepresents scholarship published in regional, non-Anglophone, or alternative venues, as well as forms of knowledge production not indexed within mainstream citation databases. The patterns of symbolic capital concentration identified in this thesis should therefore be interpreted as reflecting the structure of the indexed scholarly record rather than the full global and epistemic diversity of sustainability science. Similarly, the editorial discourse analysis focuses on three Anglophone journals, limiting the extent to which the findings can be generalised to sustainability science's broader research ecosystem, particularly in underrepresented regions and epistemic communities.

In empirical terms, the thesis analyses material covering different temporal segments of sustainability science rather than constructing a single continuous longitudinal dataset. Articles I–III reconstruct long-term dynamics of field formation and discursive change using bibliometric and editorial data spanning multiple decades, while Article IV provides a focused cross-sectional analysis of contemporary editorial governance. This mixed temporal design identifies processes of emergence, consolidation, and stabilisation, though it cannot determine whether observed patterns—such as symbolic concentration or editorial centralisation—will persist unchanged.

The operationalisation of field-theoretical constructs through bibliometric and textual indicators necessarily involves simplification. Eigenvector centrality captures relational positioning within editorial networks but does not exhaust the meaning of symbolic capital, which in Bourdieu's (1986) formulation also encompasses embodied dispositions and tacit forms of recognition not visible in structural data. Similarly, the qualitative content analysis of editorials involves interpretive decisions about how discursive claims map onto theoretical categories such as consecration and legitimation. These translations should be understood as partial operationalisations.

The thesis is theoretically grounded in Bourdieu's field theory, which foregrounds symbolic capital, hierarchy, and strategic competition as structuring forces within scientific fields. While this framework illuminates mechanisms of recognition,

consecration, and authority, it may underemphasise dimensions of scientific practice not readily captured by a field-structural account centred on symbolic capital, including material infrastructures of knowledge production, epistemic labour, and forms of coordination that do not map cleanly onto struggles over recognition (Sismondo, 2011).

8.6 Future Research Directions

The limitations also suggest directions for future research. Alternative perspectives—such as actor-network theory for material infrastructures or institutional theory for organisational routines—could address dimensions of scientific practice that a field-structural account centred on symbolic capital underemphasises (DiMaggio & Powell, 1983; Latour, 1987). Longitudinal research could further assess whether editorial reforms or diversity initiatives yield measurable shifts in symbolic redistribution over time.

Future work is also needed on the digital infrastructures that increasingly mediate scholarly visibility and recognition. Infrastructures become visible primarily when they break down or become contested, yet they continuously structure access, authority, and participation (Star & Bowker, 1999). In academic publishing, platforms such as megajournals, indexing services, and algorithmic recommendation systems embed evaluative functions into opaque and commercially governed architectures. This platformisation, as Ma (2023) argues, restructures scholarly communication by displacing traditional modes of editorial oversight with automated curation and metric-driven visibility. Megajournals were initially framed as egalitarian alternatives to disciplinary gatekeeping (Spezi et al., 2017), yet empirical research shows that they generate new stratifications that reproduce symbolic inequality through alternative mechanisms of visibility and evaluation (Siler et al., 2020). These developments offer a test case for SCIM in environments where recognition is mediated by digital platforms rather than disciplinary authority alone.

Future research could further foreground epistemologies and publishing systems from the Global South. Multilingual approaches, comparative fieldwork, and sustained engagement with regional infrastructures could surface models of scholarly legitimacy currently obscured by dominant indexing regimes. Such work would contest the universalising tendencies of dominant bibliometric methods and expand the theoretical horizon of field theory beyond its Eurocentric intellectual lineage (Bhambra, 2016; Go, 2016).

8.7 Final Reflections

The institutionalisation of sustainability science exemplifies a broader structural condition shaping all heterodox academic fields: recognition must be secured through the very mechanisms that reproduce inequality. SCIM specifies how this transformation paradox operates: expansion in volume and diversity proceeds simultaneously with persistent concentration in symbolic authority.

The thesis traces how recognition is produced, legitimised, and stabilised across relational, positional, and discursive registers, offering a sociological account that denaturalises academic hierarchy. The multimethod approach reveals what single-method studies miss: heterodox fields reshape discourse while reproducing orthodox structures. Interdisciplinarity expands while authority concentrates. Transformative ideals circulate while evaluative mechanisms ossify. Understanding transformation and reproduction as interdependent rather than opposing constitutes the central theoretical contribution.

These dynamics extend beyond sustainability science. Fields pursuing epistemic justice, interdisciplinary collaboration, or institutional transformation confront the same infrastructures through which recognition is distributed and power is organised. Making visible what governs academic legitimation does not resolve the transformation paradox, but it creates conditions for recalibrating how symbolic capital circulates.

Recalibration requires confronting a structural condition: transformative commitments cannot bypass the symbolic reward structures of the field—they must be pursued through them, even as this pursuit reproduces aspects of the hierarchies being challenged. This demands a sociologically informed strategy, not resignation. The transformation paradox is structural, yet structures are neither immutable nor self-executing. They require constant reproduction through practice—editorial decisions, citation choices, evaluative judgements, institutional investments—and it is precisely in these practices that opportunities for recalibration exist. The question becomes not whether to engage existing infrastructures, but how to redirect them towards more equitable and epistemically plural configurations.

Understanding how symbolic capital is accumulated, stabilised, and reproduced—its origins, mechanisms, and durability—provides an analytical basis for scholarly projects that seek not merely to describe academic hierarchies, but to engage them strategically. Such engagement clarifies where and how intervention is possible: within the everyday practices through which recognition is conferred,

authority is exercised, and academic value is made durable. From this perspective, scientometrics and bibliometrics within LIS—read alongside the sociology of science—occupy a critical analytical position: they are reflexive modes of inquiry that make visible the institutional and evaluative structures through which scholarly recognition, authority, and legitimacy are produced and stabilised.

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PART II: INCLUDED ARTICLES

Article I

Schirone, M. (2023). Field, capital, and habitus: The impact of Pierre Bourdieu on bibliometrics. *Quantitative Science Studies*, *4*(1), 186–208. https://doi.org/10.1162/qss_a_00232

RESEARCH ARTICLE

Field, capital, and habitus: The impact of Pierre Bourdieu on bibliometrics

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Keywords: bibliometrics, Bourdieu, informetrics, quantitative science studies, scientometrics, sociology of science

ABSTRACT

This study is a critical review aimed at assessing the reception received in bibliometric research by the theories and concepts developed by the sociologist Pierre Bourdieu. The data set consists of 182 documents, including original articles, editorial material, review articles, conference papers, monographs, and doctoral dissertations. A quantitative analysis was used to establish the authors and countries that most frequently make use of Bourdieu's theories, as well as the most popular concepts, which were identified as "field," followed by "symbolic capital" and "social capital." Then, the article discusses the impact of Bourdieusian key concepts such as "field." Among the findings, the following are noteworthy: the integration of his field theory into pre-existing bibliometric conceptualizations of research fields, especially when power relations are problematized; the use of "symbolic capital" in connection with citation analysis and altmetrics; and greater interest in Bourdieu's theories compared to his methods, although some sources have used Bourdieu's preferred statistical method, correspondence analysis. Moreover, Bourdieu's theoretical impact is noticeable in research on journals, university rankings, early career researchers, and gender. The paper's conclusions point to future research paths based on concepts less used in the bibliometric literature, such as "delegation."

1. INTRODUCTION

1.1. Background

Pierre Bourdieu is one of the most influential sociologists in history, and his theories have been, and are, used extensively across a broad spectrum of fields (da Silva, 2021; Korom, 2020). The sociology of science is one of the fields in which Bourdieu, primarily through *Homo academicus* (1988), has had a significant influence, and his works have also been cited in the field of bibliometrics.

The influence of Robert K. Merton, another impactful sociologist of science, has attracted the attention of scholars in the field of quantitative science studies (e.g., Crothers, Bornmann, & Haunschild, 2020; Desrochers, Paul-Hus et al., 2018), and, more specifically, his influence on research in bibliometrics (and related metrics field) has been amply discussed, most notably by Eugene Garfield (2004, 2009) as well as others. Similarly, we aim to provide a systematic analysis of how Bourdieu's theories and concepts have been applied within bibliometric research and to propose and discuss the further potential of Bourdieu's theories in the field.

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For this purpose, the present literature review includes a synopsis of the sociologist's key ideas, followed by a section on the paper's data sources and methods. The text then moves to a critical review of the sources, supported by their content analysis and network visualization, and structured according to the conceptual triad constituted by "field," "capital," and "habitus." The last section discusses the sociologist's overall impact on bibliometrics and future lines of inquiry.

1.2. An Overview of Bourdieu's Life, Works, and Theories

Pierre Bourdieu (1930–2002) was born in Denguin, a small town in southwest France. His career has been effectively summarized as the trajectory of an anthropologist who became a sociologist without ever forgetting his roots in philosophy, which was his formal academic background (Jenkins, 2014). At the beginning of his career as a scholar, he taught at the University of Algiers and undertook anthropological field research in colonial Algeria (Yacine, Wacquant, & Ingram, 2004). Later in life, he was appointed to the chair of sociology at the Collège de France, this country's most senior academic position in that field (see also Wacquant, 2002).

A general overview of Bourdieu's numerous works is accessible elsewhere (Golsorkhi & Huault, 2006), and in particular through the lens of his critics (Jenkins, 2014; Sismondo, 2011), collaborators (Wacquant, 2002), and even Bourdieu's own (Bourdieu & Wacquant, 1992). Several works are nevertheless particularly relevant to the scope of this review and worthy of mention.

In the first period of his career, Bourdieu lived in Algeria and wrote anthropological work concerning its society in the wake of the war of independence. Later, in the book *Distinction* (2010), first published in 1979, he analyzed the social conditions that influence the appreciation of artistic works and other cultural objects, a theme resurfacing in later works (Bourdieu, 1980, 1993). In *Homo academicus*, Bourdieu (1988) studied the French university system, and in particular the power struggles between scholars with more status and resources or the "dominant" fraction, and the "dominated" ones that have more limited availability of the necessary means to succeed in the field. The theme of power and status in academia reappears in his book on philosopher (and university manager) Martin Heidegger (Bourdieu, 1991c) and in *State nobility* (Bourdieu, 1996b).

Bourdieu's oeuvre has addressed many topics, as this brief recollection of some of his major works can testify. However, his interest in the sociology of science has been long-lasting (1975b, 1988, 1991b, 2004). Bourdieu's (2000) analysis of the scholarly field, as well as any other social field, hinges on the triad formed by the concepts "field," "capital," and "habitus."

Bourdieu's thought is broader than this triad, as one of his former collaborators pointed out (Wacquant, 2014). However, for an assessment of Bourdieu's impact in a scientific field, the triad deserves particular attention because of the popularity of Bourdieu's sociology gained via the utilization of its three concepts. According to Wacquant, nevertheless, the success of the triad has sometimes been accompanied by the "fetishization" of these concepts and their overuse (Wacquant, 2018).

Against Alfred Schütz's social phenomenology, deemed by Bourdieu (1975a, p. 45, note 41) as too subjectivist and politically "neutral," and the formalism of Structuralists, he treats scientific and artistic fields as being two types of the intellectual *champ* (1996a). Moreover, as with the instances of "fine" and "popular" art—which are valued differently in society—scientific fields are conceived as "distinct" (Bourdieu, 2010), with some science being more

prestigious than others. The cases of the higher status of economics and the "pariah science," sociology (Bourdieu, 2005), are both examples of the "social hierarchy of the faculties" (Bourdieu, 1988, p. 37). In any case, the scientific field is a type of social field and, as such, is a "social space" (Bourdieu, 1985b) inhabited by several components: the social agents (individuals and groups), their positions, relations, and conflicts; the institutions that grant access to the field and legitimize the exercise of power; and the assets available to the agents (Bourdieu & Wacquant, 1992). The genesis and development of fields correspond to the agents' struggles to secure a position or acquire a more advantageous one. Eyal (2013) has argued that Bourdieu's field theory is more beneficial for studying relations within fields than between fields. Bourdieu has indeed been more concerned with the history and organization of individual fields, such as sociology (Bourdieu, 2002) and philosophy (Bourdieu, 1991c), than the interactions between scholarly domains or their interdisciplinarity. Such limitation of his field theory, pointed out also by Sismondo (2011), could be understood if one considers Bourdieu's strong beliefs in an "established hierarchy of the disciplines" and his emphasis on the relative "autonomy" of scientific fields from each other and from societal structures such as the market (Bourdieu, 1975b, p. 34). According to Burawoy (2018), an overestimation of the autonomy of social fields led Bourdieu to consider the "capitalist university"—the university influenced by neoliberalism and New Public Management—more independent from external market pressures than it was (and in Burawoy's view, still is).

Nevertheless, a significant share of Bourdieu's legacy derives from an innovative analytical toolbox based on the concept of "capital." Bourdieu (1986a) identifies three primary forms of capital: economic capital, or the assets that can be readily marketed and monetized; social capital, or the intangible assets constituted by relations and networks; and cultural capital, or an agent's knowledge assets. Moreover, following Max Weber's sociology (Wacquant, 2018), Bourdieu (1991a) also theorized the "symbolic capital," which consists of other intangible assets (i.e., prestige, authority, and status). In addition to these primary forms of capital—found across many social fields—Bourdieu also conceptualizes other types that are "legal tender" only within specific social fields, as in the case of academic capital and scientific capital. Although intertwined, these two types of capital have different meanings and are used slightly differently by Bourdieu. The former concept emphasizes academic institutions' bureaucratic roles (e.g., universities as degree-granting institutions). The latter means prestige or symbolic capital that individual researchers and collective agents, such as universities, acquire in a field.

Whereas a distinction and tension characterize Bourdieu's theory—between primary capital and field-related ones such as the scientific capital—the third pillar of the triad, habitus, always exists as habitus-of-a-field. Drawing upon David Hume's dispositional account of human agency, Bourdieu (1977) defined the habitus as those conscious and unconscious dispositions that drive an agent's behavior, are shaped by the field's practices, and consolidate such practices (Bourdieu, 1991c). Humans develop the habitus typical for the field through socialization processes, which, in turn, reinforces the reproduction of the social order (Bourdieu, 1991a, p. 251).

Statistical methods are necessary to analyze a field as a "whole" (Bourdieu, 2010). From the middle 1970s onwards, Bourdieu used the statistical method of correspondence analysis developed by the mathematician Jean-Paul Benzécri (2006), with whom Bourdieu entertained a long-lasting personal and intellectual relationship (see also Le Roux & Rouanet, 2010). At the same time, Bourdieu acknowledged the potential limitations of quantitative analyses, particularly their possible reinforcement of the "biographical illusion" (Bourdieu, 1986b). According to this fallacy, information about individuals is considered constant in time and space rather

than being ever-developing. Because the agents are always caught in practices that develop historically, the statistical analyses have to be grounded in history. Inversely, historical analyses of social fields require a bird's-eye view of the field provided by statistical approaches.

Although the emphasis on history in Bourdieu's sociology is well known (Calhoun, 2013), far less mentioned is its "probabilistic" nature, an essential aspect that Strand and Lizardo (2021) have recently pointed out. The practices of the human agents that are more likely to occur (e.g., because of power structures) become, with time, consolidated characteristics of a field. In this perspective, power structures are conservative. In contrast, the struggles for capital and better positions in hierarchies introduce change and variability into social practices, such as the production of scientific knowledge. In intellectual fields, be they scientific or artistic (Bourdieu, 1975a), social and cognitive relations are intertwined. Amid such relations, power structures in society legitimize certain fields rather than others, generating and reinforcing hierarchies between "dominant" and "dominated" fields, as with the case of the "fine" and "popular" forms of art, or between established scientific fields and other emerging or declining ones."

2. DATA SOURCES AND METHODS

The review type of this study, the critical review, seeks in the sources it assesses their "conceptual contribution to embody existing or derive new theory" according to the typology created by Grant and Booth (2009, p. 94) which Price (2022) has lately considered as having "stood the test of time." According to two more recent surveys of review types, the critical one belongs to the "traditional" review family (Sutton, Clowes et al., 2019), and it seeks "to critically analyze and examine the literature and the main ideas and relationships of an issue" (Snyder, 2019, p. 336).

The relevant documents for the present review article were identified through a multistep approach based on the workflow illustrated in Figure 1. The Web of Science Core Collection was used to identify documents published in the core journals. Their keywords were subsequently used to search for the additional literature constituting the review's final data set, which is available in Appendix A of the Supplementary material.

2.1. Data Sources

In Step 1 of the data collection, an initial data set of documents was identified using the function Cited Reference Search in all the citation indexes of Web of Science Core Collection (Clarivate Analytics). A search for all documents that cite any works authored by Bourdieu (on January 31, 2022) and published between 1960 (when his scholarly contributions began to be printed) and 2021 (the last complete year at the time of writing) resulted in 15,167 hits. In Step 2, the data set of core literature for the field (n = 76) was identified by looking for documents (of any type) in core journals in bibliometrics (and related metrics), according to the study by Milojević and Leydesdorff (2013), whose findings Maltseva and Batagelj (2020) have more recently confirmed. In Step 3, six documents not pertinent to the bibliometrics field (all published in the *Journal of the Association for Information Science and Technology*) were excluded. The full texts of the resulting 70 documents were downloaded in Step 4. At this stage, moreover, the R package for science mapping bibliometrix (Aria & Cuccurullo, 2017) was used to analyze the 70 documents and explore the characteristics of this initial literature set, such as the most productive and cited authors, the core documents, and the most recurring author-assigned keywords that is, the keywords present in the original documents and not algorithmically generated in the database's environment (on how to utilize bibliometrix in

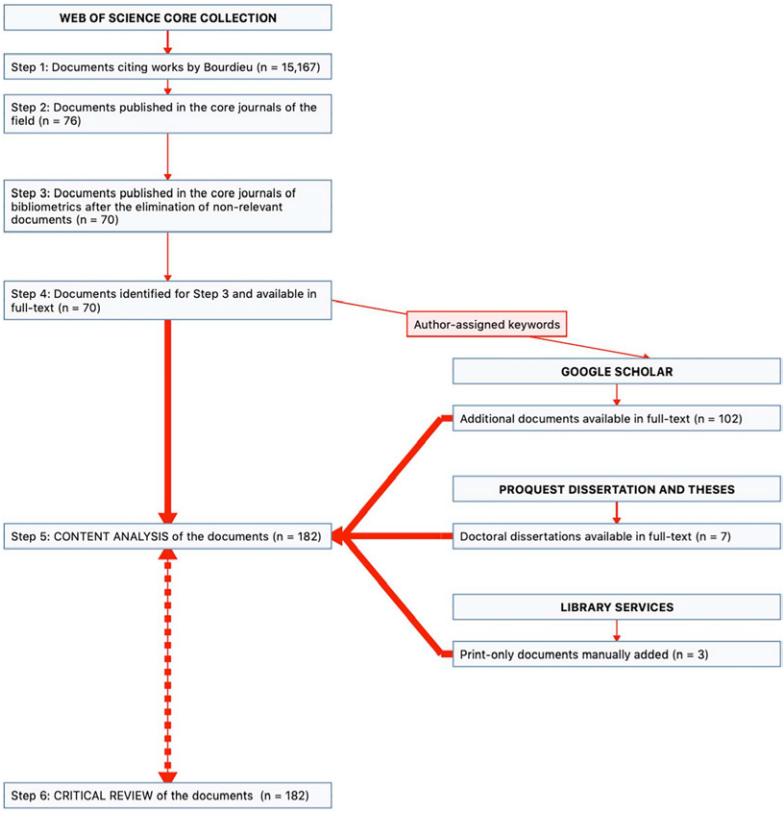

Figure 1. The workflow of the study. *Note*: The core journals of bibliometrics in Step 2 were identified based on the study by Milojević and Leydesdorff (2013). The identification of the author-assigned keywords (for building the search query in Google Scholar) and of the core authors (for searching additional documents for the content analysis in Step 5) was a bibliometric analysis of the documents (n = 70) in Step 4 performed with the R package bibliometrix (Aria & Cuccurullo, 2017).

a review study, see also Secinaro, Calandra et al., 2021). In Step 5, these author-assigned keywords were included in a search query used for collecting additional sources available from the search engine Google Scholar (Alphabet). Broad terms such as *research* or out-of-scope ones such as *physics* were excluded, whereas additional ones derived from the study by Bar-Ilan (2008) such as *informetric* and *webometric*, were included. The characteristics of the search engine make it redundant to key in the Boolean operator AND in the search box and to specify both the singular and plural form of the terms. The following Google Scholar query also included the term "Bourdieu" (because a web page that has a reference to a work by Bourdieu must include the word "Bourdieu" in its text) and was structured with the search operator allintext:

allintext:Bourdieu (scientometric OR bibliometric OR webometric OR informetric OR altmetric OR "citation analysis" OR citation OR "network analysis" OR authorship OR

citation OR "citation network" OR co-authorship OR interdisciplinarity OR "international academic awards" OR "research agenda" OR "research collaboration" OR "research performance" OR "scientific collaboration")

The data set of full-text documents in English retrieved comprised journal articles (including review articles), conference papers (standalone or printed in proceedings), monographs, textbooks, book chapters, and doctoral dissertations published between 1960 and 2021. Those documents had to fit the theoretical or methodological scope of bibliometrics (and related metrics), and Bourdieu's concepts had to be explicitly mentioned. The relevance to the field of bibliometrics (and related fields) was evaluated based on the document's title, abstract, and keywords and by accessing the full-text version whenever these metadata fields did not suffice and the full text was available. In Step 5 still, more full texts were retrieved using the software Publish or Perish version 8.2 (https://harzing.com/resources/publish-or-perish) through citation searches for Bourdieu's works in Google Scholar. Besides all the documents retrieved with the abovementioned steps in Google Scholar (n = 102), doctoral dissertations (n = 7) were retrieved from the database ProQuest Dissertations and Theses A&I (ProQuest), and print-only documents were accessed through library services (n = 3).

The review's final data set obtained through these steps consisted of 182 documents. Their metadata information was imported into the reference management software EndNote (https://endnote.com) for manually cleaning the data and obtaining the RIS format file used for the network visualizations based on their publication data (see Section 2.2). Their full texts were imported into the text analysis software NVivo for the content analysis (see Section 2.3). Lastly, Step 6 corresponds to the detailed reading of these sources and their critical review, which builds on the content analysis in Step 5. Conversely, the reading of the resulting documents in the critical review stage of the study strengthened the content analysis.

2.2. Network Visualizations

Two network maps based on data from the 182 documents were generated in the visualization software VOSviewer version 1.6.18 (van Eck & Waltman, 2010). The first map was based on the coauthorship relations extracted from an RIS format file created with EndNote. The fractionalization approach was used to normalize the links' strength. Nodes in the network were weighted according to the number of documents (van Eck & Waltman, 2022). Furthermore, the RIS file, which included all the author-assigned keywords manually curated, was imported into the VOSviewer environment (van Eck & Waltman, 2010). A text-mining network was generated with the software's default settings and an additional VOSviewer thesaurus file (van Eck & Waltman, 2011).

2.3. The Content Analysis

According to Krippendorff's (2019) typology of content analyses, the approach pursued in the review is problem driven rather than text driven or method driven—with the research problem being the impact of Bourdieu's concepts. Thus, the full-text documents were imported into the text-analysis software NVivo (https://www.qsrinternational.com), read, and coded (Jackson & Bazeley, 2019). Print-only documents had to be added manually. The content analysis combined quantitative elements (e.g., the frequency of the occurrences of the concepts in the corpus) with qualitative ones (e.g., the significance of these concepts in the context of bibliometrics). The paragraphs of the individual documents were treated as the data's "emergent units" (Krippendorff, 2019, p. 286). The coding scheme through which these "conceptual

units" (Lacity & Janson, 1994, p. 143) were identified is provided in Appendix B of the Supplementary material. Bourdieu's conceptual framework was used to determine the codes. Additional notions not found in Bourdieu's work but still useful for the data analysis were included in the coding scheme. One example of this latter case is "ego's network size," which Abbasi, Wigand, and Hossain (2014) utilize to study the social capital of scholars. Certain terms can be associated with other theoretical perspectives than the Bourdeusian one, for instance, "field" or "discipline" (Hammarfelt, 2020; Sugimoto & Weingart, 2015). Thus, a mention of at least one of Bourdieu's works in the paragraph was required to associate the text with that specific code. A unit of analysis—the paragraph—was treated as "multi-valued data," that is, multiple codes could be associated with the same coded text (Krippendorff, 2019, p. 287).

I performed coding, although the coding process and data analyses were discussed with two senior researchers in bibliometrics who are also knowledgeable of Bourdieu's works. The coding and interpretation of the units were conducted through an iterated reading of the data, according to which a concept was added to the coding scheme based on its first occurrence in the data set. Following an abductive standpoint to content analysis, this process was repeated until sufficient "empirical grounding" (Krippendorff, 2019, p. 39) was reached. With me as the only coder, the repeated reading of the sources and my continued debriefing with the two experts mitigate the lack of statistical tests for assessing intercoder reliability. In addition, the mixed-methods nature of the content analysis granted an element of triangulation in virtue of which qualitative and quantitative approaches strengthened reciprocally their respective findings.

3. RESULTS

This results section begins with Bourdieu's influence seen through the quantitative findings of the content analysis and the network visualizations. Thereafter, this initial picture of his legacy will be followed by a more fine-grained assessment of sources based on the qualitative analyses.

3.1. A Quantitative Overview of the Corpus

Five of the most productive authors in the data set are associated with a Canadian university (Vincent Larivière, Adèle Paul-Hus, Yves Gingras, Philippe Mongeon, and Nadine Desrochers). The countries associated with the most documents (according to the authors' affiliations) are the United States (n = 54) and Canada (n = 40), followed by the Netherlands (n = 23), Germany (n = 13), Spain (n = 12), and Brazil (n = 9).

Figure 2 presents different colors corresponding to the chronology of the documents on which the network is based. The map thus highlights the pioneering role of the U.S.-affiliated Blaise Cronin (author of 14 documents) and the Canadian Yves Gingras (author of nine documents). The color of these two authors' nodes is found at the left end of the color spectrum, indicating early publications. Although the Soviet scientometrician Haitun (1982) is the first to cite Bourdieu, the book on the field of Canadian physics by Gingras (1991) has been paramount in introducing Bourdieu in bibliometrics research. Vincent Larivière, a former PhD student of Gingras, is the most productive author (with 20 documents). The map also shows Cronin's centrality in the network, and Cassidy R. Sugimoto (with eight documents), a former PhD student of his, is also among the most prolific authors. The other authors who have published the most documents are Adèle Paul-Hus and Rodrigo Costas (nine documents), Loet Leydesdorff, Nadine Desrochers, and Philippe Mongeon (seven documents), and Björn Hammarfelt and Jacqueline Leta (five documents). In particular, Figure 2 shows the pivotal role in the network of Leydesdorff, Desrochers, and Costas.

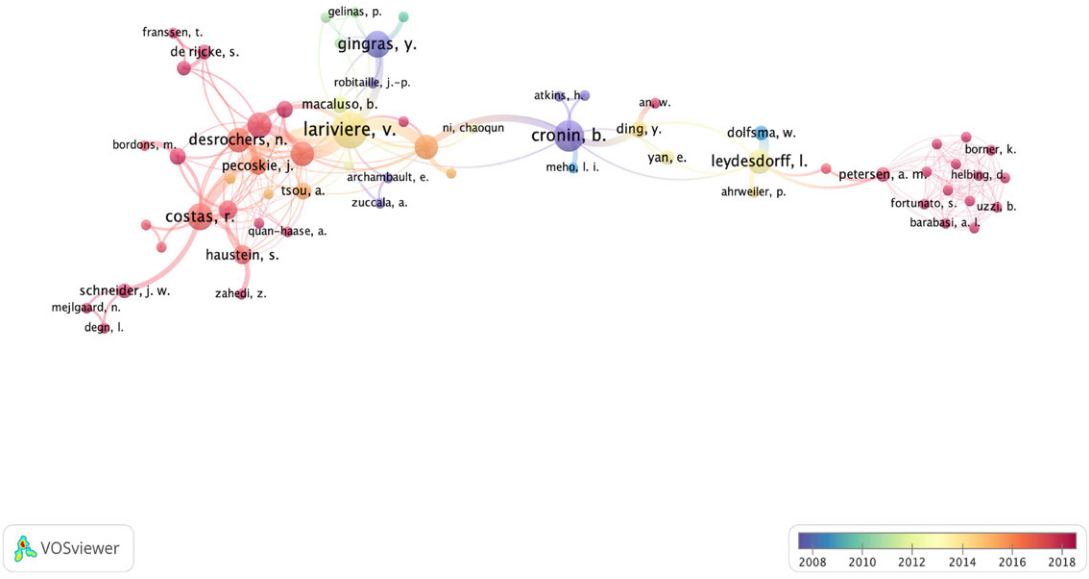

Figure 2. The coauthorship network of the authors of documents in the data set.

Figures 3(a)–(c) show the most frequent concepts according to their mention in the data set (Figure 3(a)), the number of documents (Figure 3(b)), and the types of capital (Figure 3(c)). In Figure 3(a), the concept of "field" ranks first, followed by "capital" and "habitus," whereas Figure 3(b) shows that the most mentioned types of capital are the symbolic and the social. Figure 3(b) confirms the assertion made by Wacquant (2018), according to whom Bourdieu's concepts are often parsed and used individually. Occurrences of more than one type of capital in the same text are rare, with a few exceptions where both social and symbolic capital are mentioned (Abbasi et al., 2014; Desrochers et al., 2018), and in sources that report both "scientific capital" and "symbolic capital" to specify that the former is a subtype of the latter, that is, symbolic capital in the field of science (Champely, Fargier, & Camy, 2017; Desrochers, Paul-Hus, & Pecoskie, 2017; Jiang & Liu, 2018).

Figure 4 shows the connections between the author-assigned keywords associated with the documents. The overlay visualization functionality of the software adds a chronological dimension: terms associated with more recent documents appear in a color closer to the right end of the color spectrum. Among them, the nodes "sociology of sociology," "social capital," "sociology of science," and "field theory" would suggest that sociological thinking, broadly speaking, has impacted the conceptual organization of the review's corpus. Other terms, such as "gender gap," "evaluation," and "ranking," are to be re-encountered later in the review.

3.2. The Impact of Bourdieu's Triad on the Corpus

Emirbayer and Johnson (2008) and Malsch, Gendron, and Grazzini (2011) have effectively put to use this "conceptual triad (field-capital-habitus)" as a vantage point to gauge Bourdieu's

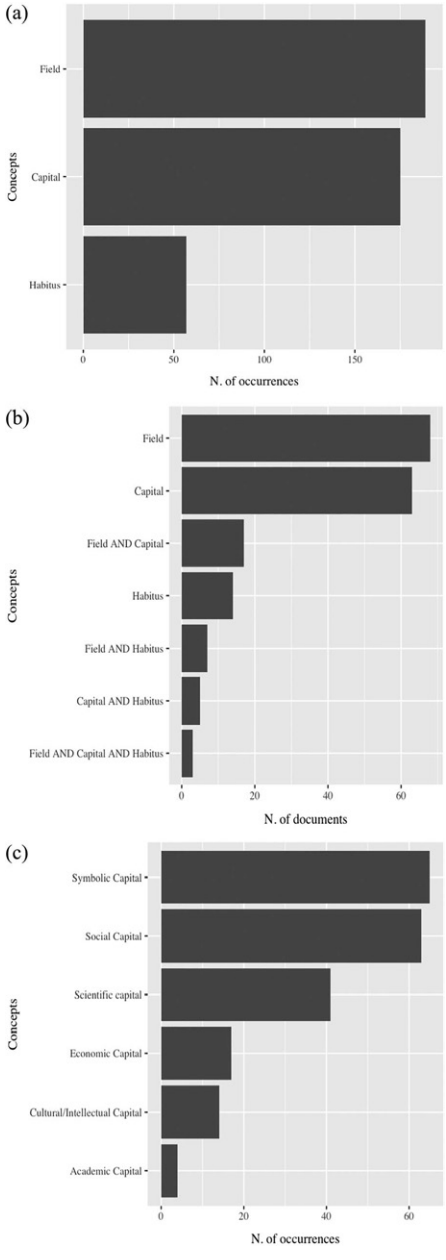

Figure 3. (a) Bar chart of Bourdieu's triad according to occurrences of the codes. (b) Bar chart of Bourdieu's triad according to the number of documents. (c) Bar chart of Bourdieu's triad according to occurrences of the concept *capital* in the data set.

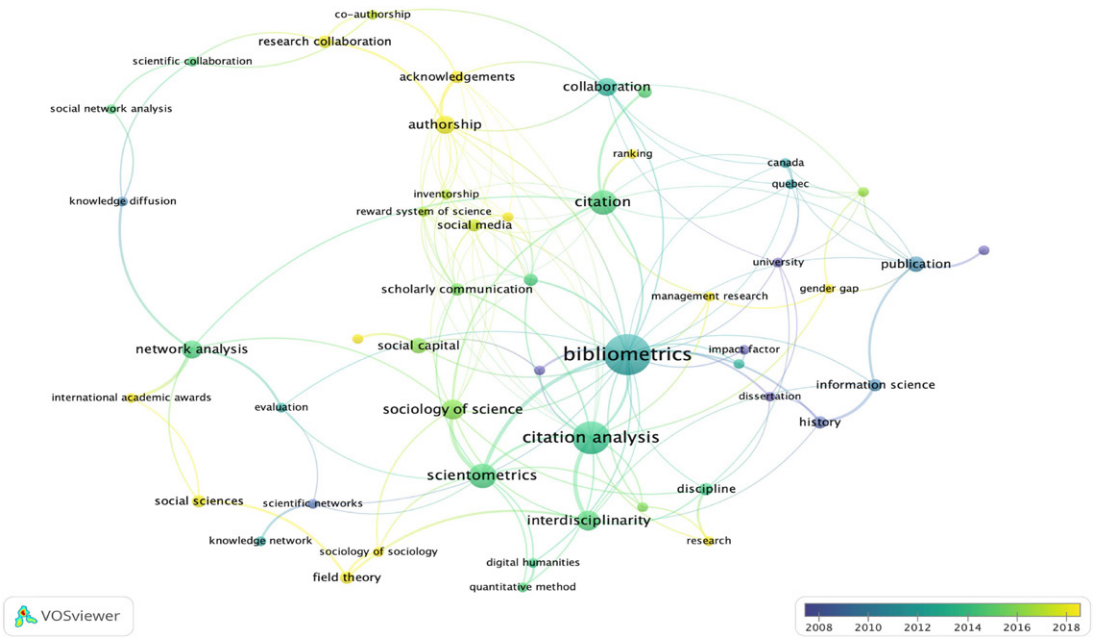

Figure 4. Text mining network based on the co-occurrence of author-assigned keywords.

impact on other fields (the fields of organizational analysis and accounting, respectively). More recent studies (Doblytė, 2019; Millar, 2021) also employ this perspective of the triad. Similarly, the content analysis and the detailed reading of documents ground this section, which focuses on how the key concepts in the triad have been used. Bourdieu's thought is broader than the triad, and "it rests not on three but on six conceptual pillars (the triad plus doxa, symbolic power, and reflexivity)" (Wacquant, 2014, p. 125). Besides the triad, these three other concepts have therefore been used to code the texts (together with other concepts that have emerged from the data). However, because "field," "capital," and "habitus" occur with significant frequency in the corpus of the present review, the discussion of the results is structured in sections corresponding to the elements of the triad.

3.2.1. Field

Spatial metaphors are not uncommon in bibliometrics (Hammarfelt, 2020), which is a crucial factor for understanding how Bourdieu has been received in this field. In Bourdieu's conceptual framework, social fields are spaces that possess three dimensions (Salö, 2020): (a) the physical and material dimension (i.e., a geographic space that human agents inhabit and the materiality of their practices); (b) a social dimension (i.e., the relations between agents in the field); and (c) a semantic dimension (i.e., the meanings exchanged through communication). The bibliometrics literature has focused on (b) and (c), often combining his field theory with theoretical approaches established in this research domain. Bourdieu's idea of a "social topology" based on the relations between agents is translated into a topology of relations between documents or, less often, authors. The organizational (Whitley, 2000) and the

cybernetic (Leydesdorff, 2011) approach in science studies have played a key role in reinterpreting Bourdieu's topology according to bibliometric terminology and therefore deserve special mention. According to Whitley (2000), scientific fields are work organizations with a cognitive dimension characterized by degrees of "task uncertainty" and a social dimension determined by the "mutual dependency" of the scientists upon each other in performing their everyday work tasks and in making a decision (e.g., where to publish their research). Several studies have associated the Bourdieusian conceptualization of the scientific field with Whitley's organizational account of science (Gómez-Ferri, González-Alcaide, & Llopis-Goig, 2019; Hammarfelt, 2011, 2018; Hyland, 2003; Prpić, 2007; Sheble, 2017). The connection between Bourdieu and Whitley is perhaps most evident in the works of Loet Leydesdorff, who combines Bourdieu's idea of the relative autonomy of the scientific fields with a cybernetic perspective. From this standpoint, a research field is a relatively autonomous subsystem in the system of science, which is a subsystem within society. Further down in the hierarchies of systems, a field is a "self-organization of cultural constructs" that follows the cybernetic principle of autopoiesis (Leydesdorff, 2011, p. 398). According to Bourdieu (1975b), social fields (the scholarly field being one of them) possess relative autonomy, which agrees with the conceptualization of scientific fields as self-sustained work organizations (Whitley, 2000) or cybernetic systems that evolve based on their internal feedback (Leydesdorff, 2011). The idea of the relative autonomy of fields—or "spaces of meanings," to use Leydesdorff's phrasing—also appears in the literature dedicated to the institutionalization of fields and the conceptual identification of disciplines (Dolfsma & Leydesdorff, 2010; Hammarfelt, 2020; Pierce, 1992; Sugimoto & Weingart, 2015). In fact, according to Bourdieu (1985a), a discipline is a scientific *champ* that has undergone "institutionalization." In other words, the *champ* has its formally accepted "means of knowledge production," such as specialized "associations, meetings, journals," the rights to grant academic degrees and titles, and to choose "official representatives" (Bourdieu, 2004, p. 50). Sociology is a discipline because of its established means of knowledge production, even if it is intellectually "scattered" by diverse points of view and schools of thought (Bourdieu, 2002). This discipline is, at least to Bourdieu's eyes, a "pariah science that is always under suspicion for its supposed political leanings" (Bourdieu, 2005, p. 10). However, sociology is also less interesting for the agents of the political *champ* than the higher status "state science" of economics (Bourdieu, 2005, p. 10). Subsequently, the risk of losing autonomy from the political *champ* is higher for the latter than for the former. In the data set identified for this review, Bourdieu's view on "discipline" is mentioned concerning the "strong connection between discipline and power" and contrasted with the work of Bourdieu's colleague at the Collége de France, Michel Foucault (Hammarfelt, 2020, p. 246). In the paper by Sugimoto and Weingart (2015), Bourdieu's conception of "discipline" is associated with the social connotation of disciplinarity, which is based on personal relationships and networks, a shared habitus, and common interests. A noteworthy element is that, according to Bourdieu (2004), the description of the struggles between physicists and engineers for identity and resources portrayed in the book by Gingras (1991) is emblematic of the social and power component of the discipline as institutionalized *champ*.

Several sources have focused on the interdisciplinarity of science fields and their disciplinary boundaries (Hammarfelt, 2018; Horta & Santos, 2020; Shibayama & Wang, 2020; Sugimoto & Weingart, 2015). This literature could be read as a sign of bibliometric research's more pressing interest in the interaction between fields compared with Bourdieu's original sociology of science—if the criticisms of Bourdieu's emphasis on the autonomy of scientific fields, discussed in Section 1.2., are considered (Burawoy, 2018; Eyal, 2013). On this topic, however, it is crucial to remember that several bibliometrics papers emphasize the relative

autonomy of the domain of journals from the actual relations between authors (Katchanov & Markova, 2017; Katchanov, Markova, & Shmatko, 2016; Leydesdorff, 2011).

Bourdieu's topology of fields is intrinsically social and cognitive. Separating the cognitive organization of intellectual—scientific and artistic—fields from their social organization is, for Bourdieu (1985a), a fallacy because this operation legitimizes existing power relationships, as the field of German philosophy exemplifies (Bourdieu, 1991c). The traditional emphasis on the cognitive dimension of Martin Heidegger's philosophy (i.e., his theories and concepts) disentangles intellectual from social relations. According to Bourdieu, Heidegger's view of philosophy as the foundation of any other type of knowledge stems from his position as a professor at the dawn of the Third Reich, when the role of philosophy professors was declining because of the competition brought forward by emerging social sciences. Interpreting research fields as sociocognitive structures is also a perspective rooted in the bibliometrics tradition (Hammarfelt, 2018), as shown by the sources using the term *sociocognitive* (Díaz-Faes & Bordons, 2017; Gingras, 2008; Sheble, 2017). In particular, Díaz-Faes and Bordons (2017) consider acknowledgments as sociocognitive reflections of a scholarly community, and Gingras (2008, p. 78) proposes the study of cocitation relations as a historical "socio-cognitive analysis" of the collective citation behavior of physicists.

Scientific fields are spaces of power struggles for the control of the means of knowledge production, that is, for scientific authority as embodied in "technical capacity" and "social power" (Calabrese, 1992, p. 208). The Bourdeusian theme of asymmetric power relations has emerged in studies focused on the skewness of publication and citation patterns. Even before Bourdieu's most popularized works were published, he was cited in a paper on "scientometric patterns" (Haitun, 1982). Studies on distributions and normality (Ivancheva, 2001), models of knowledge diffusion (Vitanov & Ausloos, 2012), and citation distributions (Katchanov & Markova, 2015) are also focused on the skewed nature of publication and citation patterns.

Bibliometric literature has referred to Bourdieu's concept of power as the creation or consolidation of asymmetric relations in the field and has focused on topics as diverse as gender inequality (Olinto & Leta, 2011), language bias in evaluating research (Frey & Pommerehne, 1988; Vasconcelos, Sorenson et al., 2009), disparities between senior and junior researchers (Larivière, 2012), and the ranking of scientists, journals, and universities (Gingras, 2016).

Bibliometrics scholars have used Bourdieu's methods far less frequently than his concepts. They have often reinterpreted his field theory as connections between authors (e.g., coauthorship), references, or citations, e.g., cocitation and bibliographic coupling, or words in the text (e.g., topic modeling and coword analysis) (Yan, 2014). In their study on Russian physics, Katchanov et al. (2016) replicate the approach of *Homo academicus* (Bourdieu, 1988), although employing multidimensional scaling rather than multiple correspondence analysis. On this topic, mathematicians (and Bourdieu's former collaborators) Brigitte Le Roux and Henry Rouanet wrote that multidimensional scaling dominated multiscale statistics, whereas correspondence analysis was left "underutilized" (Le Roux & Rouanet, 2004, p. 14). In the literature set of this review, however, correspondence analysis has been applied in the article by Paul-Hus, Díaz-Faes et al. (2017) to investigate acknowledgment practices. Other examples of the use of correspondence analysis are found in the paper by Pandiella-Dominique and Bautista-Puig (2018) on sustainability research, the article by Brahimi and Fordant (2017) on the citation impact of the social theorist Edward Said, and the more recent paper by Schwemmer and Wieczorek (2020) on the divide between quantitative and qualitative methods in sociology.

More generally, methodological diversity reigns among the studies that refer to Bourdieu. Coauthorship is used as a proxy for collaboration (Forte, 2017). Coauthorship *and* mentions in

blogs (Roth & Cointet, 2010) but also cocitation (Zeng, Shen et al., 2019) are used for community detection. Scholarly journals as "spaces of meanings" are studied through factor analysis by Leydesdorff (2011), whereas Roth and Cointet (2010) analyze the field as the space defined by the relations between agents—a specific community of scientists—rather than those between journals. Moreover, in bibliometrics, there have been various conceptualizations of "field." As mentioned by one reviewer of the present article, it suffices to consider the discussion regarding "field-normalization," a topic discussed in the review's data set in several sources (Costas, Perianes-Rodríguez, & Ruiz-Castillo, 2017; Leydesdorff, 2021; Lietz, 2020; Sugimoto & Larivière, 2018). Discussing the concept of "field" in bibliometrics without referring to Bourdieu's *champ* might be more appropriate for the research questions driving that specific line of inquiry, which also holds for documents that include references to Bourdieu. In fact, the review's data set comprises documents that have utilized Bourdieu's framework to a more significant extent—the case of *Physics and the rise of scientific research in Canada* (Gingras, 1991) is emblematic, as discussed earlier on in this section—but also other sources in which a reference to Bourdieu's *champ* appears to be just one among the many, as, for instance, in the paper by Sheble (2017). These latter cases are nevertheless helpful in gauging the influence of Bourdieu because they still suggest an interest in his works.

In sum, Bourdieu's field theory has been used connected with the topic of the sociocognitive organization of the sciences and, from the methodological perspective, mediated by established bibliometric approaches, such as semantic analyses of texts or coauthorship.

3.2.2. Capital

The concept of capital is associated in the literature with both "evaluative spheres" of a field (Åström & Hammarfelt, 2019), that is, the institutional sphere of formal research evaluation and the sphere of scholars' reputation in their communities. Bourdieu (1988) considered citations as proxies for symbolic capital, a view shared by Cronin (1998) and Gingras (Gingras & Wallace, 2010), the two pioneers of the review's literature set, as mentioned earlier. In this perspective, achievements based on citations and citation indexes convey a scholar's symbolic capital, a driving force in the reward system of science. Cronin (1998) regarded Bourdieu's stance on citations as symbolic assets as a stable ground for a "metatheory of citation," responding to Leydesdorff's (1998) call for a broader conceptual standpoint for theorizing citation patterns. Hyland (2003) pointed out that Bourdieu's (1991a) theory of symbolic capital in *Language and symbolic power*—a book also influential in Cronin's (2005) interpretation of citations as symbolic capital—has contributed to the success of the "market metaphor" that presents citations as the assets of academia.

Fuchs Epstein (2010) has regarded Bourdieu as indebted to Merton's theory of cumulative advantage. Nevertheless, on several occasions, Bourdieu (Bourdieu, 1975b, 2000; Bourdieu & Wacquant, 1992) criticized Merton's approach as a simplified account of the scientific field based on the ideal of the scientific norm. In his last lectures at the Collège de France (2001b), Bourdieu mitigated his criticism of Merton. On the one hand, Bourdieu considered the conflicts or "war" (in French *guerre*, see Bourdieu, 2001b, p. 93) between agents as the driving force of science, rather than the scientific community's pursuit of common goals as theorized in Merton's sociology. On the other hand, for Bourdieu, the norms sanctioned by a scientific community still regulated which weapons were allowed on the scientific battlefield. Thus, Bourdieu's position towards Merton is more contradictory than he would have liked to admit. He criticizes Merton but includes the perspective of the Mertonian norm into his view of socialization through the habitus of the field. In other words, Merton's scientific norms add to Bourdieu's theory a stable framework in which the conflicts emerge and find solution,

strengthening Bourdieu's (2001b) argument against views on science he deemed relativist (such as that of Bruno Latour and David Bloor, among others). In the review's data set, references to Merton's book *The sociology of science* (Merton & Storer, 1973) and his paper on the Matthew Effect (Merton, 1968)—cited by 62 and 44 documents, respectively—show the coexistence of Bourdieu's concept of capital and Merton's conception of science as a reward system self-regulated through its norms. This coexistence emerges in papers on citations (Cronin, 2000; Cruz-Castro & Sanz-Menendez, 2021; Larivière & Costas, 2016), acknowledgments in the reward system of science (Paul-Hus, Mongeon et al., 2020), and journal acceptance rates (Sugimoto, Larivière et al., 2013). In particular, the article by Desrochers et al. (2018) discusses the reward system of science from the perspective of Merton's and Bourdieu's distinct sociological standpoints and their presence in Cronin's works. From such a vantage point, Desrochers et al. (2018) deliver a picture of the state of the art of scholarly communication research as more and more inclusive in terms of which activities and achievements generate academic rewards—from authorship, contributorship, and inventorship to citations, acknowledgments, and social media metrics. As also pointed out on several occasions in the literature set analyzed in the present review, symbolic capital can have other proxies besides citations: distinctions, promotions, web hits, media mentions (Cronin & Shaw, 2002), scientific prizes (Bégin-Caouette, 2017; Cronin & Shaw, 2002; Ding & Cronin, 2011; Gingras, 2008; Gingras & Wallace, 2010), the place in the author byline of coauthored publications (Larivière, Desrochers et al., 2016; Mongeon & Larivière, 2016), mentions in an article's acknowledgments (Desrochers et al., 2017), social media mentions (Diaz-Faes, Bowman, & Costas, 2019), and invitations to take part in popular science activities such as TED Talks (Sugimoto, Thelwall et al., 2013).

For Bourdieu, symbolic capital depends on *illusio*, or "the set of rules that defines a field and legitimizes its existence" (Desrochers et al., 2018, p. 225). The rules that govern fields are *illusio* if seen from the perspective of the field and *doxa* from the agent's perspective. This latter concept, mentioned in the data set of the review by Bjerregaard (2010), means a belief system that guides the social agents to act according to the correct behavior for the field (Bourdieu & Wacquant, 1992). Altmetrics (or alternative metrics) exemplify how new criteria for prestige (besides those of traditional metrics) may affect the *illusio* of the field and arguably the mindsets of social agents, their *doxa*. If, or when, alternative metrics become part of the "rules of the game" of science, agents such as authors or research evaluators might follow those rules even if they are not forced to do so by formal practices, such as research assessment exercises and workplace requirements (Desrochers et al., 2017; Díaz-Faes & Bordons, 2017).

Regarding the method aspects, bibliometricians have reinterpreted the symbolic capital using their field's data collection and analytical tools. For instance, Gingras and Wallace (2010) move beyond Bourdieu's (1975b) reservations about the idea of one scientific community (and its underlying Mertonian assumption). The two authors operationalize the concept of "global symbolic capital" with the total number of citations received in the citation index. An author's "local" dominance in a field corresponds, instead, to the centrality of publications in a cocitation network and the number of citations received from other authors in that field. In another example of how symbolic capital has been reinterpreted according to bibliometric notions, Ding and Cronin (2011) differentiate symbolic capital as popularity (to be mentioned by any paper, regardless of its citation score) and prestige (to be mentioned by highly cited papers).

Various aspects related to coauthorship appear in the literature that refers to symbolic capital. Cronin (2005) points out that the significant number of authors typical of highly collaborative fields where expensive apparatus is shared—the phenomenon of "hyperauthorship"—

complexifies the relation between the symbolic capital gained through authorship and the corresponding rewards. The sharing between coauthors of the loss of symbolic capital or "negative capital obtained when a discovery is found to be fraudulent" is the topic of the paper by Mongeon and Larivière (2016). From a large-scale analysis of contributorship statements Larivière et al. (2016) find that "technical" contributions are most often performed by junior academic staff. In contrast, senior researchers conduct more typically "conceptual" tasks, indicating a "shift from technical work to more conceptual work as researchers age and rise in the hierarchy of science" (Larivière et al., 2016, p. 426). Moreover, the study's findings would support the practice of contributorship statements to increase the transparency of scientific knowledge production, including the accountability for one's work that comes with being an author.

For Bourdieu (2010), statistics are crucial to the success of sociology as a science. Yet, they may reproduce established ways of classifying social phenomena and reinforce power hierarchies. From such a perspective, citation indexes and bibliometric indicators—that Bourdieu (1988) mentioned in *Homo academicus*—possess an "ambiguity" (Bourdieu, 2000, p. 187) similar to the one he ascribes to the official statistics in sociological work. Publishing research output in top-ranked journals is a decisive "rule of the game" of science, one key strategy to secure a position in the field (Gingras, 2016). Similarly, Ordorika and Lloyd (2015) consider university rankings as social constructs that transform economic and social capital into symbolic capital and consolidate power inequalities in the global academic market. Nevertheless, analyses of publication and citation patterns or studies on university rankings can make the power structures more visible. For instance, university rankings can be used to operationalize the notion of "elite status," as the paper by Siler (2013) effectively shows.

Research collaboration can generate more or less symbolic capital according to the prestige of who is involved. However, collaboration always increases social capital—the second most mentioned type of capital—although often in texts more directly relevant to a specific national context (Djuric, Dobrota, & Filipovic, 2020; Prpić, 2007; Vasconcelos et al., 2009). Some papers derived tools and methods from social network analysis applied to coauthorship (Abbasi et al., 2014; Niu, 2014). Several authors (Forte, 2017; Letina, 2016; Martín-Alcázar, Ruiz-Martínez, & Sánchez-Gardey, 2019; Rost, Teichert, & Pilkington, 2017) mention Bourdieu's notion of social capital together with that of Robert D. Putman, James Coleman, and Ronald S. Burt (Forte, 2017; Letina, 2016; Martín-Alcázar et al., 2019; Rost et al., 2017).

Finally, the concept of "scientific capital," that is, the symbolic capital typical of the field of science (Bourdieu, 1975b) is also mentioned in the literature (Desrochers, Bowman et al., 2015; Desrochers et al., 2017, 2018; Ernø-Kjølhede & Hansson, 2011; Olinto & Leta, 2015), although less often compared with symbolic and social capital.

3.2.3. Habitus

The third concept of the triad, habitus, is also found in the literature, although to a minor extent. Some authors have focused on particular aspects of habitus formation, in particular, social class background (Andersen, 2001; Chiappa & Perez Mejias, 2019), the professional habitus (Herring, 1999), gender (Olinto & Leta, 2011), and academic seniority (Larivière, 2010a, 2010b; Larivière et al., 2016). Andersen (2001) finds that access to elite positions at Danish universities is more limited for those with a working-class upbringing (even if subsequent socialization after entering the scientific field mitigates the effects of class origin). His conclusion agrees with Bourdieu's (1988) findings on French academia and recent work on Chilean universities (Chiappa & Perez Mejias, 2019). Several studies by Larivière (Larivière,

2010a, 2010b; Larivière et al., 2016) focus on the junior staff's socialization into their role of independent researchers. In PhD programs, acquiring the habitus of the field explains the correlation between a higher number of articles written by Québécois PhD students throughout their doctoral program and their later prolificacy after completing the doctoral program (Larivière, 2012). More recently, Bes, Lamy, and Maisonobe (2021) have provided a compelling analysis of the socialization of PhD students based on copublishing between doctoral students and members of thesis committees at a French university. The topic of gender differences in science is discussed in several papers (Larivière, Vignola-Gagne et al., 2011; Leta, Olinto et al., 2013; Sheble, 2014) and are conceptualized as habitus by Olinto and Leta (2011). In particular, Larivière et al. (2011) refer in their paper to a key aspect of Bourdieu's theory of the habitus, which is the internalization of "dominant" values and their incorporation in the habitus of the "dominated." As they write,

> Given that men still occupy, more often than not, the dominant positions and participate actively in the formulation of research policies, and that many women also internalized these "dominant" values, it could happen that even in the current reconfiguration of the tasks assigned to universities, domains that are considered "significant" will remain for a long time those of "hard" and "masculine" science (Larivière et al., 2011, p. 495).

Together with other feedback mechanisms at play in the system of science, for example "publications lead to grants, which lead to further publications" (Larivière et al., 2011, p. 493), the authors mention this dynamic, the self-reinforcement of dominant values in the formation of the habitus, which is at the heart of Bourdieu's sociological thought, most famously in the book *Distinction* (Bourdieu, 2010) in regard to aesthetic values, and more specifically in relation to the topic of gender in *Masculine domination* (Bourdieu, 2001a). One aspect of what Bourdieu (2001a, p. 9) termed the "socially constructed division between the sexes" is the self-reinforcement of "academic gendered stereotypes" mentioned in a paper by Paul-Hus et al. (2020). The findings of this study show that "gender disparities generally found in authorship extend to acknowledgements," with women acknowledging "proportionally more women than men do" (Paul-Hus et al., 2020, p. 591). Moreover, the breaking down of the results according to the scholarly disciplines also shows differences that the authors relate to the male *vis-à-vis* female dominance in the field in terms of staff composition.

Rather than analyzing which elements influence an agent's habitus, as in the studies mentioned above, other authors associate the habitus of scientists with the topic of bibliometric indicators in research evaluation (Nielsen & Borjeson, 2019; Olinto & Leta, 2011). In particular, Alvarado and Arango (2015) discuss how bibliometric terminology has become part of the scientific habitus of researchers. In their view, attending courses in bibliometrics has facilitated the formation of a "bibliometric habitus" among Brazilian authors. This mindset appraises publication channels based on their bibliometric impact and international reach. Citizen bibliometrics (Leydesdorff, Wouters, & Bornmann, 2016) that is, the "nonprofessional use of bibliometrics by managers and researchers" (Hammarfelt & Rushforth, 2017, p. 170) could be a valuable perspective to frame Alvarado and Arango's notion of a "bibliometric habitus." The more diffused this "bibliometric habitus" is, the more needed the reflexive attitude advocated by Bourdieu becomes. Gingras (2016) provides a clear example of reflexivity when discussing the *h*-index and the journal impact factor's intrinsic weakness. However, Leydesdorff (2017) warns against Gingras' proposal of rational arguments as a countermeasure against the misuse of bibliometric indicators. These arguments might underestimate that bibliometrics has become "the subject of a political economy that its co-constructs" (Leydesdorff, 2017, p. 596). In the light of such a political economy, the need for reflexivity would seem even more pressing.

4. DISCUSSION AND CONCLUSION

To summarize the main findings, the three concepts of field, capital, and habitus have been used as a "social critique" of the asymmetric power relations and inequalities built into the system of scholarly communication. Most studies focus on one or more of the following aspects: gender inequality, junior researchers, journals and university ranking systems, and language biases in research assessment. The most common concepts in the literature are "field" and "symbolic capital." Furthermore, Bourdieu's concept of "field" is harmonized with other well-established theoretical viewpoints in bibliometrics, such as Merton's sociology of science and Leydesdorff's cybernetic approach to quantitative science studies. Furthermore, Leydesdorff's (2021) research shows the weight of Whitley's (2000) organizational approach in Bourdieu's reception. Another important insight gained from the literature review is the theme of the "ambiguity" of bibliometrics methods as instruments that can both reinforce the power structures at work in science and bring such structures to the fore, as in the case of gender inequalities.

With the notable exception of Prpić (2007), the literature has not discussed what Bourdieu (1991b, p. 7) calls "delegation," or the transfer of capital from an institution to an individual agent or a group. This notion could help interpret the transfer of capital in knowledge production based on the "*capital of social authority* in matters of science" that rest on "delegation from an institution" (Bourdieu, 1991b, p. 7; italics in the original text). In other words, if a university is "dominant" in the hierarchies of the field, the capital embedded in the institution is transferred or "delegated" to the individual researchers. When researchers are authorities or, as Bourdieu writes, possess "*capital of strictly scientific authority*, which rests upon the recognition granted by the peer competitors" (1991b, p. 7; italics in the original text), the delegation of power from the university to the researcher becomes less relevant. The connection between "elite status" and "university rankings" (Siler, 2013) encountered earlier in the review offers a direction to study the phenomenon by using the position in the university rankings as a proxy for its "dominance" in the field. Research with a standpoint in systems theory and cybernetics (Fujigaki, 1998; Leydesdorff, 2011, 2021; Leydesdorff, Petersen, & Ivanova, 2017) could also help define the dominance of a university beyond its rankings, in particular its position in the system of "university-industry-government relations" (Leydesdorff, 2021, p. 90).

In addition, although, as mentioned in the review, there have been papers that have used correspondence analysis (Pandiella-Dominique & Bautista-Puig, 2018; Paul-Hus et al., 2017), further bibliometric research could apply the statistical side of Bourdieu's work—currently being developed in quantitative social science by some of Bourdieu's former collaborators under the name of *Geometric Data Analysis* (Le Roux, Bienaise, & Durand, 2019)—to investigate topics not yet explored with this methodology, for instance, the power position of publishers (see Bourdieu, 2008).

On a more general note, it is challenging to establish a field's instances of "obliteration by incorporation" (Garfield, 1975) and all the authorities who are taken for granted and thus no longer explicitly cited. On the one hand, given the more significant number of occurrences of the concept "field" in the data set of this review, one would probably need to look in that direction to gauge Bourdieusian concepts that have been "incorporated and obliterated." On the other hand, the review has shown the presence in the literature of several documents that address "capital" and "habitus," (see also the reading list provided as Appendix C in the Supplementary material), as well as papers that also employ correspondence analysis (Paul-Hus et al., 2017), Bourdieu's signature method. The diffusion of a broader conceptual and methodological "toolbox"not limited to the most recurring concept of *champ* might well expand the domain of the notions which become incorporated by their progressive obliteration.

The rationale of this critical review has stemmed from the use of Bourdieu's works by bibliometric research and the need to understand in which contexts his thought has been considered relevant—an operation that Hussey (2010) has earlier pursued for research in Library and Information Science. It goes without saying that the references to Bourdieu alone do not reveal anything about the depth of the analysis of the texts that cite his works (or those that do not cite them at all). References to Bourdieu and the engagement with his thought (from more extensive discussions of the *champ* and other Bourdeusian concepts to far shorter mentions of his works) derive ultimately from the type of research questions being answered. The review has nevertheless delivered a picture of a nonnegligible portion of the research output in quantitative science studies. With its surveys of the topics, Bourdieu's triad first of all, this article has attempted to cast light on the literature that has invoked Bourdieu's framework and incorporated it through references, which are ultimately "indicators of selection processes" (Leydesdorff, 2021, p. 41). Future research could repeat this operation to look for changes in perspectives and research priorities, including possible developments in the social and cognitive relations between bibliometrics (and related fields) and the sociology of science.

Notably, the present review itself comes with limitations. The phenomenon of "obliteration by incorporation" (Garfield, 1975), according to which well-established ideas do not receive explicit references in a scientific text, might have caused the exclusion of potentially relevant literature that did not have explicit references to Bourdieu. Considering only sources available in English might have meant missing relevant sources in other languages. Data sets of literature in other languages, particularly French, could address this issue. Overall, this means that Bourdieu's thinking may well have had a larger impact on the field of bibliometrics than can be inferred by studying references to his works in the data set studied here.

To conclude, one might recall Bourdieu's (1991c) interpretation of Heidegger's idea of a premodern era before bureaucracy and technological advances—and statistics—had dehumanized human existence (the *Dasein*), reducing it to mere numbers (the *Das Man*). Thus, from a Bourdieusian perspective, statistics can reinforce power structures or provide tools to understand power relations, the first step toward social change. Therefore, acknowledging the ambiguity of statistics is essential for achieving the goal of reflexivity in quantitative science studies.

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The author has no competing interests.

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DATA AVAILABILITY

The full data set of the review (Appendix A), as well as the coding scheme (Appendix B), and a list of suggested readings based on the finding of the study (Appendix C) are available from Zenodo (https://doi.org/10.5281/zenodo.7437298).

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Article II

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The formation of a field: sustainability science and its leading journals

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Abstract
This study investigates the scholarly field of sustainability science between 2001 and 2021 from the perspective of 18 frequently cited journals. For this purpose, the article employs the concept of the "scientific field" developed by the sociologist Pierre Bourdieu and the associated methodology of Geometric Data Analysis (GDA). Thus, two GDA approaches, the Principal Component Analysis (PCA) and the Multiple Correspondence Analysis (MCA), as well as analyses of co-citation and co-authorship relations, were used to identify the positions of these journals in the field. One key finding is the historical shift from an earlier dominance of chemistry-related journals to publications more broadly concerned with sustainability research. The MCA analyses show that the selection of research topics is in line with a "weak" rather than "strong" interpretation of the concept "sustainability." Networks based on co-authorship relations reveal an overall increment in this type of collaboration, both at the level of organizations and countries. Since 2008, Chinese universities have notably increased their presence in the output of the journals examined in the study. Three strategies in shaping the field through its journals are discernable: publications strongly characterized by a systems theory perspective, notably *Sustainability Science*; generalist journals committed to sustainability research in a broader meaning; and publications that address sustainability issues mainly within a specific discipline.

Keywords Sustainability science · Sustainability · Bibliometrics · Scientometrics · Pierre Bourdieu · Geometric data analysis

Background and aim of the study

Bibliometrics has a long tradition of studying the historical developments of knowledge domains (Garfield, 2004). In particular, emerging fields have attracted the attention of researchers because of the challenge represented by their resistance to being filed under existing classifications (González-Alcaide et al., 2016; Muñoz-Écija et al., 2019).

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Sustainability science is a burgeoning research field centered on the concept of sustainable development and related challenges (Kates, 2011). This field requires the synthesis of disparate theories and methods, along with the unification of complementary and conflicting knowledge perspectives (Jerneck & Olsson, 2020) and new "models of knowledge generation" (White, 2013, p. 186) and a "wide range of outlooks regarding what makes knowledge usable within both science and society" (Kates et al., 2001, p. 641). As already remarked by Leydesdorff (1997) long ago, research in this area is closely intertwined with policymaking. In this respect, Kajikawa (2022) has recently set the agenda for "transdisciplinary bibliometric research" and emphasized the need to integrate bibliometric analyses into evidence-based policymaking. This type of bibliometric research should address the diversity of policy contexts and the characteristics of policy-oriented transdisciplinary sciences, such as the interactions between scientists and other stakeholders. Notably, a recent case study on the validity of altmetric measures as proxies for societal impact investigates one research center with a sustainability science profile (Kassab et al., 2020).

Bibliometric studies of journals can be a valuable approach for gaining insights into the intellectual and social organization of scientific fields. (Åström, 2007; Leydesdorff, 2021). This approach has also been applied to the sustainability science field (Buter & Van Raan, 2013; Kajikawa et al., 2014). In particular, Bautista-Puig et al. (2021) have provided a valuable classification of the journals of this field based on citation data. The disciplinary status of the research in sustainability science has been described as multidisciplinary, cross-disciplinary, interdisciplinary, and transdisciplinary (Kajikawa, 2008). Among these four interpretations, the multidisciplinary one requires the least integration between the theories and methods offered by the individual sciences. The disciplinary status of a field as cross-disciplinary, interdisciplinary, and transdisciplinary implies an increasing level of synergy between the contributing sciences. The interactions between scholarly fields—their cross-, multi-, inter-, and transdisciplinarity—are recurring topics in the bibliometric literature (Hammarfelt, 2011; Hellsten & Leydesdorff, 2016; Larivière, 2012a). A seminal bibliometric study by Buter and Van Raan (2013, p. 266) found that the interdisciplinary approach to sustainability science was still being developed, and "a trend towards a state of transdisciplinary research" was yet to be seen. Their conclusion agreed with research in sustainability science from the same period (Lang et al., 2012).

Existing bibliometric research on sustainability science has primarily focused on the semantic aspects of organizing the field, examining clusters of research topics (Buter & Van Raan, 2013) or the taxonomy for the journals in the field (Bautista-Puig et al., 2021). While this research is insightful and valuable, the current article takes a different approach by using the sociologist Pierre Bourdieu's (2004) perspective on scientific fields as social fields. Moreover, this article follows the path of "transdisciplinary bibliometrics" recently proposed by Kajikawa (2022), which aims to apply bibliometric methods to transdisciplinary sciences, as well as the historical approach in bibliometrics (Pölönen & Hammarfelt, 2020). By doing so, this study contributes to the existing body of knowledge represented by earlier bibliometric investigations on sustainability research (Bautista-Puig et al., 2021; Buter & Van Raan, 2013; Kajikawa et al., 2014) and further develops the Bourdieu-inspired approach to the bibliometric study of scholarly fields (Schirone, 2023). More specifically, the overarching aim of the current study is thus to examine the emergence and development of sustainability science as a field, drawing upon Bourdieu's conceptual framework and the methods he developed.

Bourdieu (1975) has argued that the power struggles between scientists regarding prestige, academic advancements, and economic resources affect how a scientific field is structured intellectually and socially. Even if economic capital is an essential component of the science system, another intangible capital also plays a crucial role in shaping scholarly fields' social and intellectual organization. Contrarily to the economic capital, this other capital—the symbolic capital or "the mastery of symbolic resources based on knowledge and recognition" (Bourdieu, 2005, p. 195)—cannot easily be translated into countable units of value and thus measured. Yet, the structure of scientific fields is, for Bourdieu, shaped by a "symbolic" economy that values knowledge and peer recognition (Bourdieu, 2004). Essential to this economy is the symbolic capital, which is a second-order type of asset ultimately depending on two first-order, or "primary" in Bourdieu's (1986) terms, types of capital: the cultural capital, which represents the field's specific knowledge; and social capital, which pertains to the networks and personal connections within the field.

The value of the symbolic capital, although not readily translatable into monetary assets, can still be visible. For instance, scientific prizes and rank in citation indexes are "the most objectified of the indices of symbolic capital" (Bourdieu, 1988, p. 76). From this perspective, scientific journals can be seen as artifacts that represent—or, in Bourdieu's terminology, objectify—a specific volume of capital. The value of capital that journals incorporate can be monetary as, for instance, goods that generate revenues in the publishing market. At the same time, in the "market of symbolic goods" (Bourdieu, 1985), journals incorporate other capital not reducible to mere economic assets: knowledge or cultural capital, as well as the social capital represented by the collaboration between researchers, departments, universities, and countries. If seen as symbolic goods, journals incorporate not only cultural or social capital (Denord et al., 2011) but also symbolic capital. The value of symbolic goods rests, in fact, on the extent to which the agents of the field perceive them as valuable, that is, their symbolic capital. This type of capital, in turn, depends upon the specific historical shifts in the value attached to the cultural and social capital specific to the field. Field Bourdieu (1991b) states that understanding such value shifts requires examining its past. Notably, Gingras' (1991, 2008) works on the history of physics have developed this Bourdieusian historical perspective in bibliometrics, also through the study of journals (Khelfaoui & Gingras, 2020).

Against this background, the present study frames the leading journals of a field as artifacts where symbolic capital is incorporated as objectified capital. Being perceived as valuable objects by the agents of the field, such "symbolic goods" function as gatekeepers, endorsing legitimated knowledge, establishing research areas appropriate for the discipline, and bestowing recognition upon authors and their associated institutions (Bourdieu, 1985). Therefore, this study investigates the leading journals of the sustainability science field and their place in the intellectual and social organization of this field (Whitley, 2000). The research questions that guide the article are:

RQ1 Based on the symbolic capital that sustainability science's leading journals represent, which position in the field do these publications occupy? Which is the position of their publishers?

RQ2 Which position do the most productive research organizations and countries occupy in the field?

The following section gives a short introduction to the field of sustainability science, followed by a description of the data sources and methods used in the current study. Thereafter, its findings are presented according to the bibliometric methods used to analyze the symbolic capital that the leading journals incorporate. The article also presents an overarching discussion and a conclusion that suggests future research paths.

Sustainability science

The roots of sustainability science can be traced to the domain of policymaking when a set of international policy efforts addressed the challenge of global economic growth that managed not to be detrimental to the environment. Although the term "sustainable development" had circulated since the '70 s, the UN's report *Our Common Future* in 1987 represented a milestone for establishing sustainability policy (Brundtland Commission, 1987). The report famously defined the concept of "sustainable development" as development that meets the needs of future generations.

The concepts of "sustainability" and "sustainable development" and a scientific praxis that would address them have been conceived in several ways (Mino & Kudo, 2020). De Vries (2012) underlines that the initial criteria for conceptualizing a development that had to be sustainable were rooted in ecological thinking. However, from the '90 onwards, social scientists, and economists in particular, advanced the perspective of "welfare economics and societal cost–benefit analyses" (p. 4). Sustainable development is, in this sense, "a societal negotiation" in which the economic/social perspective is added to the environmental one (De Vries, 2012, p. 4). The commitment of academia towards addressing sustainable development issues was an outcome of the United Nations Conference on Environment and Development in 1992 (Mino & Kudo, 2020). This conference, also known as the Rio Summit, is another pillar, after the *Bundtland Report*, in the history of the scientific study of sustainability. To that point, key concepts in the policy narrative of sustainable development were the integration between the needs of environmental preservation and economic growth, societal participation, and information (Nolin, 2010). The *Agenda 21* signed at the Rio Summit played a crucial role in advancing the social dimension of sustainable development. It brought to the fore sustainability goals, such as fighting poverty and promoting social equality, which earlier held an ancillary position vis-à-vis the environmental and economic dimensions. Subsequent summits (the Millennium Summit 2000, the Johannesburg World Summit on Sustainable Development 2002, and the New York World Summit 2005) confirmed *Agenda 21* with minor revisions until another milestone was reached with the agreement in 2015 on the 17 Sustainable Development Goals (SDGs) of the *Agenda 2030 for Sustainable Development* approved by all UN Member States (Nolin, 2010). As the *Agenda 2030* emphasized "science, technology, and innovation" in achieving sustainability goals, the idea of a field dedicated to the study of sustainable development grew in parallel with this reinforced involvement of science in the domain of policy (Colglazier, 2015, p. 6252).

Sustainability science is concerned with the interactions between nature and society, and in particular, the interplay between global systems and local human and ecological environments (Kates et al., 2001). A review by Kajikawa (2008) identifies ten domains of sustainability-related research: economic development, climate, biodiversity, agriculture, fishery, forestry,

energy and resources, health, lifestyle, and water. Notably, Spangenberg (2011) distinguishes between two approaches in sustainability research: a science *for* sustainability and a science *of* sustainability. The term "science for sustainability" applies to disciplinary fields that address sustainable development issues within their own knowledge domain. To be able to tackle sustainability issues, the disciplinary fields that make for this science *for* sustainability ought to be interdisciplinary, or at least "interdisciplinarity-ready" and open to a dialogue with other fields (Spangenberg, 2011, p. 276). The emerging scholarly field labeled "sustainability science" or "sustainability studies" (Lam et al., 2014) corresponds to Spangenberg's definition of the "science of sustainability" as a separate field with a specific research agenda that targets sustainable development as the predominant study object. Research of this type addresses the global perspective of a sustainable world and conceptualizes sustainability as "a condition, or the state of a system" (Lam et al., 2014, p. 161). The notion of sustainability stems from the need to integrate the many societal, economic, and environmental systems and, in particular, harmonize their sustainable development. The role of systems theory in the formation of this field has been underlined by De Vries (2012), who has also traced back to the research field known as Global Change Science or Earth System Analysis as the catalyzer for an array of new scientific fields such as atmospheric and ocean science, marine biology, human ecology, and ecological economics. The historical origins of sustainability science can be found in these new sciences and, more generally, in systems theory, besides the global policy initiatives for sustainable development mentioned above.

In addition to the heterogeneity of the sciences contributing to sustainability research, another source of variability in sustainability science derives from the different interpretations of sustainable development, most notably in the distinction between "weak" and "strong" sustainability. Söderbaum (2007, p. 613) has characterized the struggle between advocates of the different understandings of sustainable development as a "power game." Readings of the concept vary from the business-as-usual-interpretation, "in the sense of 'sustained economic growth' and 'sustained profits' in business," to the Ecological Modernization path to sustainability (p. 614). This latter standpoint promotes implementing environmental management systems and similar certification schemes, corporate social responsibility, and methods such as life cycle analysis and environmental impact assessment. More radical interpretations emphasize the social and environmental dimensions of sustainable development and the impact of processes that cannot be easily translated into monetary assets. Ruggerio (2021) distinguishes between "weak" sustainability research, exemplified by research on green economy and circular economy, and "strong" sustainability research. This latter conceptualizes the "environment and sees its components as being more than commodities and services traded in markets" (p. 8). Examples of strong sustainability research are the scientific output inspired by the idea of degrowth, which is based on the hypothesis "that it is possible to organize a transition and live well under a different political-economic system that has a radically smaller resource throughput" (Kallis et al., 2018, p. 292).

To sum up, sustainability science has a complex, although recent, history characterized by ties with the domain of global policy and different conceptualizations of sustainability. The history of the topics discussed in the journals reflects the knowledge and social connections, that is, cultural and social capital, which characterize the scientific field. As symbolic goods, highly cited journals incorporate the field's cultural and social capital in the form of symbolic capital. The following section describes the bibliometric methods used in this article to study sustainability science from the perspective of these symbolic goods and their place in the field.

Data sources and methods

Data selection

Although notoriously controversial (de Rijcke & Rushforth, 2015), the Journal Impact Factor (JIF) can be useful to detect the "status" of journals (Bollen et al., 2006) or, in Bourdieusian terminology, their "symbolic capital" (Khelfaoui & Gingras, 2020), in particular, frequently cited journals represent higher-than-average symbolic capital (Chipidza & Tripp, 2021). The present study uses the JIF as a proxy measure for the prestige of these "elite subsets" (Vinkler, 2019). The calculation of the JIF for 2020, the last completed year available at the time of the data collection, was obtained from the Clarivate Analytics database Journal Citation Reports (JCR).

Figure 1 illustrates the workflow. In Step 1 of the study, following the study by Bautista-Puig et al. (2021), the field of sustainability research was operationalized by using the category *Green & Sustainable Science & Technology* in the JCR classification (66 journals were associated with the category at the time of the data collection, March 2022). The Journal Citation Indicator (JCI) is a measure that normalizes the JIF according to the world average for the field. Thus, it was used to identify the elite sources whose citation score is higher than this average and listed in decreasing rank of JCI as follows: *Nature Sustainability*, *IEEE Transactions on Sustainable Energy*, *Green Chemistry*, *Journal of Cleaner Production*, *Journal of Sustainable Tourism*, *ACS Sustainable Chemistry & Engineering*, *Sustainable Development*, *ChemSusChem*, *Renewable Energy*, *Sustainable Cities and Society*, *Journal of Industrial Ecology*, *Sustainability Science*, *Sustainable Materials and Technologies*, *Agronomy for Sustainable Development*, *Renewable & Sustainable Energy Reviews*, *International Journal of Sustainability in Higher Education*, *International Journal of Precision Engineering and Manufacturing-Green Technology*, and *Sustainable Production and Consumption*. These 18 journals reported (as of March 31, 2022) a value of JCI higher than one—the value one is given to the world average for publications in a specific field based on the same document type and period.

In Step 2 of the workflow, the metadata information of documents published in the 18 journals was retrieved (on March 31, 2022) from the Clarivate Analytics database Web of Science Core Collection (WoSCC). The range considered for the selection was the period 2001–2021, and the documents included belonged to the type "article," whereas editorial materials and reviews were excluded. The need to create comparable subsets of documents motivated the choice of 2001 as the starting point for the dataset of documents to include for analysis. As shown in Table 2 in the Supplementary Material, most of the documents have been published in the last period, which strengthens the choice of excluding documents published before 2001. The last complete year at the time of data collection was 2021, thus chosen as the other end of the timeline. The final dataset comprised 71,871 documents, 1,819,331 references, and 122,760 author-assigned keywords. Metadata information on the documents was saved as an R data frame in the environment of R version 4.1.3 (R Core Team, 2023) and analyzed using the package for science mapping *bibliometrix* (Aria & Cuccurullo, 2017).

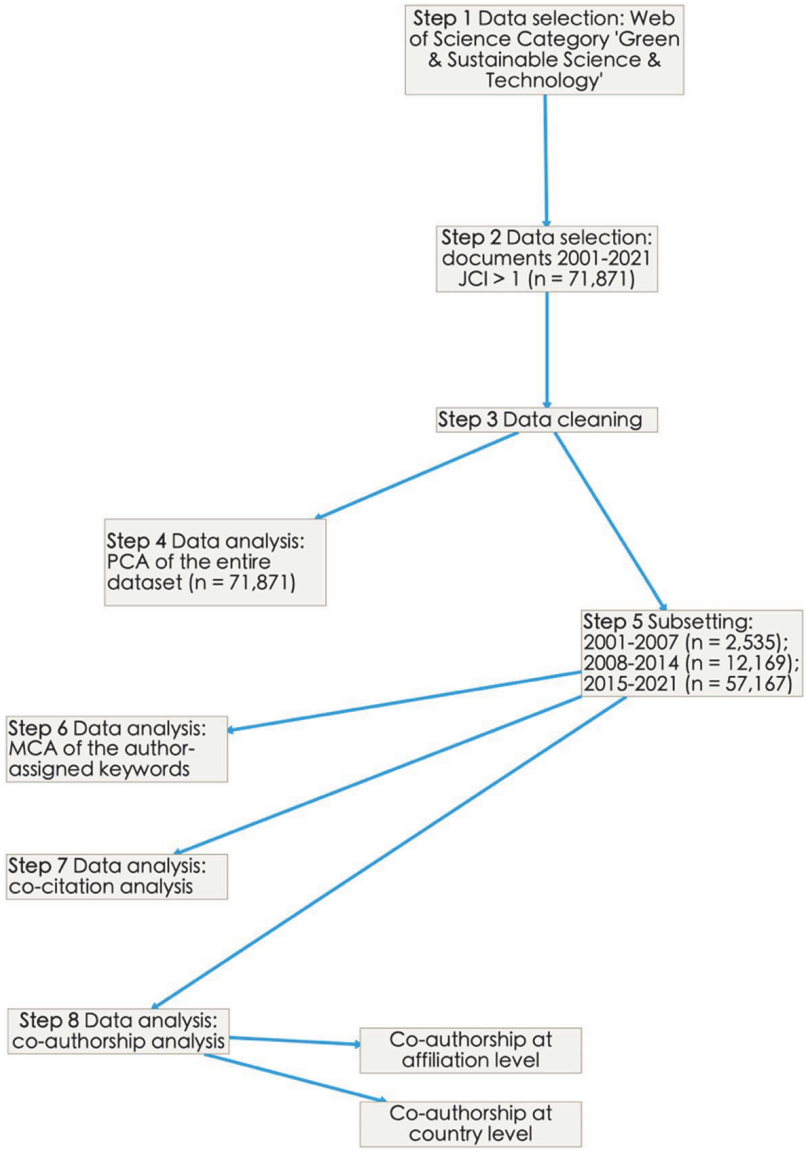


Fig. 1 The workflow of the study note. JCI means Journal Citation Indicator (Clarivate Analytics). PCA and MCA are the respective abbreviations for Principal Component Analysis and Multiple Correspondence Analysis

GDA approaches and network visualizations of the field

In Step 3, in addition to the default data cleaning routines implemented in bibliometrix, the R package tidyverse (Wickham et al., 2019) and the data wrangling tools OpenRefine (Ham, 2013) and Trifacta (https://www.trifacta.com) were used to obtain metadata information of a higher quality (see also Petrova-Antonova & Tancheva, 2020). As pursued by Bourdieu (1988, 2008) and others (Blasius et al., 2019; Ekelund, 2016), the present study employs GDA (Le Roux & Rouanet, 2004, 2010). This methodology,

alternatively known as Principal Components Methods (Husson et al., 2011), was used to map the organization of sustainability science. Two GDA methods were used to gain an overview of the capital embedded in the 18 journals: the Principal Component Analysis (PCA) and Multiple Correspondence Analysis (MCA). Following the research by Ekelund (2016) on citation behavior, the present article combines GDA methods with the Bourdieusian perspective on the sociology of science.

GDA comprises approaches that involve quantitative and qualitative data, as in the case of the bibliometric data outputted by bibliometrix in the context of this article. The present study uses two of these approaches, (Robust) PCA and MCA, which are dimensionality reduction techniques used for different purposes. PCA typically reduces the complexity of datasets based on quantitative variables, while MCA applies to categorical variables. The present article utilizes both approaches because it analyzes quantitative variables (e.g., the number of citations received by a journal) and qualitative ones (i.e., the keywords associated with the articles published in the journals). However, neither the Robust PCA nor the MCA, based on the data used for this study, could render the extent of research collaboration in the field. Therefore, approaches to approaches to network analysis and visualization— the Leiden algorithm (Traag et al., 2019) and the Fruchterman-Reingold algorithm (Fruchterman & Reingold, 1991)—were also used to gauge this social component of the distribution of symbolic capital in the field (see Step 8 below).

The PCA approach, effectively applied in previous bibliometric research by Zopiatis et al. (2015), "simplifies the complexity in high-dimensional data while retaining trends and patterns" and targets quantitative variables (Lever et al., 2017, p. 641). In Step 4, which corresponds to RQ1, the PCA was performed with the software JPM version 17 (https://www.jmp.com) based on three quantitative variables: the number of articles published in the journal in 2001–2021, the number of years, that is, the years in which documents published in the journal were included in the data, and the number of citations received per year in the time frame of the study. Two supplementary qualitative variables were included in the PCA: the journals' titles and—following Bourdieu's (2008) study of the French publishing market—their publishers' names. The four quantitative were not normally distributed, according to the Shapiro–Wilk test. Therefore, this study chose the version of PCA developed by Candès et al. (2011) as Robust PCA, available in JMP 17, which addresses specifically skewed distributions, a known challenge for PCA.

In Step 5, the dataset was split into three time periods: 2001–2007 (2,535 documents, seven journals), 2008–2014 (12,169 documents, 15 journals), and 2015–2021 (57167 documents, 18 journals). Such a subsetting of the dataset provides an equal number of years across the three periods.

Step 6 aimed to investigate the symbolic capital incorporated in the journals, as required by RQ1. This stage of the data analysis corresponds to the MCA of the 50 most recurring author-assigned keywords for each period. The MCA method is comparable to PCA, although this latter requires quantitative variables rather than categorical ones (Le Roux & Rouanet, 2004, 2010). A list of words to exclude (the name of countries) and another one of synonyms and alternative terms (e.g., "life cycle assessment," "life-cycle assessment," and "LCA") complemented the default term-matching routines of the package bibliometrix. Step 7 also addresses RQ2 and, in accordance with Bourdieu's analyses in *Homo Academicus* and existing bibliometric research inspired by his work, treated the citation score as a proxy measure for the symbolic capital (Bourdieu, 1988; Cronin, 2005; Khelfaoui & Gingras, 2020). More specifically, the co-citation relations between articles (the relation between document A and document B whenever both are cited by a third document C) were used to analyze the distribution of symbolic capital embedded in the 18

journals (Gingras & Wallace, 2010). The co-citation networks computed in R were visualized on a sphere rather than a two-dimensional plane to gain more realistic images (Perry et al., 2020).

In Step 8, which answers RQ2, the co-authorship relations between documents were analyzed. Abbasi et al. (2014) have considered co-authorship relations as additional measures that operationalize the journal's symbolic capital. The resulting networks formed by these relations were analyzed at the level of the author's affiliations and countries, respectively. The Leiden algorithm for community detection was used to cluster the co-cited journals in Step 7 and the co-authorship relations in Step 8 (Traag et al., 2019). The Fruchterman-Reingold algorithm was used to visualize the co-authorship relations based on the authors' affiliations (Fruchterman & Reingold, 1991).

Further details on the methods used and additional analyses are available in this article's Supplementary Material.

Table 1 Analyzed journals (2001–2021) in decreasing rank of Journal Citation Indicator (JCI)

Journal	Year	Articles	Total citations	JCI
Nature Sustainability	2018	377	15,984	3.22
IEEE Transactions on Sustainable Energy	2010	1830	76,240	1.74
Green Chemistry	2001	7256	35,3585	1.66
Journal of Cleaner Production	2002	24,488	71,8400	1.51
Journal of Sustainable Tourism	2008	1032	38,468	1.51
ACS Sustainable Chemistry and Engineering	2013	10,094	260,153	1.50
Sustainable Development	2001	820	22,643	1.42
ChemSusChem	2008	4481	16,6581	1.40
Renewable Energy	2001	12,732	39,7844	1.32
Sustainable Cities and Society	2011	2952	60,515	1.32
Journal of Industrial Ecology	2005	1262	42,373	1.28
Sustainability Science	2006	752	18,393	1.06
Sustainable Materials and Technologies	2017	254	3619	1.06
Agronomy for Sustainable Development	2005	635	13,768	1.05
Renewable and Sustainable Energy Reviews	2013	1310	19,709	1.05
International Journal of Sustainability In Higher Education	2010	566	9370	1.04
International Journal of Precision Engineering and Manufacturing-Green Technology	2014	486	6508	1.02
Sustainable Production and Consumption	2017	544	7055	1.02

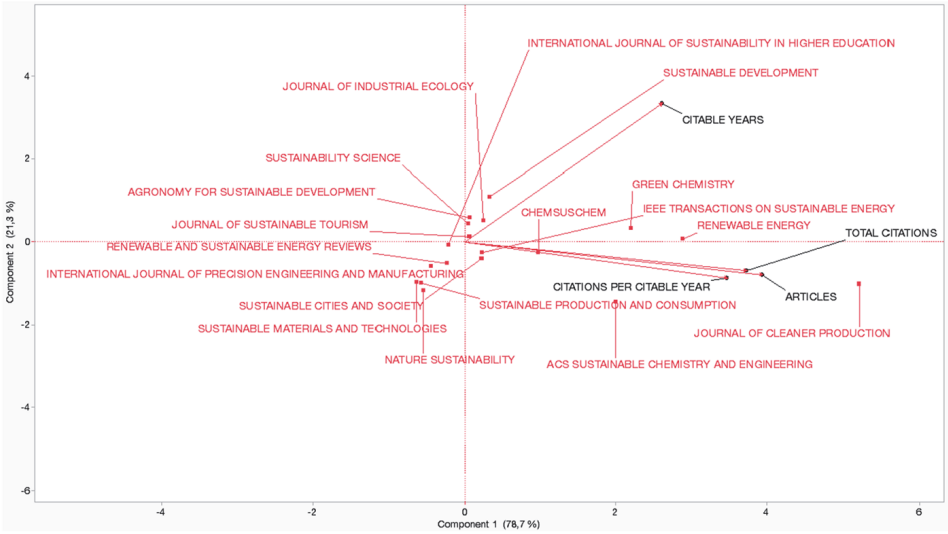
Note. The number reported in the column "Year" indicates the beginning of the timeline chosen as inclusion criteria (i.e., 2001) or, for more recent sources, the first year of publication. The column "Total Citations" specifies the number of citations received by the journal based on the index of the entire database. The metric Journal Citation Indicator (JCI) is based on the calculations for the year 2020 available from the Journal Citation Reports (Clarivate Analytics)

Results

From the Bourdeusian perspective discussed earlier, journals are artifacts in which capital of various types is incorporated (Bourdieu, 1985). Their emergence, disappearance, and historical development correspond to variations in the volume and type of capital of a field.

Table 1 below presents key characteristics of the journal (the year when they were first indexed in the database and the number of articles and citations in the period 2001–2021). Thereafter, the data analysis is presented according to the methods used to analyze the journals' symbolic capital and their respective position in the field, thus providing answers to RQ1. More specifically, the Robust PCA of publication and citation data provides answers to RQ1 on the position of journals and their publishers. The MCA of the keywords and the co-citation analyses complement the picture of the field obtained with the PCA by visualizing the symbolic capital incorporated in the journals and observable through the research

a *A PCA Biplot of the Field: 18 Leading Journals (2001-2021)*



b *A PCA Biplot of the Field: The Publishers (2001-2021)*

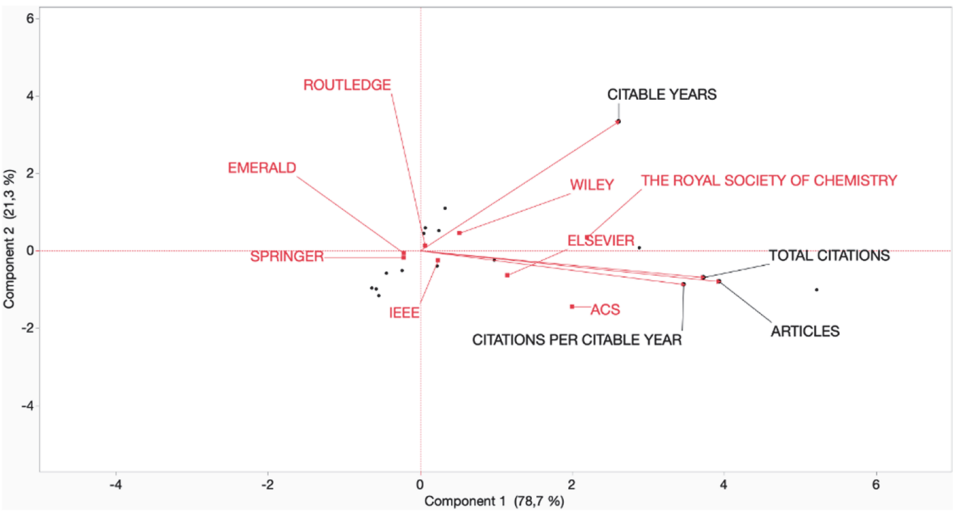


Fig. 2 **a** A PCA Biplot of the Field: 18 Leading Journals (2001–2021) **b** A PCA Biplot of the Field: The Publishers (2001–2021). In a and b, the label "Years" indicates the number of years (1–21) for which the dataset includes documents published in a journal between 2001 and 2021

topics chosen and the citation relations between publications. Finally, the study of the co-authorship at the level of analysis of research organizations and countries addresses RQ2.

The two PCA planes in Fig. 2a and b outline the sustainability science field from the perspective of leading journals and their publishers, the two supplementary qualitative variables designated by red labels. Black color denotes the four quantitative variables. The label "Citations per citable year" in Fig. 2a and b refers to the number of citations received by a journal divided by the number of citable years, i.e., the years in which the dataset includes articles published in the journal. The number of documents included in the dataset is the variable labeled in the biplots "Articles."

The plane structured by the Robust PCA is characterized by two principal components or dimensions, which account for most of the variability in the data: the first principal component—corresponding to the x-axis—accounts for 78.7% of the variance, whereas 21.3% is the percentage explained by the second dimension represented by the y-axis. The two first dimensions suffice for a satisfactory description of the data as they together explain 100% of the variance of the axes, (based on the eigenvalues associated with the axes). In the plane, the position of the 18 journals, i.e., the individuals in the calculation of the PCA, is interpretable according to the following two criteria: (1) "an individual is on the side of the variables for which it takes high values" (Husson et al., 2011, p. 27); and (2) "differences between individuals can be explained by the variables, and relationships between variables can be illustrated by individuals" (Husson et al., 2011, pp. 39–40).

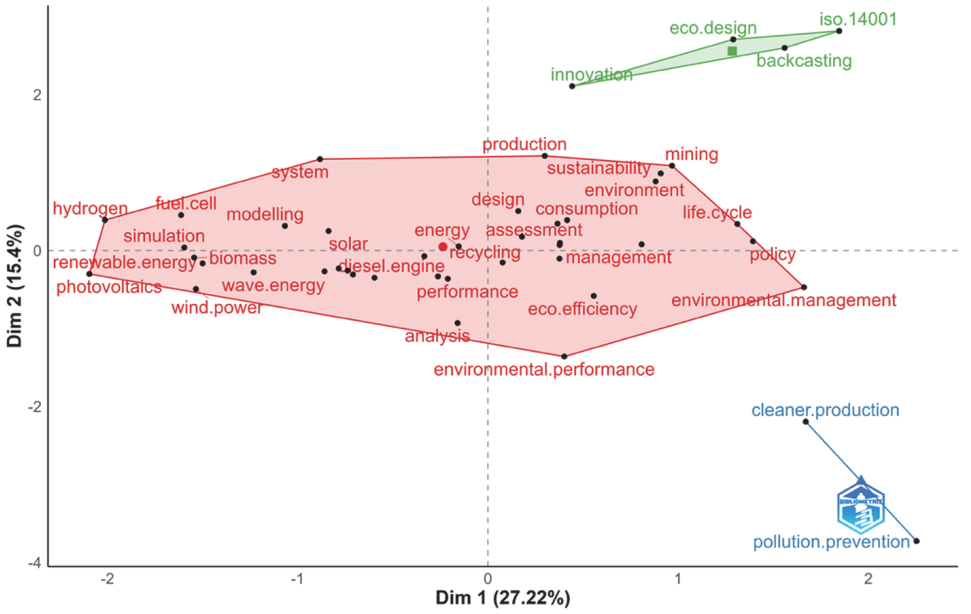
The variables Year correspond in the Euclidean space of the PCA to the temporal dimension, or the field's history, in Bourdeusian terminology (Bourdieu, 1991b). In Fig. 2a, for instance, the journal *Nature Sustainability* is represented in the dataset from 2018. Given the period 2001–2021 as inclusion criterium for this study, the journal is thus represented in the dataset for four years. *Nature Sustainability* is found in the bottom-left section of the plane in Fig. 2a, corresponding to the more recently published journals. That same section also includes periodicals that have received more citations according to the following calculation: the number of citations received by a journal between 2001 and 2021 divided by the years of the journal's inclusion in the dataset. More cited journals incorporate more symbolic capital and, in the case of *Nature Sustainability*, the symbolic capital of this publication can be interpreted in light of the recent research by Khelfaoui and Gingras (2020) on *Nature*'s "spin-off journals." The brand value of this prestigious publication of the publisher Springer Nature could be deemed a contributing factor in the citation impact of this spin-off *Nature Sustainability*.

More generally, with regard to the publishers, the PCA approach allows calculating the position of the journal's publishers in the Euclidean space in Fig. 2b (Blasius et al., 2019). The PCA biplot shows Wiley as being the publisher which has invested in journals of the field earlier than any other. The label corresponding to this publisher is found in the top-right section of the plane, corresponding to more years of inclusion in the dataset compared with the rest of the plane. The American Chemical Society (ACS) and Elsevier are found in the bottom-right section of the plane, occupied by individuals with a higher-than-average number of citations for articles published between 2001 and 2021.

The MCA of the author-assigned keywords

The study utilizes the author-assigned keywords as proxies for the scientific topics discussed in the journals and, ultimately, the symbolic capital embedded in these publications. The topics investigated in the sustainability research published in these journals provide

a *The Multiple Correspondence Analysis of the Author-Assigned Keywords (2001-2007)*



b *The Multiple Correspondence Analysis of the Author Keywords (2008-2014)*

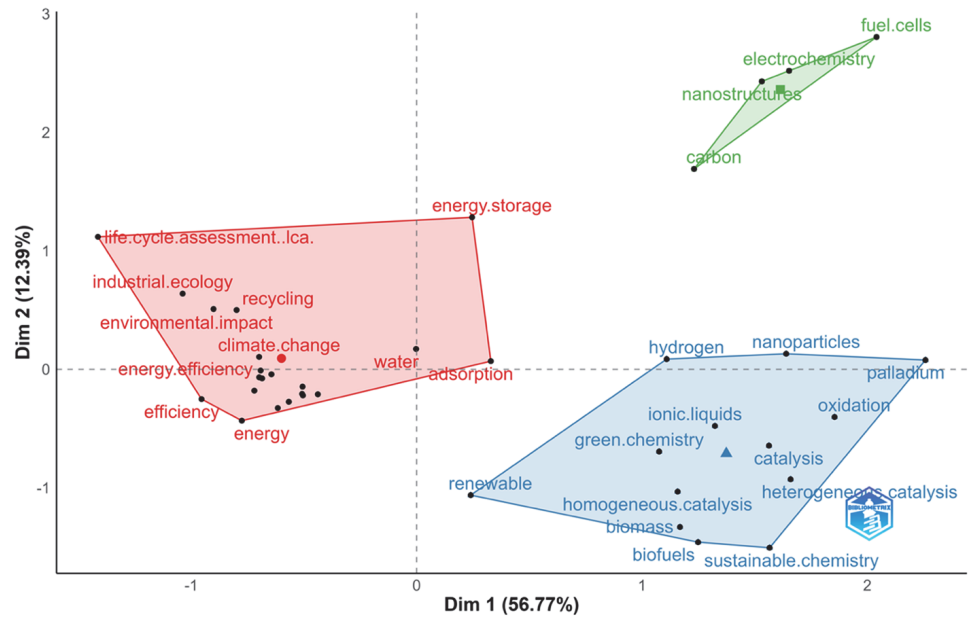


Fig. 3 **a** The multiple correspondence analysis of the author-assigned keywords (2001–2007). **b** The multiple correspondence analysis of the author keywords (2008–2014). **c** The multiple correspondence analysis of the author-assigned keywords (2015–2021)

c *The Multiple Correspondence Analysis of the Author-Assigned Keywords (2015-2021)*

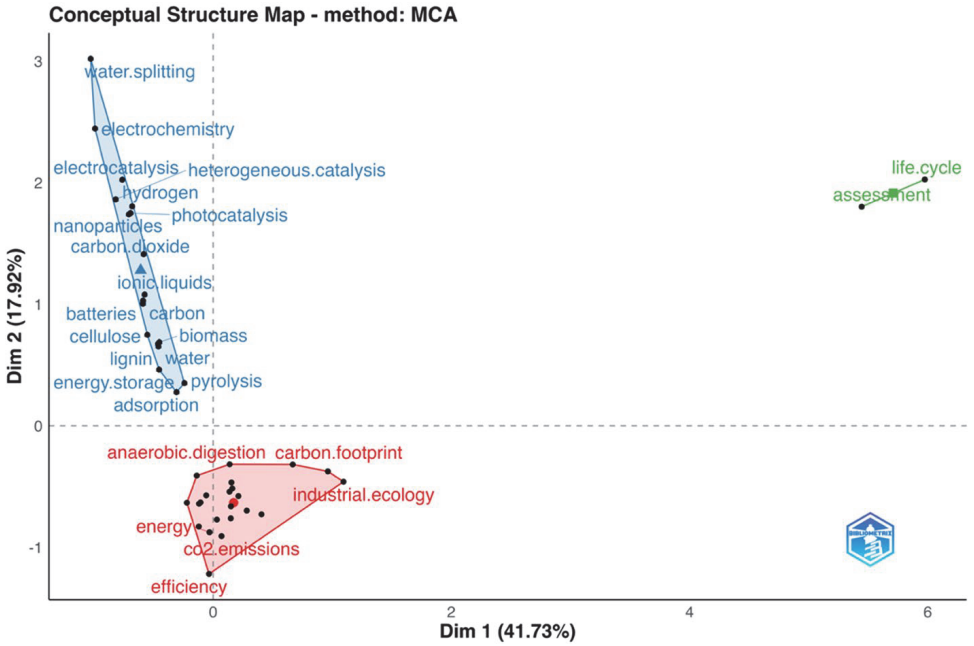


Fig. 3 (continued)

information on the terminology used, which is informed by the primary forms of capital, the cultural and social capital, and at a second-order level, also of the symbolic capital—being recognized as a legitimate agent of the scientific field.

In the specific case of Fig. 3a, the multiple correspondence analysis of the dataset (with the author-assigned keywords as qualitative variables) identifies three clusters. The large red cluster comprises most of the terms: it stretches from the center of the Euclidean space (with terms such as "sustainable development," "life cycle assessment," "analysis," "system," and "recycling") to the right section that includes the terms "hydrogen," "photovoltaics," "biomass," and "wind power." In the top-left corner, the blue cluster includes the terms "sustainability," "backcasting," "policy," and the term "ISO 14001," which corresponds to the standard for environmental management systems (International Organization for Standardization, 2015) and, more broadly, to the Ecologic Modernization Path, that is, the approach to sustainability which emphasizes the use of environmental certifications and regulations for private companies (Cohen, 2006). The terms "pollution prevention" and "cleaner production" are found in the smallest cluster at the bottom-left of the plane.

Figure 3b shows the MCA analysis of the author-assigned keywords of the second period. The green cluster at the upper-right section of the plane is chemistry-related, as shown by the terms "electrochemistry," "carbon," and "nanostructure." The cluster in blue on the left-bottom hand of the plane is also chemistry-related (as implied by the terms "green chemistry," "sustainable chemistry," and "catalysis"). On the left of the Euclidean space, the red cluster comprises the terms which contribute to the second dimension (e.g., "life-cycle assessment," "industrial ecology," "climate change," and "environmental impact"). The terms "sustainability" and "sustainable development" are also found in this cluster. If a line is drawn between the origin and the dots corresponding on the plane to the variables "sustainable development" and "sustainability," the angle formed by the two lines

and having a vertex in the origin would be smaller than the angle formed in the same way on the MCA plane of 2001–2007. Thus, "sustainable development" and "sustainability" are more closely associated with each other in articles published in 2008–2014 than in the previous period.

Figure 3c reports three clusters generated from MCA analysis of author-assigned keywords. One difference compared with the preceding period is the more significant presence of terms from the field of systems modeling, e.g., "analysis," "performance," "optimization," "simulation," and "uncertainty." This finding agrees with the earlier assessment of the field based on citation networks by Kajikawa et al. (2017), according to which "environmental and social systems" and "economy and business systems" were the largest topic clusters found in the mapping of the sustainability research of this period. Moreover, the term "uncertainty" was the most used author-assigned keyword during 2015–2019 in Chinese research in environmental flow science, a field related to sustainability research (Hao et al., 2021). The blue cluster in the bottom section of the plane includes chemistry terms such as "biomass," "biogas," and "cellulose." The keyword "water splitting" is found at the top-left corner of the plane, far from any other terms and, at the same time, positively contributing to both dimensions of the plane, which grants the topic particular relevance in the research context depicted by the MCA plane. According to the seminal review of the field by Kajikawa (2008), water-oriented research was the least studied subfield in sustainability science.

The review by Ruggerio (2021) has discussed the distinction between research focused on (a) "sustainable development" or "weak sustainability," with an emphasis on the green and circular economy, and (b) "sustainability" as "strong sustainability." This latter conceptualization is typical of more radical proposals, as with degrowth-oriented schools of thinking for which "the notion of sustainable development is not a premise for degrowth" (Ruggerio, 2021, p. 786). Even if the weak and strong conceptualizations of sustainability can be, or should be, differentiated, the hypothesis of two separate research paths—for weak sustainability and strong sustainability, respectively—in 2001–2021 is not corroborated by this study's findings. Regarding the examples of weak sustainability research given by Ruggerio (2021), the only one found is "circular economy" (see Tables 17 and 22 in the Supplementary Material of this article). Neither the weak-sustainability term "green economy" nor the strong-sustainability term "degrowth" are found in any of the MCA plots.

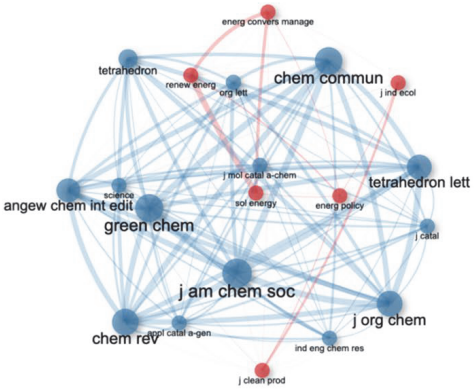
Journal co-citation relations

The function for extracting metadata information with bibliometrix *metaTagExtraction* was used to identify the journal's name of each document included in three datasets of the 18 periodicals divided according to time periods (Aria & Cuccurullo, 2017). Thus, based on the name of the journals associated with each document, the relations of co-citation between the 18 periodicals were further computed with bibliometrix and visualized in Fig. 4a–c; more details on the journal co-citation analysis are available from Tables 13, 18, and 23 in the Supplementary Material.

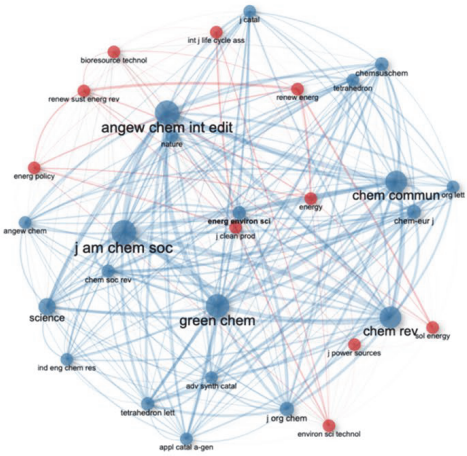
The co-citation map in Fig. 4a shows two clusters. Journals with a chemistry disciplinary profile constitute a larger one (in blue). *Green Chemistry* and the *Journal of the American Chemical Society* are the most prominent ones based on the size of their nodes on the map (i.e., the links of co-citations). The other cluster in red color includes energy research journals, e.g., *Solar Energy* and *Renewable Energy*. Noteworthy in the co-citation

Fig. 4 **a** Co-citation network of the journals (2001–2007). **b** Co-citation network of the journals (2008–2014). **c** Co-citation network of the journals (2015–2021)

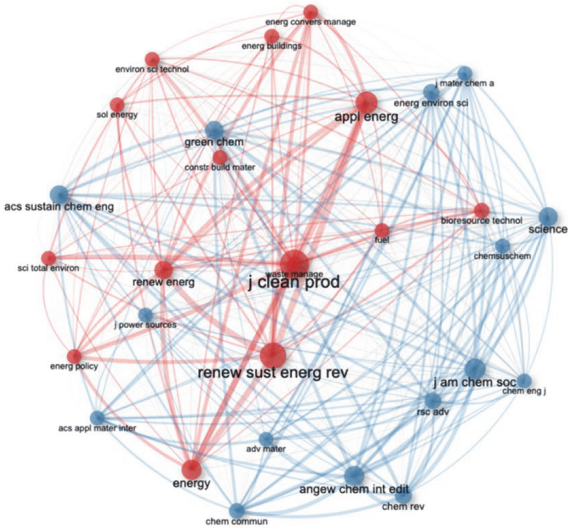
a *Co-Citation Network of the Journals (2001-2007)*



b *Co-Citation Network of the Journals (2008-2014)*



c *Co-Citation Network of the Journals (2015-2021)*



network is the multidisciplinary journal *Science*, a highly cited multidisciplinary journal whose coverage of chemistry and engineering has been found by Milojević (2020) to be higher than the other prestigious general science journals *Nature* and *PNAS*.

In the period 2008–2014, the journals publishing the most articles are *Renewable Energy* ($n = 2959$), the *Journal of Cleaner Production* ($n = 2523$), *Green Chemistry* ($n = 2465$), and *ChemSusChem* ($n = 1438$), and *ACS Sustainable Chemistry and Engineering* (n = 552). The sources with the most citations in the Web of Science Core Collection are *Green Chemistry*, with 168,973 citations; the *Journal of Cleaner Production*, with 153,859 citations; and *Renewable Energy,* with 150,062 citations. Some journals published their earliest issue in this period and, thus, had less time for accruing citations and the corresponding symbolic capital in the field. An example of these periodicals is *Sustainable Cities and Society*, which started in 2011 and received 169 citations in this period. In terms of symbolic capital, represented through co-citation links in Fig. 4b, the cluster of chemistry journals in blue is still the one that is composed of the most nodes and the nodes with the most co-citation links and, therefore, of a larger diameter on the map.

The co-citation map in Fig. 4c shows the broadening of the cluster (in red) that includes the *Journal of Cleaner Production*. This latter's position in the network, and that of energy fields publications such as *Energy* and *Applied Energy*, are more predominant in this third period than in the previous two. The blue cluster, formed by journals with a chemistry profile and by the multidisciplinary *Science*, shrinks in 2015–2021 compared with the previous two periods.

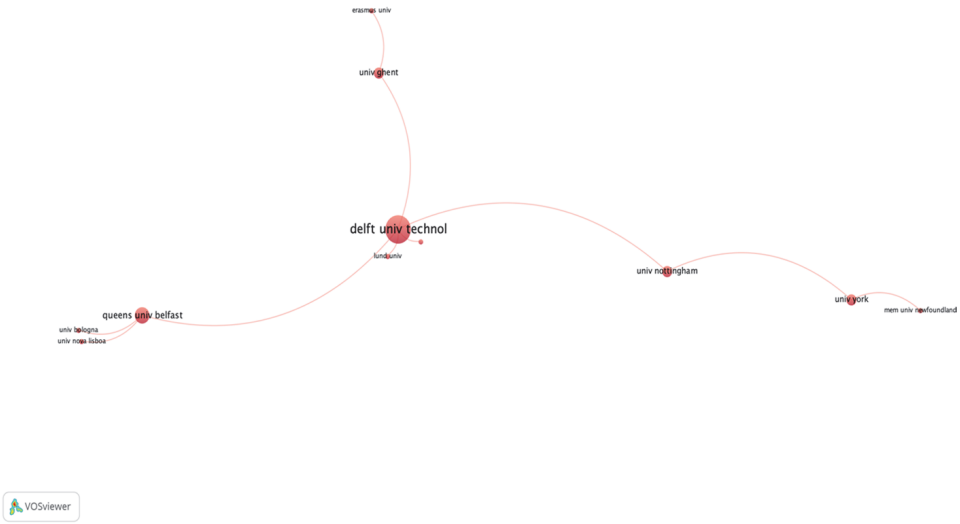
The co-authorship relations (Affiliations)

Co-authorship is just one type of scientific collaboration and, consequently, of the symbolic capital involved in knowledge production. Nevertheless, co-authorship relations between affiliations and, on a larger scale, between countries show capital incorporated into a set of publications. The collaboration between research organizations, as measured by co-authorship relations, is illustrated in Fig. 5a–c. Although the level of cooperation may seem sparse from these network visualizations, it is important to note that a threshold was applied to improve the readability of the graphs. In all three figures, the maximum number of nodes that could be shown in the visualization was limited to 50, based on the algorithms used to construct the graph (Fruchterman & Reingold, 1991; Traag et al., 2019) from co-authorship data. Biblioshiny, the web application of bibliometrix, was used to export network structure in a Pajek file (Batagelj & Cerinšek, 2013), which was subsequently visualized using VOSviewer (van Eck & Waltman, 2010), as it is also found in recent scientometric studies (Chaudhari & Pawar, 2021; Guleria & Kaur, 2021). The clustering in VOSviewer was based on a threshold of a minimum of 10 items per cluster.

The co-authorship map in Fig. 5a on the links between the field's academic organizations shows the Delft University of Technology and The Queen's University of Belfast as significant collaboration hubs based on the number of co-authorship links.

In the network shown in Fig. 5b, organizations that could be found in 5a are still represented (such as the Delft University of Technology, Lund University, The Queen's University of Belfast, the University of Nottingham, and Monash University). However, several universities are found at the later stage of the history of the field represented in 5b, for instance, The University of Tennessee, Zhejiang University, and the University of Tokyo. Particularly close connections in the map are found between an organization in the

a *The Co-Authorship Network Based on the Authors' Affiliations (2001-2007)*



b *The Co-Authorship Network Based on the Authors' Affiliations (2008-2014)*

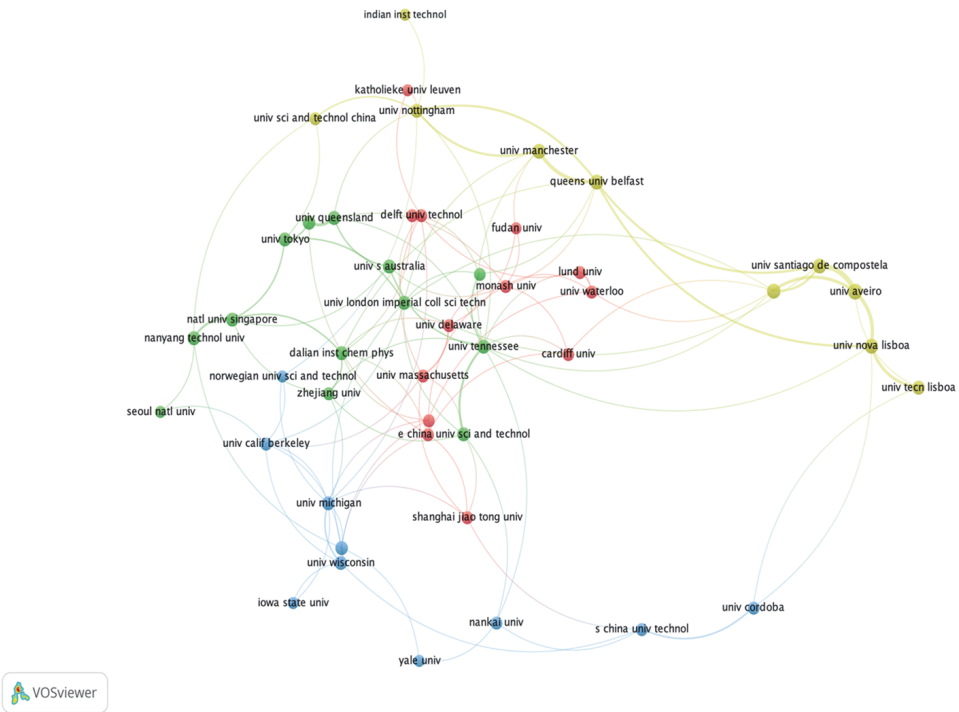


Fig. 5 **a** The co-authorship network based on the authors' affiliations (2001–2007). **b** The co-authorship network based on the authors' affiliations (2008–2014). **c** The co-authorship network based on the authors' affiliations (2015–2021)

c *The Co-Authorship Network Based on the Authors' Affiliations (2015-2021)*

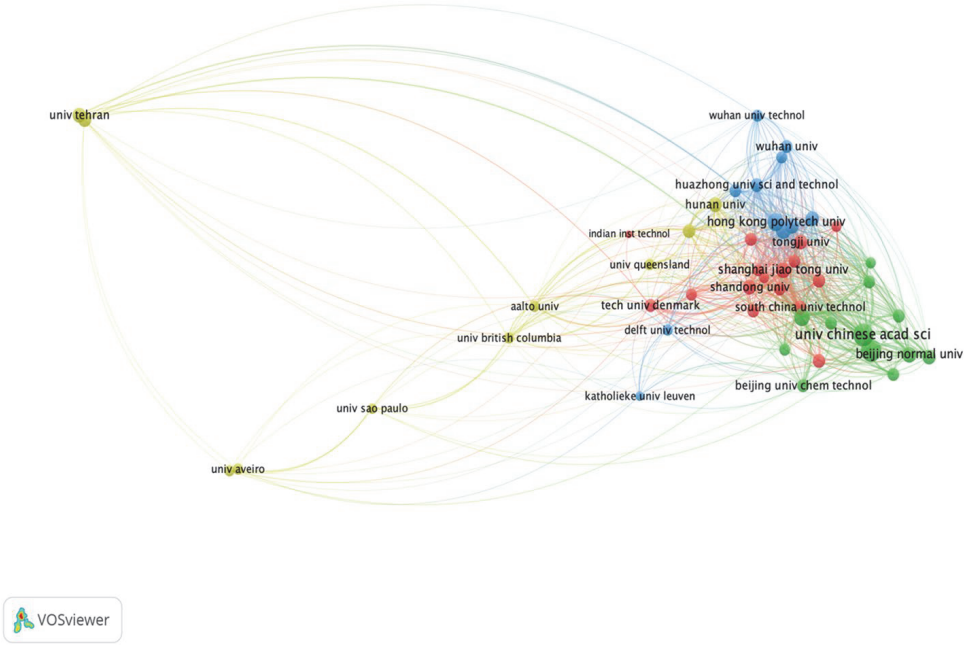


Fig. 5 (continued)

same country, e.g., The National University of Singapore and the (Singaporean) Nanyang Technological, between The Autonomous University of Barcelona and The University of Aveiro, and between The University of Manchester and The Queen's University of Belfast.

In the last period, 2015–2021, The University of the Chinese Academy of Sciences has the most links in this period, found in a portion of the graph which shows a high degree of collaboration between Chinese research organizations. Although scientific and policy discussions on sustainability in China predate this period (Liu, 2010), Liu et al. (2021) have more recently underlined the dominance of China in the sustainability research field in the period 2013–2019, with a particular focus on five areas: sustainable urbanization, carbon emissions, sustainable land use, sustainability calculation, and decisions for sustainability.

The co-authorship relations (Countries)

The map in Fig. 6a is based on the co-authorship relations between countries during the period 2001–2007. The visualization has a threshold of at least ten co-authorship links between countries. The shade of blue correlates with the number of papers associated with affiliations in that country. Although the contributors to the total publication output worldwide are several, the degree of collaboration is extremely limited. To improve the readability of the maps in Fig. 6a–c and avoid excessively numerous co-authorship links affecting the quality of the visualizations, a threshold of at least 50 co-authorship connections between countries was chosen. Therefore, in the time frame of the first period, even the most frequent connections between countries—the one between the US and the UK (15

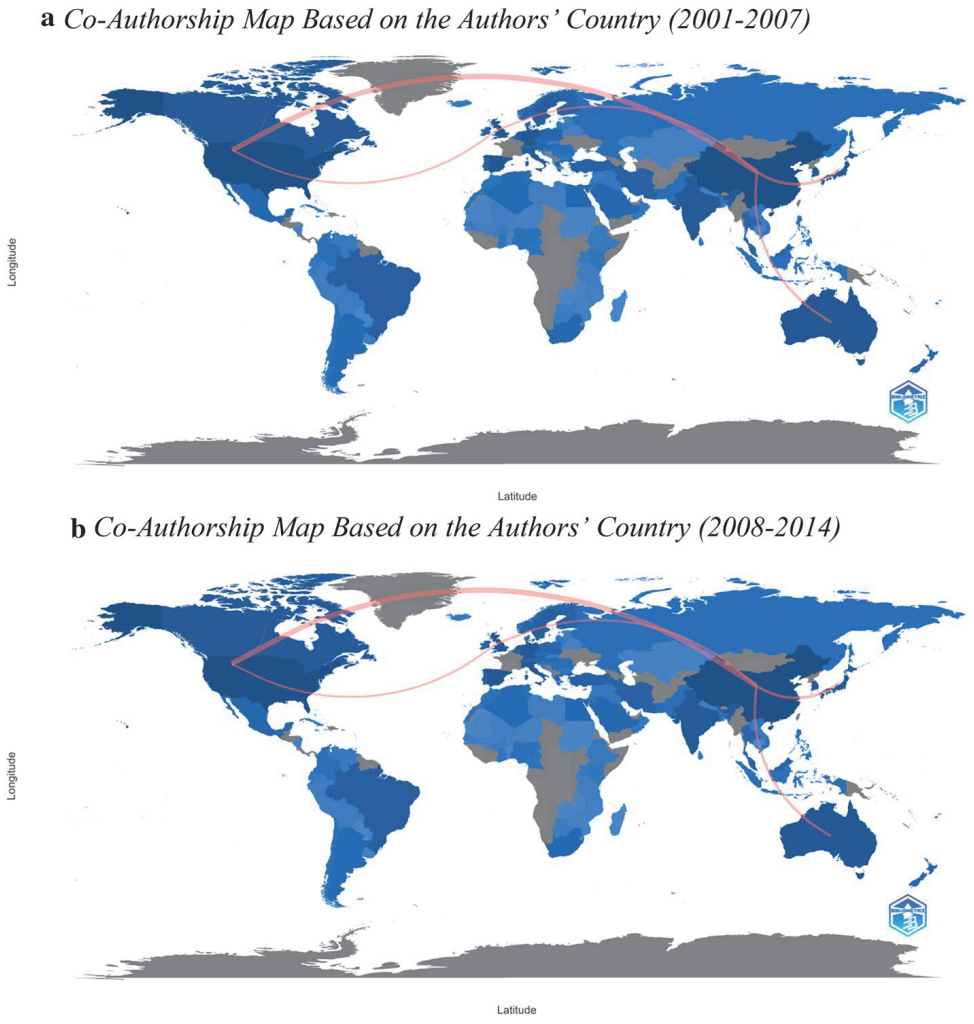


Fig. 6 **a** Co-authorship map based on the authors' country (2001–2007). The map is based on a threshold of at least 50 co-authorship links between countries. The shade of blue in which a country is represented is correlated with the number of papers associated with an author's affiliation in that country. **b** Co-authorship map based on the authors' country (2008–2014). The map is based on a threshold of at least 50 co-authorship links between countries. The shade of blue corresponds to the number of papers associated with an author's affiliation in that country. **c** Co-authorship map based on the authors' country (2015–2021). The map is based on a threshold of at least 50 co-authorship links between countries. The shade of blue in which a country is represented is correlated with the number of papers associated with an author's affiliation in that country

links) and the US and China (ten links)—are not visible on the map (see Table 15 in the Supplementary Material for further details).

Particularly collaborative countries between 2015 and 2021 are the US, China, the UK, Australia, and Japan. The foundation of the journal *Sustainability Science*, earlier in 2006, by the University of Tokyo contributed to explaining Japan's higher productivity and collaboration in this period (Kajikawa et al., 2017). The highest number of links is reached by the collaboration between the US and China (176 links), followed in decreasing order

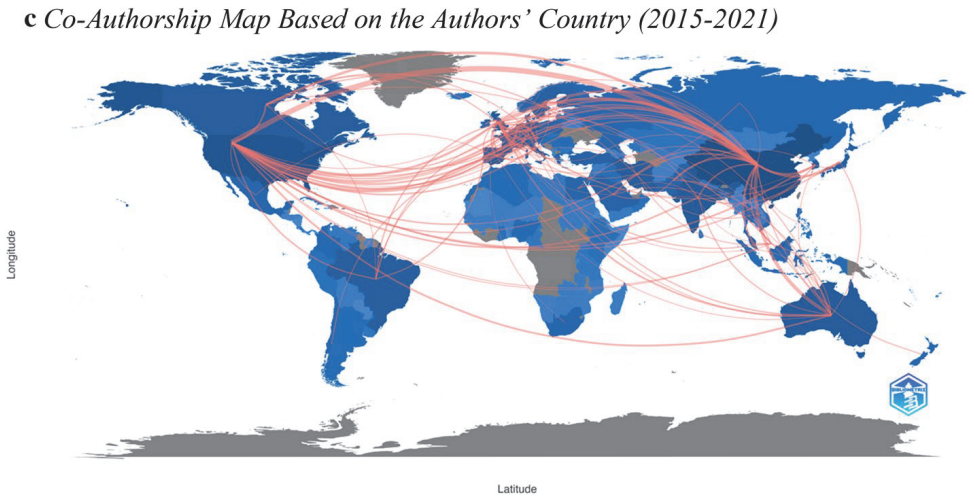


Fig. 6 (continued)

by the one between China and Japan (83 links), China and Australia (74 links), China and the UK (66 links), and the US and the UK (63 links). The 2013 initiative of The Ministry of Science and Technology (MOST) of China—the Citation Impact Upgrading Plan (CIUP)—should also be mentioned (Zhou & Leydesdorff, 2016). This policy initiative encouraged researchers, through financial support, to publish in journals with high impact measured according to bibliometric data from the Clarivate Analytics database Science Citation Index—Expanded (SCIE) and MedLine, or the Journal Impact Factor of the journals in which Chinese researchers publish their findings (Teixeira da Silva, 2017). These policies can be read through the lens of Bourdieu's (2005) sociology as interactions between the political and the scientific field with the mediation of the economic one. However, other financial incentives to publish in top-tier publication channels were in place in China before the CIUP initiative, as shown by the paper by Shao and Shen (2012), who criticized similar governmental strategies because of adverse effects such as several cases of research misconduct.

Taking a global perspective, it can be observed that from 2015 to 2021 there has been an overall increase in the degree of co-authorship. Besides China, the US, Canada, the UK, Spain, Germany and the Netherlands, Australia, and Japan are still highly collaborative countries. More countries from the Global South are represented on the map, with co-authorship links connecting former colonies with their former colonizing states, notably in the case of Brazil and Portugal (125 links) and India and the UK (120 links).

In this study, two series of co-authorship maps answered RQ2 on the position of research organizations and their countries in the field, respectively. The networks pictured in these maps show that most of the publications are associated with a Chinese or American affiliation. However, the period 2015–2021 is also characterized by the entry into the field of several more Global South countries. The dominance of Chinese universities in the second and, even more so, in the third period is a significant finding that cannot be explained merely by the increment of the Chinese publication output in general, and in particular, the one represented in the Web of Science's citation index. In fact, this article compares the three periods, always using leading journals as units of analysis. Thus, the study reveals Chinese universities' success not merely as newcomers entering the field.

They have secured a position in the symbolic economy of the field where the most prestige can be found. The last two periods see the increasing role of another Asian context, Japan. In particular, the publication success of this other country involves the foundation of the journal *Sustainability Science* and the investment in the field by the University of Tokyo (Kajikawa et al., 2014).

Discussion

This study identifies the leading journals' topical profiles, co-citation relations, and co-authorship networks, which in turn define, more broadly, their position in the field. In the remainder of the article, answers to the research questions RQ1-2 are paired with the fundamental question: "What kind of science is sustainability science?" (Kates, 2011). In all three periods, the survey of 18 leading journals conducted so far has shown particular prominence in the field of already established research fields, notwithstanding the generalized call for a transdisciplinary science *of* sustainability beyond the interdisciplinary and disciplinary science *for* sustainability (Spangenberg, 2011). These scientific fields can be identified as belonging to research areas of chemistry, renewable energy, and a more general topic area engaged with the topic of sustainability and sustainable development as well as life cycle management, recycling, and the entities which De Vries (2012) calls "socio-ecological systems" (SES). The historical contribution of these different research areas is visible through the MCA of the author-assigned keywords, where the "hard sciences" (Becher & Trowler, 2001), notably chemistry and energy research, have a leading position in the field. However, social science research on SES has been the most successful "soft science"-challenger of the "hard sciences."

The introduction of this article mentioned the seminal bibliometric study of sustainability science by Buter and Van Raan (2013), where the authors concluded through a fine-grained semantic analysis of research topics that the field had yet to become fully transdisciplinary. The research design of Buter's and Van Raan's (2013) article differs from the journal-oriented analysis of the field proposed in this study. However, the latter is partially relatable to the former. In fact, the findings presented so far have shown an increase in the transdisciplinarity of sustainability science if the field is seen from the perspective of the sustainability-specific journals in which scholars communicate their research. These new publication venues correspond to one criterium set for transdisciplinary sustainability science by Lang et al., (2012, p. 34, italics in the original text): "targeted 'products' for both parties." The term "products" does not mean only scientific articles, although it still comprises them. Thus, as shown in the present study, the *Journal of Cleaner Production*, explicitly defined as "transdisciplinary" in its aims, has progressively gained more symbolic capital (Elsevier, 2022, para. 1).

These findings can be read through the lens of a perspective that could be called the "Gingras-Bourdieu hypothesis." According to the historical analysis of the field of physics by Gingras (1991), which Bourdieu (2004) further discussed in one of his lectures at The Collège de France, a scientific field acquires prestige the more it becomes a social field of scientists and the less a field of practitioners. Specific, formalized, and esoteric knowledge discourages newcomers from entering the field, leading to a higher status for the agents already admitted to the field. This hypothesis corresponds to Bourdieu's conceptualization of the relative autonomy of scientific fields (Albert & Kleinman, 2011). The "mathematization" of physics following the discoveries of Newton created an intellectual

threshold to access the field that left out those that could not master it, as with engineers and other practitioners of the field. The intellectual organization of a field, including its concepts and theories, has a profound impact on the social structure of the field, influencing who is granted access and participation within it. Publishing in journals is not the only way to enter a scientific field as a legitime member of its community (being part of learned societies is, for instance, another). However, authoring papers in the known journals of a field still constitutes a salient characteristic of those who are recognized as a legitime agent of a scientific field, as discussed by Small (2004) in broader terms, and by Larivière (2012b) in relation to the publication output of doctoral students. As Anzola (2019) underlines, although specialized languages are for Bourdieu (1991a, p. 137) compromises between expression and "censorship," i.e., between what an author wishes to express and what the scientific community allows, Bourdieu's understanding of what turns a field into a discipline hinges more on establishing the means to judge the researcher's contributions to the field than the birth of the language of the "academic tribe" (Becher & Trowler, 2001). Journals are those arenas where, through peer review, the contributions of the authors are scrutinized by other agents in the disciplinary field.

From the standpoint of the Gingras-Bourdieu hypothesis and of Bourdieu's theory of scientific fields as relatively autonomous social fields within society, the foundation of the journal *Sustainability Science* by researchers from the University of Tokyo is a paradigmatic case (Kajikawa, 2008). In the market of the symbolic goods of the field, the creation of this specialized journal represents the explicit pursuit of disciplinary autonomy for this new scientific field (Kajikawa et al., 2017).

Three strategies for facing sustainability issues and three types of sustainability science journals discussed below correspond to decreasing levels of disciplinary autonomy. The journals of the field reflect the debate on the disciplinary status and defining features of sustainability science. A typology (a)–(c) of journals can be constructed based on the findings of this study and their relation to the debate on the disciplinary status of sustainability science:

(a) *Sustainability Science* exemplifies the type of publication that promotes the diversification of sustainability science from other existing sciences. The strategy here is to promote through a journal the establishment of a transdisciplinary albeit relatively autonomous field, with the potential of becoming an established discipline in Bourdieu's meaning of an academic community of agents that share common interests (intellectual and economic ones) as well as rules for regulating the entry and scrutiny of newcomers (e.g., acceptance to publish in the field's journals and speak at its conferences). To this strategy belongs also those perspectives that are open to sustainability as a "room of its own" beyond the difference between basic and applied science, e.g., as use-inspired "basic research" (Clark, 2007, p. 1737) or even as a field that seeks to utilize unprecedented types of knowledge (White, 2013), e.g., indigenous knowledge, which challenges the legitimized boundaries of "scientific authority" (Bourdieu, 1991b, p. 7).
(b) The second type of journal corresponds to the strategy of creating publication venues less concerned with the foundation of a new scientific field compared with journals of type (a) but equally oriented towards the topic of sustainability in a broad meaning, that is, without situating the journal in a disciplinary, thematic area (such as chemistry, agronomy, economics). *Nature Sustainability*, a newcomer in the field that appeared

in 2018, could be ascribed to this second profile together with older publications such as the *Journal of Cleaner Production* and *Sustainable Development*.

(c) Specialized journals form the third group. The strategy is to treat "sustainability issues" within distinctive established disciplines (White, 2013). However, not all sciences appear to share this group, although sustainability issues should be relevant for all sciences (Nolin, 2021). This type includes *ACS Sustainable Chemistry* and *Engineering, Agronomy for Sustainable Development*, and the more recent *IEEE Transactions on Sustainable Energy*. As shown in the PCA biplot in Fig. 2a, discussed earlier in the paper, most of the leading journals belong to this third profile.

As a scientific field, sustainability science is conceived as more autonomous when being treated as a "room of its own" (Clark, 2007, p. 1737) in the (a) type of the (a)–(c) typology than in the other two cases. However, in contrast to the evolution of the field of physics with its disconnect from engineering professions, as extensively discussed by Gingras (1991), sustainability science—even according to strategy (a)—can never sever its connection with the field of sustainability practices and policies. It is not desirable that it would do so either. This emerging field is, in fact, a problem-driven science that hinges on focused on a normative concept: societies should strive to achieve sustainable goals or solutions to sustainability issues (Kates, 2011; White, 2013). These goals and solutions require the involvement of agents from other fields, e.g., the field of sustainability policy. The need for a new epistemology of "sustainability knowledge," as emphasized by White (2013) calls for new viewpoints on knowledge and science highly desirable. Transdisciplinary research strategies corresponding to the shift from Mode 1- to Mode 2-type of knowledge production (Gibbons et al., 1994) have been deemed by Lang et al. (2012) as the most adapted to tackle sustainability issues. This article is also the most cited document in the dataset during the subperiod 2008–2014 and the second most cited paper in the whole period 2001–2021 (see Tables 17 and 5 in the Supplementary Material). It should be noted that Lang et al. (2012) raise an important point on the disciplinarity of sustainability research: even if "transdisciplinary research is, in many cases, a promising choice," at the same time, "this does not undermine the relevance of disciplinary or interdisciplinary approaches" (p. 40).

Furthermore, several co-authorship patterns found in the present studies could be read as instances of "neo-colonial academia" (Yalkin & Özbilgin, 2022) and confirming the "post-colonial collaboration," for instance, between Brazil and its former colonizing country, Portugal. These findings confirm earlier studies that have found that the sharing of the same language favor collaboration between former colonies and colonizers (Boshoff, 2009). In any case, a more accentuated diversity in terms of countries of publication, including the Global South, found by the present study and also by earlier large-scale analyses (Confraria et al., 2017) can be expected to advance novel non-Western perspectives on sustainability and conceptualizations of "sustainable knowledge." An example could be the "strong sustainability" concept of *buen vivir*, which "originated in South American native cultures (in particular in Andean cultures) and substantially opposes the proposals of development and sustainable development, discussing the essence of Western culture […] that contrasts the anthropocentric conception with a perspective based on respect for Mother Earth and all living beings" (Ruggerio, 2021, p. 786). It is not excluded that the apport of the Global South to the publication output of the field will not only introduce to the field different perspectives, and, in particular, "strong sustainability" ones, but also the contribution of "softer sciences" from which

some of these perspectives have originated, e.g., the field of environmental philosophy in the case of the deep ecology movement (Naess, 1973).

The discussion of the results so far has hinged on the historical formation of sustainability science, and it has provided a descriptive narrative of how the field has been shaped based on the leading journals. However, both Bourdieusian sociology of science (Bourdieu, 2004) and the research agenda of transdisciplinary scientometric research (Kajikawa, 2022) encourage seeking beyond the descriptive level of analysis a more normative approach. Although the question of what type of science sustainability science ought to be goes beyond the scope of this article, the findings allow for normative considerations.

As a normative concept, sustainable development establishes the ground for the emergence of specific norms, e.g., scientific and legal ones. From a Bourdieusian perspective, sustainability science can be seen as the scientific and self-reflexive study of sustainability-oriented norms and the processes that promote or obstacles them—within and beyond scientific fields. Sustainability is a research field close to the field of policy and the power structures of society. The idea of integrating the framing of sustainability issues into potentially all existing scientific discourses across the soft-hard science spectrum would superficially appear to imply that the maturity of the field would coincide with its disappearance. If sustainability thinking is found everywhere in the literature of all sciences, who would then need a science called sustainability science? However, this would be equal to saying that integrating social aspects in other sciences ought to exhaust the role of sociology as a field of research. Sociology is considerably more than that (Bourdieu & Wacquant, 1992). In this sense, much of Bourdieu's discussions regarding the connection between sociology and power structures and the need for reflexive sociology also apply to sustainability science (Bourdieu & Wacquant, 1992). In sustainability science, Jerneck & Olsson (2020) have emphasized the reflexive nature of the field. The concept of framing "examines the process to determine what is worthwhile to sustain in line with the direction of sustainable development" (Kudo & Mino, 2020 p. 9). Framing can be applied to sustainability issues (Mino & Kudo, 2020), to the notion of evidence in policy-making (Kajikawa, 2022), and also to the type of scientific discourse that is being created around sustainability, e.g., through scientometrics studies. When considering sustainability science from the meta-perspective of the scientific discourse on science, framing sustainability issues becomes self-reflexivity. In this regard, the perspective of symbolic capital helps gauge competition between agents and institutions and "power struggles" (Bourdieu et al., 2019, p. 165), e.g., not all universities can be the leading ones in a field. However, symbolic capital is a resource that can also be transferred and shared, which is the ground for alliances between sciences and between science and other societal actors—or synergies, to use the terminology of Leydesdorff (2021). Journals of the type (c) discussed above represent a synergy between some established disciplines, such as agronomy, and the newer field of sustainability research. Ultimately, for the sake of the self-reflexivity of sustainability science, research on sustainability journals is no less necessary than their creation.

Conclusion

Taken together, this study's findings have shown that Bourdieu's field theory and the correlated methodology of GDA can serve the purpose of "transdisciplinary bibliometric research," to use the term recently proposed by Kajikawa (2022). As emphasized by Bourdieu (2008) and, more recently, by other scholars of various social science fields

(Blasius et al., 2019; Ekelund, 2016; Lebaron, 2018; Lu et al., 2021), PCA, MCA and other GDA approaches have the strength of providing a picture of social fields based on the volume and type of capital. The present article has focused on symbolic capital and built on earlier bibliometric research inspired by Bourdieu's sociology of science (Schirone, 2023). The publication and citation data were processed with the R package *bibliometrix*, which already includes one GDA method, the MCA, as one of its features (Aria & Cuccurullo, 2017). An overview of the field and the position of journals and their publishers were obtained with another GDA approach, the PCA. As is often the case with bibliometric data, the study's data were skewed. Therefore, a variant of PCA, the Robust PCA, was preferred to the canonic version of PCA. Future research could apply and adapt this approach to the bibliometric and scientometric analysis of other research fields.

However, this study has limitations that need to be acknowledged: using one bibliometric database, Web of Science, and operationalizing the concept of "leading journal" with a value of Journal Citation Indicator that is higher than the world average. Therefore, the study could be replicated using other journal rankings. Another limitation of this study is the choice to include only research articles, which left the editorial material out of the study's dataset. Future research could clarify the editors' role in shaping the field.

To conclude, this study has revealed the picture of a scientific field organized around three main strategies to conceive sustainability science research (each strategy paired with a corresponding type of journal): sustainability science as a field of its own and, in particular, as the science of sustainable socio-ecological systems; this field as concerned with the subject of sustainability more broadly conceived; and as a specialty within other fields, that is, as the study of sustainability issues and their potential solutions from the perspective of green chemistry, renewable energy, and other sciences with their already established disciplinary status. The field's history also indicates a process of expansion to which more and more newcomers, in terms of journals, universities, and countries, are contributing.

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Article III

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Discover Sustainability

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The emergence of sustainability science in the editorials of three scholarly journals

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Abstract
This study examines editorials from leading journals in sustainability science published between 1993 and 2022. By analyzing 76 editorials from *Environment, Development, and Sustainability*; *International Journal of Sustainable Development & World Ecology*; and *Sustainable Development*, the article investigates the field's historical development, interdisciplinary connections, and interactions with sustainable development policies. Using qualitative content analysis, the editorials are categorized into three distinct periods: foundation (1993–2002), introspection (2003–2012), and diversification (2013–2022). The foundational phase emphasizes key themes, such as systems thinking, participatory research, and indigenous knowledge, along with the interplay between scientific knowledge and environmental policy. The introspection phase is characterized by increasing interdisciplinarity and a problem-oriented approach, focusing on socioecological and economic systems, particularly ecological modernization. The diversification period—marked by global crises like climate change and COVID-19—highlights the importance of transdisciplinarity, with a focus on involving non-academic stakeholders, including policymakers and local communities. Additionally, editorials underscore the need to address global equity while integrating cultural sustainability into sustainability efforts. The study further analyzes the diversity of research contributing to the field, key concepts, the tension between global and local perspectives, and the role of journals as gatekeepers that help establish sustainability science as an autonomous research field. Drawing on Pierre Bourdieu's sociology of science, the article interprets sustainability science as a heterodox science that challenges the boundaries of traditional disciplines; and as a field that competes for legitimacy and recognition, balancing interdisciplinary and transdisciplinarity with its disciplinary identity.

Keywords Sustainability science, Sustainable development, Bourdieu, Editorial, History of science, Field theory

1 Introduction

Sustainability science integrates knowledge across various disciplines to address complex, multifaceted sustainability challenges—often referred to as 'wicked problems'—which require adaptive strategies and engagement with multiple stakeholders [1–3]. Achieving sustainable development requires innovative knowledge and collaboration

across academic, governmental, and societal domains, as underscored by the Brundtland Commission's landmark report [4]. Since the publication of this report, the 'stock of knowledge capital' in sustainability science has expanded significantly, marked by an increasing number of dedicated journals and research output which have effectively mapped the field's intellectual trajectory [5–8].

The evolving nature of sustainability science reflects the complexity of the challenges it addresses. The field has grappled with defining its identity, establishing legitimacy, and integrating diverse disciplinary and non-academic perspectives. While previous studies have relied on traditional academic outputs—such as research articles, literature reviews, and books—these approaches may overlook critical aspects of how the intellectual directions of sustainability science have been shaped over time. In particular, the role of editorials has not been sufficiently explored as a source of insight into the formation of the field and the origin of its debates.

This article addresses this gap by leveraging editorials as a novel lens to explore the historical development of sustainability science. Editorials offer key viewpoints on prevailing thoughts and debates within the scientific community at different times, reflecting both the intellectual climate and emerging trends within the field. Typically authored by permanent members of editorial boards or invited guest editors, editorials reflect the views of leading scholars who evaluate the scientific quality of manuscripts and suggest paths for future research. However, it is important to acknowledge that editorials may represent the perspectives of more established voices within the field, who potentially align with more dominant narratives. This raises the question as to whether the views expressed in editorials may marginalize alternative or emerging perspectives within the scientific community. Despite—or perhaps because of—these characteristics, editorials provide a unique and valuable lens into the mechanisms that set the direction of research in the field, offering insights into the shaping of academic discourse and the consolidation of intellectual trends.

Empirical studies have explored the characteristics of editorials as a genre, revealing their distinct role in shaping academic discourse. Hulme, Obermeister, Randalls and Borie [9] applied content analysis to editorials published in *Nature* and *Science*, finding differences in how these journals frame climate change: *Nature* focused on institutional and governance challenges, while *Science* emphasized technological, energy, and communication issues.

Hellsten and Leydesdorff [10] examined how editorials in the journal *Climatic Change* transitioned from multidisciplinary to transdisciplinary in focus. Initially, the journal employed a multidisciplinary approach, with contributions from various fields remaining largely within their respective boundaries. Over time, the journal adopted a more interdisciplinary profile, integrating knowledge across disciplines. Eventually, it developed a transdisciplinary focus, increasingly incorporating policy-relevant research and addressing broader societal challenges.

Furthermore, bibliometric research, such as the paper authored by Campanario and González [11], has analyzed the role of editorials in Journal Impact Factor calculations, while van Leeuwen, Costas, Calero-Medina and Visser [12] discussed the role of editorials in research evaluation, suggesting that they are increasingly recognized as significant contributions to scientific communication. The subjective tone and rhetorical strategies of editorials, including the use of metaphors and humor, further enhance their ability to

connect with readers and influence the academic conversation [13]. Editorials addressing predatory publishing often employ emotionally charged language, intended to invoke strong reactions from their readers [14]. Despite differences among traditions in various disciplines and individual journals, research on editorials underscores their crucial role in the production of new scientific knowledge.

Plakhotnik [15] highlighted the potential of editorials as leadership tools to influence the development and character of journals, although their actual implementation varies across disciplines. Petersen, Hattke and Vogel [16] defined 'editorial governance' as the framework of practices and policies which influence the integrity, independence, and strategic direction of academic journals. This governance encompasses the composition and characteristics of editorial teams, including their roles as opinion formers, gatekeepers, and arbiters of disciplinary values. Editors shape the mission, scope, and intellectual trajectory of journals by composing editorial boards, assigning reviewers, making final publication decisions—and, notably, by writing editorials.

Accordingly, this article aims to examine the field's historical trajectory and seek answers to the following research question:

How do editorials in a selected set of sustainability science journals reflect the field's historical development from 1993 to 2022?

In addressing this question, a text corpus was identified and analyzed using the methods discussed in the following section. The results are ordered in three distinct periods, followed by further analysis and discussion of these findings. More specifically, for a deeper understanding of the history of sustainability science, the analysis and discussion section of the article utilizes Pierre Bourdieu's [17] sociology of science as its analytical framework. From this standpoint, scientific fields are structured spaces of social relationships where individuals and groups compete for legitimacy and status or, in Bourdieu's lexicon, 'symbolic capital' [18]. Editorials are typically authored by editors or senior scholars and may reflect dominant positions within the field. From a Bourdieusian perspective, they can be seen as vehicles for reproducing symbolic capital and legitimizing specific epistemic standpoints, which may indirectly marginalize alternative or emerging perspectives. Moreover, scholarly journals are not conceptualized here as active gatekeepers in the Mertonian sense of regulating access to publication [19], but rather as repositories of symbolic capital that contribute to the structuring of the scientific field [20–22]. Editorials, in this view, function as instances of objectified cultural capital through which dominant perspectives are both articulated and contested.

The paper concludes by reflecting on the limitations of the chosen approach, offering suggestions for future research, and summarizing the main conclusions.

2 Data sources and methods

2.1 Data sources

The journals *Environment, Development and Sustainability* (EDS), *Sustainable Development* (SD), and the *International Journal of Sustainable Development & World Ecology* (IJSDWE) were selected for their comprehensive representation of sustainability science and their relative longevity compared with other periodicals. The selection of these journals is supported by bibliometric studies, which highlight their roles in shaping sustainability research [23–25]. These periodicals are classified in the database *Web of Science* under the category "Green & Sustainable Science & Technology" [26], analyzed in detail

by Bautista-Puig, Manana-Rodriguez and Serrano-Lopez [23]. Farrukh, Meng, Raza and Tahir [25] focused on SD, while Ellili [24] analyzed EDS, both underscoring the variation in the sustainability topics that these journals address.

The analysis begins in 1993, which marks the launch year of SD, one of the three journals in this study. This year also closely follows the 1992 United Nations Conference on Environment and Development (Earth Summit), a landmark event that catalyzed international interest in sustainable development [27]. IJSDWE was launched in 1994, and EDS in 1999. Therefore, 1993 represents a meaningful and practical starting point for the analysis, capturing the emergence and institutionalization of sustainability science in the scholarly publishing landscape.

While the selected journals publish a broad range of sustainability-related research, including topics that extend beyond the definitional core of sustainability science, this study focuses specifically on how sustainability science is represented and articulated in their editorial discourse.

Among the most prolific contributors, Luc Hens, a founding editor of EDS, authored 12 editorials, while the late David Pimentel, another founding editor of EDS, contributed 7 editorials. The late John Jeffers, founding editor-in-chief of IJSDWE, contributed five editorials, shaping the journal's mission to integrate ecological and socioeconomic perspectives. Sneha Gautam, an air pollution expert, contributed four editorials, and Guofan Shao, editor-in-chief of IJSDWE at the time of writing, authored three.

2.2 Qualitative content analysis

Although the study involves a structured analysis of published editorials, it is not conceptualized as a literature review. As defined by Schreier [28], qualitative content analysis (QCA) is a method for systematically describing the meaning of qualitative material, rather than synthesizing prior research. QCA was selected for its capacity to identify recurring concepts while also uncovering deeper layers of meaning. In line with Sutton, Clowes, Preston and Booth [29], review articles are typically aimed at summarizing and integrating findings from empirical studies, whereas the present study treats editorials as primary discourse material and applies qualitative content analysis to interpret their thematic and epistemic development over time.

In this context, the present work aligns with interpretive and reflexive strands of sustainability science that emphasize epistemological openness and theoretical framing [30]. It draws on the author's disciplinary background in information studies, and the analytical approach is informed by Bourdieu's sociology of science, particularly his concepts of field, capital, and struggle, which shape how editorial discourse is understood in relation to the institutional development of sustainability science [18]. Recognizing that qualitative content analysis is inherently interpretive, the analysis does not claim neutrality. Instead, it acknowledges that all meaning-making is shaped by the researcher's theoretical lens and positionality. Within this framework, the editorial texts are approached not simply as descriptive reflections of the field, but as discursive interventions that contribute to its ongoing formation.

This study applied Krippendorff's [31] approach to QCA, which conceptualizes a text corpus as a system composed of subsystems. In this context, the journal served as the system, with each editorial functioning as a subsystem. These subsystems operate independently in content and focus but are interconnected through shared themes that align

with the journal's broader mission, reflecting Krippendorff's view of systems as composed of interdependent parts. According to Krippendorff's approach, the relationships within and between these subsystems can be analyzed based on explicit content, such as the syntactic structure of the texts, and latent content, which requires contextual interpretation, often mediated through theoretical frameworks. Both explicit content, such as key terms like 'economic growth,' and latent content, requiring interpretation through sustainability science concepts, were examined. Bourdieu's [32] framework was also used to explore how editorials have contributed to shaping the field of sustainability science by discussing concepts and methods.

The full texts of the editorials were imported into the software NVivo for qualitative content analysis; this software was selected because of its ability to manage large text-based datasets and its advanced features, such as matrix coding queries, which allow for nuanced comparisons across documents and codes [33]. The texts were coded by the author, with individual paragraphs serving as the units of analysis. Regular cross-checking to discuss the coding of the texts and ensure consistency was conducted with two experts in scholarly communication.

The coding scheme was developed using an abductive approach, combining deductive reasoning—drawing from existing theoretical frameworks and concepts—and inductive reasoning, which allows new concepts to emerge from the data themselves [31]. The deductive part of the coding scheme uses concepts highly related to sustainability science, such as 'sustainable development,' which were expected to be mentioned in the editorials. The inductive part of the coding scheme was developed from the words identified in the texts. A pilot version of the coding scheme was tested on a subset of the corpus, leading to refinements before the final application. The final coding scheme included 111 codes.

To assess intracoder reliability, Cohen's kappa was calculated on a random sample (5.26% of the dataset, or 4 editorials) selected using the R function *set.seed* [34, 35]. After a seven-month interval, the author re-coded this subset, resulting in a kappa value of 0.70. A value of 0.70 corresponds to substantial agreement, suggesting that the coding process was reliable enough to support the analysis [34]. Using NVivo's matrix coding query functionality, documents and codes were iteratively compared and contrasted, providing a robust means of identifying key patterns across the dataset [36]. Subsequently, heatmaps for Periods I–III were generated from a matrix that matched editorials (rows) with frequencies of coded paragraphs (columns). The heatmaps show the frequency and distribution of key concepts over the three periods, highlighting trends in sustainability science through these editorials.

The coding scheme and heatmaps are available in the Supplementary Material, while Appendix A contains the complete list of the editorials that were analyzed.

3 Results

The findings are organized into subsections representing three distinct periods within the 30 years under examination. The temporal division was established for analytical convenience, aiming to create three periods of approximately equal length. The names assigned to each period ("Foundation," "Introspection," and "Diversification") were developed inductively based on the key themes, concepts, and patterns identified through the QCA approach. These patterns characterize each period, highlighting distinct phases in

the development of sustainability science. Each subsection examines how sustainability science is portrayed by the editorials, particularly in relation to other research fields and sustainable development policies.

3.1 Period I (1993–2002): the foundational phase

The initial phase of sustainability science is primarily characterized by the integration of systems thinking as a core approach. During this period, systems thinking serves as the theoretical bedrock, as illustrated by editorials that explicitly address system analysis [37, 38]. Complexity also emerges as a central concept, particularly in discussions related to land-use systems [38]. In addition to systems thinking, this phase places significant emphasis on the relevance of indigenous knowledge, particularly in the preservation of tropical ecosystems. The integration of knowledge from various scientific disciplines is linked to the field of human ecology [39]. At this early stage, sustainability science emerges as an interdisciplinary field centered on human ecology, aimed at fostering sustainable economic growth within a sustainable development framework [40]. However, some editorials from this period express growing concerns about the limitations and potential misuse of the term 'sustainable development', criticizing its adoption as an empty term unaccompanied by actual policy changes [41]. Nath, Hens and Pimentel [40] explore the gap between the growing awareness of sustainable development's necessity and the disinterest in implementing systems that meet sustainability's core requirements. Three critical factors contribute to this misalignment: the absence of an appropriate economic framework, the absence of a precise definition of sustainable development, and the lack of a "strong political will to promote or implement sustainable development" [40]. Other editorials criticize the misuse of sustainable development as a symbolic means for promoting laissez-faire economics, calling it the "development catchphrase in the 1990s" [41] and a "contradiction in terms and an illusion" [42].

Some editorials from this period also delve into the broader cultural and philosophical underpinnings of sustainability, referencing "cultures, belief systems, and faiths such as Buddhism, Sufism, and Gandhism," which are viewed as counterbalances to excessive consumption and materialism [43]. These cultural perspectives play an integral role in the emerging discourse on sustainability, offering alternative frameworks for understanding and addressing ecological challenges. The editorial by Ip [41] also connects sustainability science to human ecology and global eco-politics, tracing its historical roots back to the early 19th-century works of Thomas Robert Malthus and David Ricardo in political economy. Throughout the foundational phase, there is a strong emphasis on the importance of supportive policies, institutional frameworks, and global governance mechanisms that enable sustainable development. A recurring theme is the call for a reevaluation of global economic systems, prioritizing ecological sustainability, social justice, and long-term well-being over short-term profit and growth objectives. In this regard, Nath, Hens and Pimentel [40] lament.

In this regard, Nath, Hens and Pimentel lament that "the prevailing laissez-faire system of economics, which emphasizes and relies on continually growing production and consumption over time, is at odds with the core requirements of sustainable development—reduced production and consumption and accepting a more modest and less polluting lifestyle" (40, italics in the original).

Traditional disciplines and environmental policies are critiqued for their limitations in addressing biodiversity challenges from a planetary perspective [38]. In response, editorials during this period advocate for participatory research as a necessary alternative to monodisciplinary approaches, emphasizing the need for equal partnerships with developing countries in scientific research [44].

In conclusion, the foundational period is marked by the establishment of key concepts such as systems thinking, human ecology, and a critical perspective on global economic and governance systems. This phase underscores the importance of integrating ecological principles, participatory research, and supportive policies to prioritize sustainable development in both science and policy. However, given the limited sample of only 11 documents, the perspective offered by the editorials from this period is not comprehensive.

3.2 Period II (2003–2012): the introspective phase

In this second period, sustainability science enters an introspective phase, focusing on specific theoretical and methodological approaches rather than foundational initiatives, such as the work of the Brundtland Commission [4]. An example of this introspection is the debate on applying coevolutionary theory—originally a concept from evolutionary biology that examines how interacting species influence each other's evolution—beyond biology to social systems [45, 46]. This discussion begins in *IJSDWE* with McIntosh and Jeffrey [46] commenting on an earlier article by Rammel and Staudinger [45], which led in turn to a special issue on the topic in 2007 [47]. McIntosh and Jeffrey [46] highlight the potential of applying biological coevolutionary theories to the social sciences and argue that while these theories offer valuable descriptive tools, their practical application in guiding sustainability policy remains uncertain. In response, an editorial by Rammel and Staudinger [48] defends the use of evolutionary perspectives to understand socio-ecological systems. This debate exemplifies the broader trend during this period, where sustainability science moves beyond foundational critiques towards a more nuanced exploration of theoretical and methodological approaches.

The second period therefore shifts from broad narratives, such as those seen in Period I, regarding Western culture's negative ecological impact, to a concrete focus on actionable interventions. Editorials in Period II emphasize the more defined, applied, and problem-oriented characteristics of this emerging field. These characteristics are seen as central to interpreting sustainability science as an 'interdisciplinary' field. The complex, real-world problems that sustainability science seeks to address—such as environmental degradation, social inequality, and economic instability—are deemed challenges that cannot be effectively tackled within the confines of a single discipline. Instead, they require the integration of diverse perspectives, methods, and knowledge from multiple disciplines, ranging from the natural and social sciences to the humanities.

The focus on practical, actionable solutions further reinforces the interdisciplinary nature of the field, as it necessitates collaboration across traditional disciplinary boundaries. For example, addressing urban sustainability involves not only ecological and environmental expertise but also insights from sociology, urban planning, economics, and political science. The applied and problem-oriented approach drives the need for interdisciplinary collaboration, making it a defining characteristic of sustainability science during this period. However, one editorial notes that research at the intersection

of sustainable development and cultural heritage followed more "multidisciplinary lines than fully interdisciplinary, integrated research" [49].

In their editorial, Shao, Li and Tang [50] introduce a pyramid metaphor to depict sustainability science's four-dimensional and three-level structure: economy, society, environment, and institutions at the base, with principles, approaches, and applications as the three levels. Moreover, the editorial by Keitsch [51] emphasizes several characteristics of this new science: contributions derived from a wide range of disciplines, including political science and design; the evolution in the field from primarily eco-technical interests to multidimensional issues requiring collaborative efforts; the cultural dimension of sustainable development; and the need for the humanities to balance out positivist approaches more typical of fields such as ecology and physics.

In the interaction between science and policy during Period II, sustainability science is often seen as challenging existing economic and policy frameworks. Young and Utting [52] emphasize the role of sustainability science in influencing fair-trade policies. Baumgartner and Korhonen [53] suggest a holistic and strategic approach to connect scientific research with policy action. Springett [54] criticizes "the narrative of sustainable development as an extension of corporate business as usual," where the sustainable development label is co-opted for commercial interests. In their editorials, Roberts and Hills [55] view sustainability science as an empirical field that must scrutinize the consequences of policymaking, while Pimentel and Burgess [56] take a critical stance regarding the implementation of questionable environmental solutions, such as pesticide use (for further discussion on Pimentel's contributions to the study of sustainable agriculture, see also [57].

A central concept for understanding the interactions between science and policy in Period II is ecological modernization [55, 58–61]. Developed within environmental sociology, ecological modernization argues that economies can grow through industrial ecological innovations and environmental standards while reducing environmental impacts (see [62]). Burger, Daub and Scherrer [58] criticize, in their editorial, the limitations of standards alone in transforming society towards a sustainable Earth, framing ecological modernization as an example of neoliberal governance. Hildén and Rosenström [63] advocate for evidence-based and quantitative assessments of sustainability and the use of more complex standards than only environmental ones.

In sum, this period reflects an introspective phase in which the identity and purpose of the field are pondered. These years are characterized by a stronger focus on theoretical and methodological approaches and a shift toward interdisciplinarity, assessment indicators, and evidence-based policies within—and beyond—the framework of ecological modernization.

3.3 Period III (2013–2022): the diversification phase

Editorials in the last period reflect growing confidence in the field's ability to address diverse and complex global issues, emphasizing a shift towards transdisciplinarity—an approach that involves integrating knowledge across disciplines and engaging non-academic stakeholders, such as policymakers and communities, to co-produce solutions to sustainability challenges. This period marks a diversification of approaches, with the field's applications becoming more varied and integrated into a cohesive transdisciplinary framework.

Global challenges, such as economic crises [64] and the COVID-19 pandemic [65–68], serve as litmus tests for this framework. Several editorials highlight the urgent need for systemic changes to corporate practices [69], the legal system [70], the energy sector [71, 72], architecture and urban planning [73–75], and the food system [76], underscoring the connection between ecological integrity, social equity, cultural values, and lifestyles.

While the transdisciplinary approach is frequently highlighted for its potential to address complex global issues, several editorials from Period III emphasize the associated epistemological and ethical dilemmas. These dilemmas often arise from the complexities inherent in integrating diverse disciplinary perspectives and involving non-academic stakeholders, such as policymakers and local communities, in the co-production of knowledge [73, 77, 78]. In Period III, discussions increasingly focus on the challenges of balancing scientific rigor with the practical demands of policy goals, particularly in areas such as cultural sustainability, education for sustainable development, consumption patterns, and legal frameworks. This heightened attention to the ethical and epistemological implications of transdisciplinary research reflects the field's growing maturity and the recognition of the nuanced trade-offs involved in applying sustainability science to real-world contexts.

Several editorials reflect a continuation of the shift from the dominance of the epistemological paradigm of the biological sciences to that of human ecology and sciences related to the "formation of people's behavioral norms" [74]. These editorials emphasize perspectives on cultural sustainability, which involves maintaining cultural heritage while promoting sustainable practices [79]; education for sustainable development, aiming to equip individuals with the knowledge and skills necessary for sustainable living [78]; consumption patterns that advocate for reduced resource use and sustainable consumer behavior [69, 80]; and legal frameworks that support sustainable policies and regulations [70].

The adoption of the Sustainable Development Goals (SDGs) in 2015 is key to understanding the interactions between science and policy in this diversification phase. Hossain, Gain and Rogers [81] understand the SDGs as conceptual tools to frame sustainability research. An *IJSDWE* editorial states that the SDGs' topics had been discussed in the journal long before the 2030 Agenda for Sustainable Development set these goals [82]. This editorial emphasizes the journal's mission to facilitate communication between stakeholders, and encourages contributions from government agencies, the private sector, and civil society. Ramos, Caeiro, Moreno Pires and Videira [83] highlight both the SDGs' strengths (e.g., growing environmental awareness) and weaknesses (e.g., the gap between objectives and the actual capacity to achieve them).

In summary, the editorials from the last period emphasize the increasing importance of transdisciplinarity and diversification in sustainability science, reflecting broader confidence in the field's capacity to address complex global issues. While promising, the transdisciplinary approach introduces epistemological and ethical dilemmas; particularly relevant when balancing scientific objectives with policy goals, including the SDGs. Issues such as cultural sustainability, education for sustainable development, consumption patterns, and legal frameworks are receiving more attention than had previously been the case.

Table 1 Summary of the findings according to periods I–III

	Period I (1993–2002) Foundation	Period II (2003–2012) Introspection	Period III (2013–2022) Diversification
Sustainability science as a field of study	• Systems thinking and system analysis • Integration of indigenous knowledge • Human ecology and critiques of global economic systems • Emphasis on participatory research and supportive policies • Critique of Western consumer culture and global governance mechanisms	• Critical reassessment of interdisciplinary approaches • Focus on coevolutionary theory and sustainability indicators • Applied, problem-oriented research • Emphasis on ecological modernization • Urban sustainability and collaboration across sectors • Development perspectives of the Global South	• Addressing global challenges (climate change, COVID-19) • Emphasis on transdisciplinarity • Integration of ecological integrity, social equity, cultural values • Systemic changes in various sectors (corporate practices, legal systems, energy, urban planning, food systems) • Ethical dilemmas in sustainability science • Importance of SDGs and their implementation
Selected key Editorials	Jeffers (1999), Ip (1993), Begossi (2000), Nath (1999), Jeffers (1997), Khan (1993).	Rammel (2002), McIntosh (2004), Opschoor (2011), Shao (2011), Springett (2013), Young (2005), Baumgartner (2010), Roberts (2002), Pimentel (2011).	Gautam (2020a, 2020b, 2022), Witjes (2021), Springett (2013), Ramos (2018), Hossain (2020), Álvarez Etxeberria (2017), Mauerhofer (2020), Ferreira (2016), Skjerven (2019), Kell (2022).
Total number of editorials analyzed for each period	11	33	32

Based on the text patterns and frequency of codes found in the editorials from QCA, Table 1 provides a comparative overview of the thematic shifts in the three phases and showcases a selection of key editorials.

4 Analysis and discussion

By conceptualizing scientific fields as structured social spaces where individuals and groups compete for recognition and power, Bourdieu's [17] sociological framework provides a lens for understanding the historical and contemporary knowledge dynamics within sustainability science. A key concept in Bourdieu's framework is 'symbolic capital,' which refers to the prestige, recognition, and authority that individuals, groups, or institutions accumulate within a field [84]. Symbolic capital is not only material or financial resources but includes elements such as reputational power, academic standing, and the ability to influence the field's direction. Scientific journals play a crucial role in the accumulation and distribution of symbolic capital within academic fields [21, 85, 86]. By serving as gatekeepers of knowledge, journals determine which research is deemed legitimate, influential, and worthy of publication, thereby shaping the field's intellectual landscape. Publishing in high-prestige journals grants researchers symbolic capital, as it enhances their visibility, reputation, and authority among peers. Editors and reviewers, in turn, hold significant symbolic capital, as they possess the power to influence the direction of research and validate what is considered valuable knowledge. Consequently, symbolic capital circulates within the academic hierarchy through these publications, reinforcing the status of individuals and institutions that successfully navigate this system. In sustainability science, symbolic capital can take the form of recognition by policymakers, the ability to shape interdisciplinary research agendas, or leadership in defining key sustainability concepts.

In sustainability science, heterodoxy—defined by Bourdieu [32] as the set of approaches and positions that challenge established norms and traditional methodologies—manifests as an interdisciplinary and transdisciplinary endeavor that bridges diverse scientific perspectives to address complex challenges. This heterodox science positions itself against the orthodoxy of conventional, siloed disciplines. Externally, sustainability science competes for symbolic capital with more established disciplines such as economics, ecology, and engineering, as it seeks to legitimize itself as a distinct field capable of addressing complex sustainability challenges. These external struggles position sustainability science within the broader academic hierarchy, where traditional disciplines often enjoy greater prestige due to their longer histories and more established methodologies. Sustainability science, in contrast, must justify its interdisciplinary and transdisciplinary approaches, particularly when it comes to addressing socio-environmental problems that transcend conventional disciplinary boundaries and address 'wicked problems' [3]. Internally, sustainability science experiences competition over symbolic capital as different approaches vie for dominance. These internal struggles center on debates about the field's disciplinary status, autonomy, and varying interpretations of sustainability.

This study's findings reveal that sustainability science emerged primarily out of the necessity to address complex social–ecological problems that transcend disciplinary boundaries. While positioning itself in contrast to traditional monodisciplinary sciences—deemed ill-suited to such challenges—it also drew from interdisciplinary epistemological foundations, including fields such as human ecology and systems analysis. These interdisciplinary fields served as 'bridge sciences', facilitating collaboration between hard and soft sciences to address complex sustainability issues (see [87]). Although Bourdieu's sociology is not only about struggle, also emphasizing "networks of mutual knowledge and alliances" [88], his framework grants significant attention to struggles for control over "competency" [18]; both within scientific fields and between fields. In sustainability science, however, it is possible to observe alliances between fields, such as those between sustainability science and these 'bridge sciences' discussed in the editorials. Other knowledge production alliances mentioned in the corpus of the editorials regard those between the scientific field and civil society, not-for-profit organizations, and other stakeholders.

The analytical categories of struggle used in this study were developed through an abductive coding process, combining theoretical input from Bourdieu's sociology of science with patterns that emerged inductively from the editorials. The distinction between internal and external struggles is not meant to represent mutually exclusive categories, but rather to highlight whether the tension described in a given editorial primarily concerns dynamics *within* the scientific field (e.g., disciplinary boundaries, methodological disputes) or *beyond* it (e.g., its public legitimacy, policy relevance, or funding conditions). In some cases, these boundaries are blurred, and struggles may intersect both domains.

4.1 External field struggles: heterodoxy versus orthodoxy

Sustainability science, as it has developed, represents a heterodox field, contesting the dominant norms and practices of established disciplines like economics, ecology, and engineering. The editorials analyzed from the early foundational phase (1993–2002) illustrate this heterodoxy, as systems thinking and participatory research were

emphasized as central innovations. These approaches challenged more traditional, monodisciplinary heuristics [38, 39]. This marked a deliberate move away from siloed research toward a more integrated understanding of sustainability challenges, positioning the field against the orthodoxy of monodisciplinary science.

The early struggles over the term 'sustainable development' during the foundational phase also reflect a heterodox stance vis-à-vis the orthodoxy of economic growth as an underlying need. Several authors emphasized the potential for the term to be co-opted as a catchphrase, with little substantive impact on policy and practice [40, 41]. These critiques represent the broader struggle within sustainability science to establish a coherent theoretical framework distinct from mainstream economic models that strive for growth without sufficient regard for ecological limits.

As the field matured, the tension between orthodoxy and heterodoxy continued to shape its development. In the introspective phase (2003–2012), sustainability science refined its intellectual tools and expanded its influence in policy debates. Editorials from this period reflect the field's growing symbolic capital, particularly in its ambition to influence policy areas like sustainability assessment, as in the debate on ecological modernization, and fair-trade commerce [49, 58]. During the diversification phase (2013–2022), sustainability science broadened its scope to encompass a variety of topics, including corporate sustainability, urban planning, and cultural sustainability. These expansions, however, brought new challenges, especially regarding the field's relevance for policymaking and the need to apply sustainability principles across diverse contexts. This phase highlights how sustainability science, as a heterodox field, continues to negotiate its identity in relation to more established fields, while accumulating symbolic capital through its closeness to global sustainability agendas and the SDGs, as mentioned in the editorials [82, 83].

It is noteworthy that climate change, while undeniably central to the broader sustainability agenda today, was not a prominent theme in the editorials published during the Foundation and Introspection periods. Editorials in those earlier phases tended to focus more broadly on systems thinking, participatory approaches, and the institutionalization of sustainability as a research concern. The emergence of climate change as a central editorial topic in the Diversification period coincides with the increasing alignment of sustainability science with global policy frameworks, such as the SDGs and the Planetary Boundaries framework [89]. This shift suggests that editorial discourse has tracked, and possibly responded to, the rising prominence of climate issues in both scientific and policy domains.

4.2 Internal field struggles: hard versus soft sciences

A significant internal struggle within sustainability science involves the integration of natural (hard) and social (soft) sciences [90]. In the context of sustainability, the hard sciences, typically associated with disciplines like ecology and environmental science, focus on empirical and quantitative methods. In contrast, the soft sciences, including fields such as environmental economics, sociology, and human ecology, emphasize qualitative approaches which investigate the sociocultural, ethical, and human dimensions of sustainability challenges. Hard sciences are often perceived as more prestigious compared to soft sciences, not just in general—as emphasized by Bourdieu [91] and others [19]—but in the context of interdisciplinary research [92], including sustainability science [93].

It is important to note, however, that the distinction between hard and soft sciences should not be conflated with a simple opposition between quantitative and qualitative methods. Many disciplines within the social sciences—such as economics, political science, and certain areas of sociology—employ highly quantitative and empirically grounded approaches. Similarly, natural sciences often incorporate interpretive and model-based reasoning. In this context, the distinction refers less to methodological orientation and more to the symbolic hierarchy and epistemological framing of disciplines within the field, as represented in editorial discourse.

Despite the increasing role of soft sciences across all three periods, the knowledge produced by hard sciences remains essential to sustainability science's identity. Hard sciences provide foundational understandings of ecological processes, biodiversity, climate systems, and other natural phenomena underpinning sustainability challenges. Integrating quantitative research with qualitative contextual analyses reflects the complex nature of sustainability issues, as evidenced by editorials of the introspective phase that discuss whether—and how—to bridge hard and soft sciences by applying biological models to social systems [45, 46].

The concept of ethnosciences—involving the study of indigenous and local knowledge systems and their interactions with the natural environment—also plays a crucial role in discussions on how to integrate soft and hard sciences into interdisciplinary approaches. Ethnosciences, such as ethnobotany and ethnoecology, bridge natural and social sciences by combining empirical environmental research with the cultural and societal practices of local communities [94, 95]. This integration highlights the need to respect and include local knowledge alongside scientific data to create sustainable and context-sensitive solutions [38, 39].

During the diversification phase, the debate over balancing hard and soft sciences continued to evolve. Editorials from this period reflect an increasing reliance on transdisciplinary approaches and a further shift towards transdisciplinarity—not only bridging various academic disciplines but also involving non-academic stakeholders such as policymakers and local communities. This engagement with diverse knowledge systems highlights sustainability science's ongoing effort to integrate scientific rigor with practical relevance, fostering holistic approaches to global challenges. Notably, an editorial from the corpus [77] highlights challenges such as balancing knowledge creation with practical application, navigating ethical and political considerations, managing power dynamics in co-production, and addressing the difficulties of collaborative settings. Researchers' diverse roles—facilitators, introspective scientists, change agents, and knowledge brokers—each require specific competencies and attitudes, or in Bourdieu's [96] terminology, a different 'habitus.' These transdisciplinary methods emphasize sustainability as not just a technical issue but also a sociocultural and ethical concern, underscoring the field's broader scope in the last period [73, 78].

4.3 Internal field struggles: weak versus strong sustainability

Another key internal struggle within sustainability science is the tension between weak and strong sustainability [97]. This debate centers on the substitutability of natural capital and reflects broader ideological and ethical tensions within the field. Weak sustainability posits that natural capital (e.g., ecosystems, biodiversity) can be replaced by human-made capital (e.g., technology, infrastructure), as long as the total stock of capital

is maintained or increased. This view is closely aligned with neoclassical economic principles, which emphasize economic growth and technological solutions to environmental problems. Proponents of weak sustainability advocate for market-based mechanisms, such as carbon trading and green technology, as ways of balancing environmental protection with continued economic development. Conversely, strong sustainability argues that certain forms of natural capital are irreplaceable. Resources like biodiversity, clean air, and intact ecosystems are considered critical to the planet's ecological integrity and cannot be substituted by human-made alternatives. Strong sustainability emphasizes the need to preserve natural systems and advocates for policies that prioritize ecological limits over economic growth. This perspective challenges the market-based solutions promoted by weak sustainability advocates, asserting that technological or economic fixes alone cannot solve environmental problems.

The editorials from the foundational phase of sustainability science are largely aligned with strong sustainability principles. Editorials from this period critiqued mainstream economic models for failing to account for the environmental costs of unchecked growth [40, 42]. These early debates reflected a heterodox challenge to the dominant economic orthodoxy of the time, as sustainability science sought to redefine the concept of development through an ecological lens.

As the field moved into the introspective phase, the weak versus strong sustainability debate became more nuanced, with several editorials supporting strong sustainability. However, some texts investigated technological innovation and market mechanisms as weak sustainability strategies [49]. During the diversification phase, this tension appeared in editorials discussing corporate sustainability and urban planning [70, 80]. These texts highlighted the debate on how best to balance ecological objectives with economic growth and poverty alleviation targets.

4.4 Internal field struggles: global versus local perspectives

The balance between global sustainability frameworks such as the SDGs and local sustainability challenges represents another significant internal struggle within sustainability science. On the one hand, attention is paid to the planetary scale of the SDGs [83] and large-scale phenomena like world overpopulation [98, 99] and global health, especially in the wake of the COVID-19 pandemic [65]. The editorial by Ramos, Caeiro, Moreno Pires and Videira [83] refers in particular to the Planetary Boundary Framework, which identifies nine key Earth system processes with boundaries which, if crossed, could lead to catastrophic environmental changes [89]. This perspective's persistent significance for the sustainability science field is showed by recent research contributions [100].

On the other hand, even at the early stage of the foundational phase, editorials emphasized the importance of incorporating local knowledge—particularly from Indigenous communities—into global sustainability discussions. This heterodox approach challenged the dominance of Western environmental policies, which often imposed top-down solutions without adequately considering local contexts [39, 43]. Local perspectives were seen as essential for creating more equitable and context-sensitive sustainability strategies. Editorials from the introspective phase reflected growing concerns about how to reconcile broad global frameworks, such as the SDGs, with the specific cultural, environmental, and political realities of different localities. While global frameworks accumulate symbolic capital by aligning with international institutions and policy

agendas, local movements often challenge these frameworks by emphasizing context-specific solutions that involve local stakeholders in the co-production of knowledge [98, 101]. In the diversification phase, editorials reflect an increasing emphasis on transdisciplinary approaches that seek to bridge global frameworks with local sustainability efforts [73, 83].

4.5 Internal field struggles: thematic breadth versus autonomy and identity

Sustainability science, much like climate change research [10], has evolved from interdisciplinary to transdisciplinary approaches. While interdisciplinary work integrates knowledge from various fields [102], sustainability's complex challenges require engagement outside academia, involving policymakers, local communities, and other stakeholders. Transdisciplinarity facilitates the co-creation of actionable knowledge that is both scientifically rigorous and socially relevant [103]. This thematic breadth, while a strength in addressing global challenges, also presents a challenge to the field's efforts to establish a distinct and cohesive identity.

The editorials have shown that sustainability science faces a complex dynamic in its pursuit of autonomy as a field. In Bourdieu's terms, autonomy implies developing an internal logic and symbolic capital separate from other fields [32]. However, sustainability science depends heavily on systems thinking—an approach which emphasizes interdependencies and integration across fields—rather than isolation. Systems thinking is crucial for addressing the complex interdependencies within socio-ecological systems where traditional linear models fall short [87]. These editorials illustrate how this interdependence, rather than undermining autonomy, actually serves as the foundation for sustainability science's distinctiveness. Its autonomy emerges not from isolation but from its ability to integrate diverse knowledge and co-create solutions across academic, policy, and community boundaries, thereby establishing its own symbolic capital and legitimacy.

The broad scope of sustainability science reflects its ability to engage with diverse issues, but this multiplicity complicates its efforts to form a unified disciplinary identity within a transdisciplinary framework. Journals play a critical role in shaping the field's identity by acting as gatekeepers and accumulating symbolic capital [21]. The editorials have shown how periodicals help establish the legitimacy and autonomy of sustainability science within the academic hierarchy [18]. For instance, *IJSDWE's* founding editor-in-chief emphasized the need for sustainability science to distinguish itself as a unique discipline, positioning his journal as a platform to address gaps left by established fields and justifying its focus on sustainable development [38, 44].

These editorials show how the tension between thematic breadth and identity formation is ongoing, as they highlight both the field's diversity and the challenges of defining its core focus [75, 104, 105]. Bibliometric studies corroborate these editorial insights [24, 106], revealing a shift from early general awareness of environmental issues to more specialized topics such as urban sustainability and sustainability assessments after 2004 [24]. This diversification trend is seen in both editorials and broader research, as the field is expanding while continuing to grapple with its identity.

The editorials have also shown that conferences and research programs of centers like IIASA [37] contribute significantly to the identity-building process of sustainability science, as these initiatives help shape the field within academic hierarchies [91]. As

Clark and Harley [5] highlight, such programs have played and continue to play a crucial role in the development and establishment of sustainability science as a legitimate field and an autonomous "room of its own" [1]. Foundational conceptual contributions, such as those by Kates, Clark, Corell, Hall, Jaeger, Loweet al. [107] and Rockström, Steffen, Noone, Persson, Chapin, Lambinet al. [89], have further reinforced this identity-building process by articulating core research questions for the field and proposing integrative frameworks like planetary boundaries, which have broadened the scientific and societal relevance of sustainability science.

Moreover, editorials from the Diversification period increasingly reflect a shift toward transdisciplinary research approaches that aim not only to integrate academic disciplines, but also to foster collaboration with societal actors such as policymakers, NGOs, and community organizations. This trend aligns with calls in the literature for solution-oriented and transformation-oriented sustainability science, where the goal is to co-produce knowledge capable of supporting societal transformations toward sustainability [108]. Rather than focusing solely on interdisciplinary integration within academia, editorials from this period emphasize the need for research processes that are participatory, practice-oriented, and explicitly designed to address complex socio-ecological problems. This evolution in editorial discourse mirrors the broader maturation of sustainability science into a field that actively engages with societal actors in shaping pathways toward sustainable futures.

A second salient trend in Period III is the growing visibility of equity and social justice concerns. Editorials began to highlight not only environmental challenges but also the need for fair and inclusive sustainability transitions, reflecting stronger engagement with the social pillar of sustainability. Topics such as gender, poverty, and cultural sustainability appear more frequently, often framed in connection with SDG implementation and urban development. These themes signal a broadening of the field's normative orientation and a heightened sensitivity to the societal implications of sustainability science.

5 Limitations and future research

This study is limited by its focus on editorial material from three leading sustainability science journals with relatively long publication histories. These journals were selected based on their longevity and documented influence in the field, providing a coherent dataset for analyzing how sustainability science has evolved over time. However, the study does not aim to offer a comprehensive overview of all editorial discourse in the field. Rather, it provides a focused, longitudinal perspective based on a purposive sample of editorial content. Future research could expand this scope by including a broader range of journals, particularly those from different regions—including the Global South—to better capture a diversity of perspectives and editorial voices.

While the selected journals offer insight into how sustainability science has been framed in editorials, they may not fully capture the contributions of all relevant research communities. For instance, perspectives from ecological resilience and resource economics may be underrepresented in this dataset. Future studies could explore these and other research strands more fully by incorporating additional journals or other forms of scholarly communication.

Moreover, this study reflects how sustainability science is framed within a subset of sustainability-focused journals, and specifically from the perspective of editorial

discourse. As such, it does not provide a comprehensive analysis of sustainability science as a distinct academic field, as defined in foundational works by Rockström, Steffen, Noone, Persson, Chapin, Lambinet al. [89], Kates, Clark, Corell, Hall, Jaeger, Loweet al. [107], Lang, Wiek, Bergmann, Stauffacher, Martens, Mollet al. [108].

In addition to limitations in journal selection, the use of qualitative content analysis introduces interpretive challenges. Although coding reliability was assessed, the interpretation of editorial content is inevitably shaped by the researcher's perspective and theoretical orientation—in this case, Bourdieu's sociology of science [28].

An important area for future research lies in investigating whose voices are amplified through editorials. Often authored by a select group of individuals, editorials may reflect dominant viewpoints and potentially reinforce existing power structures within the scientific community. It would be valuable to explore whether these perspectives represent a diverse range of voices or predominantly those of established scholars. By analyzing the thematic and conceptual connections between the content discussed in editorials and research output, future studies could shed light on whether editorials serve as channels for diverse ideas or primarily reflect entrenched academic perspectives.

Moreover, although this study suggests that editorials reflect the field's intellectual development, the extent to which the broader field engages with the ideas presented in editorials remains uncertain. Future research could examine whether editorials effectively guide research and consolidate the field, or if they fail to leave a lasting impact on its development.

Expanding the range of journals analyzed in this article and applying alternative methodologies such as text mining of full texts or interviews with journal editors could further clarify the evolution of sustainability science. Large-scale analyses of the citation impact of editorials and their mentions in social media and policy documents could provide quantitative insights into their symbolic capital [109]. Such studies would help determine whether editorials shape not only academic discourse but also influence public and policy debates.

6 Conclusions

This study contributes to the growing application of sociological theory in sustainability science. While several of the editorials analyzed call for deeper integration of social science perspectives, these appeals are primarily directed at enhancing the field's capacity to address complex sustainability problems, rather than at reflexively analyzing the field itself. By drawing on Bourdieu's [32] sociology of science—particularly his concepts of heterodoxy and symbolic capital—this study offers a complementary perspective on how the identity and boundaries of sustainability science are constructed in editorial discourse. Through an analysis of 76 editorials from three leading journals, key trends were identified across three historical periods: Foundational (1993–2002), Introspective (2003–2012), and Diversification (2013–2022).

The findings suggest that sustainability science has evolved as a heterodox field, consistently challenging the established orthodoxies of traditional disciplines. The foundational phase emphasized systems thinking, participatory research, and indigenous knowledge. During the introspective phase, the field became more self-reflective, critiquing its methods and theoretical foundations, particularly in relation to interdisciplinarity and ecological modernization. By the diversification phase, the field had

broadened its scope, addressing pressing global challenges such as climate change and the COVID-19 pandemic, while incorporating transdisciplinary approaches that engage a wider range of contributors, including policymakers, private sector entities, and local communities.

A key contribution of this study is its focus on editorials—a publication type less-frequently studied compared to research articles—demonstrating their role as channels of legitimized knowledge and sources of authority in sustainability science. By linking these editorials to Bourdieu's concepts and situating them within the broader sustainability science literature, this study offers a novel perspective on how journals shape the field's development. Despite the growing trend toward individualized research consumption highlighted by Desrochers, Paul-Hus, Haustein, Costas, Mongeon, Quan-Haaseet al. [110]—where articles are often read in isolation—journals continue to confer symbolic capital through their prestige, editorial boards, and thematic foci [21]. Editorials, in particular, provide moments of reflection on emerging trends, intellectual developments, and the evolving identity of sustainability science, reinforcing the central role of journals in shaping the intellectual trajectory of the field. While this study demonstrates how editorials capture key trends and underscore the influential role of journals in sustainability science, further research is needed to assess their direct impact on subsequent research and public discourse.

The study of journals as sources of both knowledge and authority is especially relevant for sustainability science, where the community of contributors extends beyond traditional academic boundaries. In this transdisciplinary field, knowledge is co-created with non-academic stakeholders, such as policymakers and local communities. This expanded network of knowledge producers makes the processes of legitimization through scholarly outlets even more crucial, as these channels help establish the credibility of the diverse perspectives integrated into the field.

7 Appendix A: List of Editorials by Year of Publication

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Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

Supplementary Material 4

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Availability of data and materials
All data generated or analyzed during this study are included in this published article or its supplementary materials. The analyzed editorials are accessible through the journal platforms of *Environment, Development and Sustainability, Sustainable Development,* and *The International Journal of Sustainable Development & World Ecology.* A full list of these editorials is provided in Appendix A. The qualitative codes and heatmaps generated from the content analysis are included in the supplementary materials.

Declarations

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Publisher's note

Article IV

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Symbolic Capital and Inequality in Scholarly Communication:

A Bibliometric Study of Editorial Boards

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Symbolic Capital and Inequality in Scholarly Communication: A Bibliometric Study of Editorial Boards

Abstract

Editorial boards function as gatekeepers in academic publishing, yet systematic frameworks for quantifying how symbolic capital concentrates within editorial networks remain absent. This study operationalizes Bourdieu's symbolic capital theory through network analysis of 2,135 editorial positions across 30 sustainability science journals. Eigenvector centrality measures symbolic capital as prestige derived from connections to other prestigious positions, while Gini coefficients assess distributional inequality. Among 71 interlocking editors (those holding multiple board positions), women comprise only 22.5%, and scholars from Western Europe and North America dominate both numerically and structurally: editors with the highest eigenvector centrality are concentrated almost exclusively in these regions, while Latin America and Africa contribute only two interlocking editors each. A two-dimensional typology combining median eigenvector centrality with Gini coefficients distinguishes four configurations of symbolic capital across journals: concentrated core, dispersed core, concentrated periphery, and dispersed periphery. Critically, journals' positions in editorial interlock networks align only partially with their citation-based intellectual centrality, demonstrating that governance structures and knowledge networks represent distinct dimensions of academic power. This reproducible analytical framework enables systematic comparison of editorial governance structures across fields.

Keywords: Editorial governance, Symbolic capital, Network analysis, Sustainability science, Interlocking editorship

1. Introduction

Editorial boards play a decisive role in scholarly communication: they determine which manuscripts enter the published record, shape disciplinary agendas through special issues, and confer positional authority through appointments, acting as gatekeepers of academic legitimacy (Shaw & Penders, 2018). This gatekeeping function has far-reaching implications for knowledge production, as persistent inequalities in publishing have been documented along lines of gender, geography, and institutional affiliation (Goyanes et al., 2022). Prior research has demonstrated that editorial decisions are subject to systematic biases, with author reputation and network position influencing editorial outcomes (Bravo et al., 2018; Lee et al., 2012).

Despite this evidence of bias and inequality, the structural concentration of symbolic capital within editorial networks remains poorly understood. Symbolic capital—the academic prestige that endows certain actors with greater authority in decision making—accumulates through network positions (Bourdieu, 2004). Yet existing studies do not provide systematic frameworks for quantifying how this gatekeeping power is distributed or concentrated within scientific fields. This study addresses this gap by developing a quantitative framework for measuring symbolic capital in editorial networks, integrating Bourdieu's field theory with network science to advance understanding of the structural mechanisms of academic gatekeeping.

The systematic study of editorial governance has evolved into a research stream in information science, recently termed *editormetrics* and defined as "a quantitatively informed understanding of the editorial rules and roles of journal editors in the research system" (Santos & Mendonça, 2022, p. 7483). Editormetrics research has documented persistent inequalities in editorial representation, including underrepresentation of female editors (Baccini & Barabesi, 2009, 2011) and concentration of editorial positions among scholars from elite institutions in high-income countries (Liu et al., 2023). These patterns deviate from foundational norms of universalism and merit-based evaluation in science (Merton & Storer, 1973).

Moving beyond compositional analyses, scholars have examined editorial interlocks—multiple board positions held by the same individual—as mechanisms that link journals into broader governance networks (Andrikopoulos & Economou, 2015; Baccini & Barabesi, 2011; Santos & Mendonça, 2022). Building on foundational work on interlocking

directorates in corporate governance (Burt, 1978), these studies reveal how editorial interlocks function as both structural concentration mechanisms and prestige signals. Multiple memberships concentrate influence among "an elite within an elite" (Petersen et al., 2017), and editorial networks align with co-authorship and co-citation patterns (Baccini et al., 2020), often reinforcing existing gendered and geographic disparities (Mazov & Gureev, 2016; Mendonça et al., 2018; Santos & Mendonça, 2022).

These findings connect to broader theoretical frameworks for understanding symbolic capital in academia. Following Bourdieu's characterization of citations as the most objectified form of symbolic capital (Bourdieu, 1988, p. 76), Cronin extended this logic to the wider reward system of science, where citations, authorship, and acknowledgments function as objectified markers of prestige (Cronin, 2005). Subsequent research has expanded this perspective, showing how academic reward systems have become increasingly multifaceted, encompassing altmetrics and social media visibility alongside traditional bibliometric indicators (Desrochers et al., 2018). Editorial interlocks complement this literature by highlighting a relational dimension of symbolic capital: authority and legitimacy are embedded not only in texts and citations but also in the governance structures of journals themselves (Baccini et al., 2009).

Understanding how symbolic capital is distributed in editorial networks is not merely a methodological concern but a matter of power and equity in knowledge production. Editorial boards determine not only which manuscripts are published but also which research agendas gain legitimacy, which methodologies are considered rigorous, and which voices are amplified in scholarly discourse (Santos & Mendonça, 2022; Shaw & Penders, 2018). When editorial authority concentrates among scholars from Western Europe and North America, predominantly from elite institutions, and overwhelmingly men, the perspectives that shape entire fields become systematically narrowed (Dada et al., 2022). This concentration raises fundamental questions about epistemic diversity and the inclusivity of scholarly communication, particularly regarding whose knowledge counts, who determines legitimacy, and which communities remain excluded from editorial governance structures.

Despite growing recognition of these inequalities (Liu et al., 2023), existing research has not systematically operationalized Bourdieu's concept of symbolic capital within editorial networks (Bourdieu, 2004). While Bourdieu's theoretical framework has proven productive for bibliometric analyses of citation practices and academic hierarchies (Schirone, 2023a), prior studies of editorial governance have instead relied on proxies—such as citation counts, web visibility, media mentions (Cronin & Shaw, 2002), journal reputation metrics

(Chipidza & Tripp, 2021; Khelfaoui & Gingras, 2020), or authorship patterns (Desrochers et al., 2018).

This study addresses this theoretical and methodological gap by applying eigenvector centrality (EVC) as an explicit operationalization of symbolic capital in editorial networks. EVC captures prestige recursively through the prestige of one's network connections (Bonacich, 1987; Newman, 2006), aligning with Bourdieu's understanding of symbolic capital as fundamentally relational—derived not just from individual achievements but from associations with prestigious positions and institutions (Bourdieu, 2004).

Building on this approach, the study makes three contributions. Theoretically, it bridges Bourdieu's theory of symbolic capital and power in academia (Bourdieu, 1988) with network science (Barabási, 2002; Newman, 2018) and the emerging area of editormetrics (Mendonça et al., 2018; Santos & Mendonça, 2022). Methodologically, it introduces eigenvector centrality as a systematic and transferable measure of symbolic capital concentration across academic fields. Empirically, it applies this framework to sustainability science.

Sustainability science provides a well-suited empirical case for testing this framework (Clark, 2007; Kates et al., 2001). As a relatively young field, it has been framed as a transformative form of inquiry committed to co-creation, inclusivity, and societal engagement; its emphasis on navigating complexity and uncertainty makes it particularly relevant for examining how editorial influence and gatekeeping mechanisms operate in emerging transdisciplinary domains (Ravetz, 2018). At the same time, the field's stated commitment to inclusivity and global perspectives renders patterns of symbolic capital concentration especially significant, as they expose tensions between normative ideals and actual governance practices. To address these dynamics, the study poses two research questions. The first investigates the composition of interlocking editors—scholars who hold positions on multiple boards—while the second examines structural patterns across journals.

RQ1. What is the geographic and institutional composition of editorial positions in sustainability science journals? How is symbolic capital concentrated or dispersed among interlocking editors by gender and geographic region?

RQ2. How do interlocking editors create structural connections among sustainability science journals, and what patterns of inequality emerge in the distribution of symbolic capital across editorial boards?

The remainder of this article is structured as follows. Section 2 details the data collection methodology and network analysis techniques used to examine editorial interlocks among 30 sustainability science journals. Section 3 presents findings on geographic and institutional composition, interlocking editorship patterns, and journal-level governance structures. Section 4 discusses implications for information science theory and sustainability science practice, while Section 5 addresses limitations and future research directions. Section 6 concludes by summarizing the main contributions and their broader significance for understanding editorial governance and symbolic capital in academic fields.

2. Materials and Methods

This study integrates network analysis with inequality measures to examine how symbolic capital is distributed within editorial governance structures. Network analysis identifies relational hierarchies among editors and journals—revealing who occupies central versus peripheral positions—while inequality measures quantify distributional disparities in the accumulation of symbolic capital. This dual approach enables systematic comparison of journals both by their position in interlocking networks and by the internal concentration of prestige among board members. Together, these methods operationalize Bourdieu's theoretical framework within a quantitative analysis of sustainability science as an academic field.

The following sections proceed from conceptual operationalization to empirical application. Section 2.1 establishes how eigenvector centrality operationalizes symbolic capital and how Gini coefficients assess its distribution. Section 2.2 details network construction procedures for editor-editor and journal-journal networks. Section 2.3 addresses visualization strategies and robustness checks that ensure findings are not artifacts of methodological choices. Sections 2.4–2.6 describe data sources, cleaning protocols, and ethical safeguards governing the use of publicly available editorial information.

2.1 Methodology: Symbolic Capital and Inequality Measurement

Symbolic capital, in Bourdieu’s (1991) formulation, exists only through recognition by others—most decisively by those who are themselves recognized. This recursive logic is operationalized through eigenvector centrality (EVC), a network measure that assigns higher

scores to actors connected to other highly scoring actors (Poulin et al., 2000). By capturing prestige through the prestige of one's connections, EVC provides a quantitative operationalization of what Bourdieu described as the "distribution of symbolic capital"—the social importance conferred by those with "the power to recognize, to consecrate, to state, with success, what merits being known and recognized" (Bourdieu, 2000, pp. 241-243).

This operationalization distinguishes symbolic capital from other forms of structural advantage. Degree centrality captures the number of direct ties, betweenness centrality reflects bridging capacity between otherwise disconnected actors, and closeness centrality measures efficiency in reaching others across the network (Yan & Ding, 2009). While each of these metrics identifies important structural positions, none models the recursive dimension that is central to symbolic capital. Eigenvector centrality (EVC), by contrast, uniquely captures recognition by the already recognized, making it especially suited to editorial networks where prestige derives from association with other prestigious positions rather than from sheer connection quantity or brokerage capacity. As Rawlings et al. observe, EVC "rewards those with many ties to those who also have many ties, building on the mutual reinforcement of power among the powerful" (Rawlings et al., 2023, p. 201)

Editorial networks are treated as undirected, reflecting the symmetric nature of co-membership: if editor *A* serves with editor *B* on a board, the relationship is reciprocal. EVC is well-suited to such undirected structures, measuring influence through neighbors' influence without requiring directional assumptions (Newman, 2018, p. 161). EVC is computed on the giant component of the editor-editor network (undirected, weighted by shared boards)—the largest connected subgraph in which all nodes are mutually reachable (Newman, 2018). This restriction ensures comparability of centrality scores across actors while avoiding distortions from isolated components.

Degree, betweenness, and closeness centrality are calculated alongside eigenvector centrality (EVC) for robustness, confirming that each measure captures distinct structural properties. These metrics, however, are not combined with EVC into composite indices. This decision safeguards theoretical clarity in the operationalization of symbolic capital: because Bourdieu's concept functions specifically through recursive recognition rather than through connection quantity (degree), brokerage capacity (betweenness), or reach efficiency (closeness), relying on EVC alone remains the most faithful representation of symbolic capital as a theoretical construct.

While recursive prestige measures have been developed through PageRank and its bibliometric variants (Brin & Page, 1998; Yan et al., 2011), these algorithms introduce assumptions less suited to editorial governance. PageRank incorporates a *random surfer* model that calculates influence as if users randomly navigate from link to link. This assumption fits citation networks, where a reader might follow references in any direction, but it poorly represents editorial interlocks: when two scholars serve on the same board, the relationship is symmetric rather than directional (Yan & Ding, 2011). EVC aligns more directly with both the undirected structure of editorial networks and the Bourdieusian concept of symbolic capital as recursive recognition.

To assess the distribution of symbolic capital, the Gini coefficient is employed—a standard measure of inequality ranging from 0 (perfect equality) to 1 (perfect inequality) (Dorfman, 1979). Widely used in bibliometric research to capture concentration patterns (Nielsen & Andersen, 2021), the Gini coefficient is here applied to eigenvector centrality scores. Building on these applications, Gini coefficients are calculated at two levels to evaluate inequality in the distribution of symbolic capital across editorial networks. At the network level, they summarize how symbolic capital is distributed across all interlocking editors, indicating whether prestige is concentrated among a small elite or broadly distributed. At the board level, they assess internal inequalities within each journal's editorial board. While concerns have been raised about applying Gini coefficients to incomplete networks (Stark et al., 2024), such critiques address large, sparse structures where individuals compare only with local neighbors. Editorial boards constitute bounded groups with complete internal visibility, making this approach methodologically appropriate.

For comparative analysis, board-level Gini coefficients are combined with median EVC scores to construct a two-dimensional typology. This typology, presented in the Results section, classifies editorial boards according to how symbolic capital is distributed within and across them.

2.2 Network Construction

To analyze connections between individual editors, the analytical approach constructs an editor–journal bipartite graph, capturing the affiliations between editors and their respective journals. This bipartite graph is then projected onto an editor–editor network, where connections between editors are established when they serve on the same editorial

board. Edge weights in this network represent the number of shared editorial boards between any two editors, with a minimum threshold of one shared journal applied to retain even weak connections.

For analytical purposes, editors are classified based on their level of involvement across multiple boards. Interlocking editors are defined as those serving on two or more editorial boards, while *super-interlocking* editors are those holding positions on three or more boards. The symbolic capital of individual editors is operationalized through their eigenvector centrality scores within the giant component of the network.

Demographic attributes are coded through multiple verification methods. Gender classification is conducted through manual verification using ORCID profiles (Haak et al., 2012), institutional pages, and academic CVs, supplemented by automated tools including NamSor and GenderAPI (NamSor, 2025; Ozan Soft, 2024). Geographic information is derived from editors' institutional affiliations and categorized by country, continent, and subregion following the United Nations M49 classification system (United Nations Statistics Division, 2025).

The bipartite editor–journal graph is projected into a journal–journal co-editorship network, where journals are connected when they share editors and edge weights represent the number of shared editors. This projection highlights overlaps in editorial governance, which may correspond to thematic alignments within the field.

Journal-level symbolic capital is operationalized as the median eigenvector centrality of a journal's editorial board members. Individual editor centrality scores are first calculated within the editor network and then aggregated to the journal level using the median. The median is preferred over the mean because it provides a more robust indicator of typical editorial prestige, reducing sensitivity to extreme outliers.

Community structure is detected in both the editor and journal networks using the Leiden algorithm (Traag et al., 2019). Primary results are reported at a resolution parameter of 0.2, with robustness checks across values from 0.1 to 2.0 confirming the stability of the detected clusters. This approach systematically identifies clusters of journals with overlapping editorial governance, which can then be interpreted as thematic alignments within sustainability science.

2.3 Network Visualization, Reproducibility and Robustness

For visualization purposes, both the editor–editor and journal–journal networks are displayed using the Fruchterman–Reingold layout algorithm (Fruchterman & Reingold, 1991). This algorithm positions nodes in two-dimensional space such that strongly connected nodes are placed closer together, while weakly connected or unconnected nodes are pushed farther apart. To ensure reproducibility and comparability across visualizations, a fixed random seed is applied so that the spatial arrangement of nodes remains consistent across different plots (McNulty, 2022).

In the editor networks, node color indicates the median eigenvector centrality, node size reflects degree strength (number of co-editorship ties), and node shape distinguishes categorical attributes such as gender or geographic subregion. In the journal network, node size reflects the number of affiliated editors, node color represents the median eigenvector centrality, and edge thickness indicates the number of shared editors between journals. These design choices highlight both the structural relations within each network and the distribution of symbolic capital across individual and institutional positions.

All statistical analyses and network modeling are conducted in *R* (version 4.5.0) (R Core Team, 2025). Key *R* packages include igraph for network analysis, ggraph for visualization, and ineq for inequality measures (Csardi & Nepusz, 2006; Pedersen, 2025; Zeileis, 2014). Random seeds are fixed for the Fruchterman–Reingold layout and Leiden community detection to guarantee deterministic outputs. Analytical parameters—including thresholds for shared journal memberships, resolution settings for community detection, and random seeds—are externalized in a configuration file. This design ensures that the workflow can be rerun with identical results or adapted to other contexts through parameter modification.

In line with best practices in social network analysis and editormetric research (Wasserman, 1994; Wu et al., 2020), robustness checks indicate that findings are not driven by specific modeling assumptions. Results are compared across four centrality measures: eigenvector, degree, betweenness, and closeness. Community detection is repeated across a resolution parameter sweep (0.1–2.0). Editorial networks are reconstructed under varying interlock thresholds, from at least one to at least five shared journals. Metrics are also calculated on both the full network and the giant component, producing virtually identical

rankings (Spearman's rank-order correlation, $\rho = 0.997$, $n = 69$, $p = 8.2 \times 10^{-76}$). Nonparametric bootstrap resampling provides 95% confidence intervals (CIs) for field-level median eigenvector centrality (95% CI [0.106, 0.358]) and Gini coefficients (95% CI [0.411, 0.539]), confirming their stability. The complete analytical framework, including code and extended results, is available in the GitHub repository of the article (see the Data Availability Statement). This paper reports the principal findings, with additional analyses and robustness checks documented in the repository.

2.4 Data Sources

This study examines editorial board membership across thirty sustainability science journals to assess editorial influence and interlocking editorships. The selection process followed a structured approach to ensure breadth, depth, and representativeness.

First, eighteen journals were selected based on a previous study that identified leading titles in sustainability science (Schirone, 2023b). Three historically significant journals were also included because of their foundational contributions to the field: *Environment, Development and Sustainability* and the *International Journal of Sustainable Development & World Ecology* were added for their longstanding impact, while *Sustainable Development* was already part of the original subset, reinforcing its relevance.

To further enhance coverage, ten additional journals were selected from a curated list compiled by Harley and Clark (2020), developed as a complement to their literature review and synthesis (Clark & Harley, 2020). From this list, *Research Policy* was excluded because of its broad scope, which results in many articles falling outside the focus of this study. For *Proceedings of the National Academy of Sciences of the United States of America* (PNAS), only editors responsible for the "Sustainability Science" section were included.

This combination of leading titles, historically significant publications, and an expert-vetted list ensured that the dataset captured the intellectual breadth, historical depth, and structural diversity necessary for bibliometric and network analysis. The full list of included journals is provided in Table 1.

Table 1

Journals whose editorial boards were analyzed in the study

No.	Journal Name
1	*ACS Sustainable Chemistry and Engineering*
2	*Agronomy for Sustainable Development*
3	*Annual Review of Environment and Resources*
4	*ChemSusChem*
5	*Current Opinion in Environmental Sustainability*
6	*Earth System Governance*
7	*Ecological Economics*
8	*Ecology and Society*
9	*Environment, Development and Sustainability*
10	*Environmental Innovation and Societal Transitions*
11	*Environmental Research Letters*
12	*Global Environmental Change*
13	*Green Chemistry*
14	*IEEE Transactions on Sustainable Energy*
15	*International Journal of Precision Engineering and Manufacturing-Green Technology*
16	*International Journal of Sustainability in Higher Education*
17	*International Journal of Sustainable Development & World Ecology*
18	*Journal of Cleaner Production*
19	*Journal of Industrial Ecology*
20	*Journal of Sustainable Tourism*
21	*Nature Sustainability*
22	*Proceedings of the National Academy of Sciences of the United States of America*
23	*Renewable and Sustainable Energy Reviews*
24	*Renewable Energy*
25	*Sustainability Science*
26	*Sustainable Cities and Society*
27	*Sustainable Development*
28	*Sustainable Materials and Technologies*
29	*Sustainable Production and Consumption*
30	*World Development*

Note. Proceedings of the National Academy of Sciences of the United States of America includes only editors of the "Sustainability Science" section

Following Baccini and Barabesi (2011), who noted variability in editorial role titles across journals, the analysis focused on functional responsibilities rather than formal titles.

Editorial board members no longer involved in decision-making, or whose roles were primarily logistical or journalistic, were excluded. Advisory boards focused mainly on peer review quality control were excluded. This determination was based on publicly available role descriptions on journal websites at the time of data collection. For example, the advisory panel of *Environmental Research Letters* was excluded because its stated role centered on supporting peer review and maintaining review quality rather than editorial governance. This process resulted in a dataset of 2,135 editorial positions across the 30 journals. Within this set, 71 interlocking editors were identified—unique individuals holding positions on more than one editorial board—forming the basis for additional analysis of gender and geographic aspects.

2.5 Data Cleaning

Data were collected between January 6 and January 12, 2025, from publicly available editorial board information on journals' official websites. Because website designs and the availability of standardized data vary considerably, a hybrid collection strategy was employed. While initiatives such as *Open Editors* (Nishikawa-Pacher et al., 2023) provide structured editorial board data for some journals, their incomplete coverage and inconsistent formats for the journals analyzed required a custom approach. Whenever feasible, automated web scraping with the *R* package rvest was used to systematically retrieve editorial roles, names, and affiliations (Wickham, 2025a). Extracted data were cleaned and reviewed for accuracy. For most journals, however, webpage formats prevented automated collection; in these cases, data were gathered manually and verified against institutional websites for editorial roles, names, and affiliations.

To ensure consistency, editor names and institutional affiliations were standardized through a hybrid approach combining manual verification with automated processing. Custom *R* scripts performed text normalization, duplicate detection, and string matching (R Core Team, 2025; Wickham, 2025b).

2.6 Ethical Considerations

This study relies exclusively on publicly available information about editorial board membership, including names, institutional affiliations, and professional roles. Data were collected from journal websites, ORCID profiles, and academic CVs, in line with established practices for bibliometric data collection (Lindelöw et al., 2025).

To safeguard privacy while ensuring transparency, findings are presented only at the aggregate or structural level through network representations, and no individual editor is identifiable in the results. This reliance on anonymized structural data is consistent with ethical standards for research using public information (Schaefer, 2024). Therefore, the GitHub repository associated with this article provides a sample dataset rather than the full dataset of identified editors (see the Data Availability Statement). Finally, gender was analyzed within a binary classification framework due to limitations in available data and current tools. This approach does not capture non-binary or gender-diverse identities, and findings should therefore be interpreted with this limitation in mind.

3. Results

3.1 RQ1: Geographic and Institutional Composition (All Editorial Board Positions)

Editorial board positions in sustainability science exhibit marked geographic concentration rather than global distribution. The United States demonstrates the highest editorial representation (n = 372), followed by China (n = 246), the United Kingdom (n = 184), Australia (n = 109), Italy (n = 96), and Germany (n = 84). This concentration across Europe, North America, and East Asia results in substantial underrepresentation from the Global South, challenging sustainability science's commitment to global inclusivity (Schirone, 2025). An interactive world map showing the global distribution of editorial positions by country is included in the Supplementary Material.

Editorial positions exhibit pronounced institutional concentration among elite research universities. The University of California leads with 26 appointments, followed by Stockholm University (n = 22) and the Chinese Academy of Sciences (n = 19). The University of Tokyo and Arizona State University each hold 18 editorial positions. This concentration establishes these institutions as central nodes in sustainability science's editorial infrastructure, with five institutions accounting for 103 of the 2,135 total editorial positions (4.8%).

3.2 RQ1: Interlocking Editorship and Editorial Power Structures

The analysis identifies a small yet highly influential subset of scholars who serve on multiple journals. Among the 2,135 editorial positions analyzed, 71 scholars (3.33%) held multiple editorial positions, corresponding to 150 instances of interlocking editorship (7.03% of all editorial positions). While most editors (96.67%) are affiliated with only a single

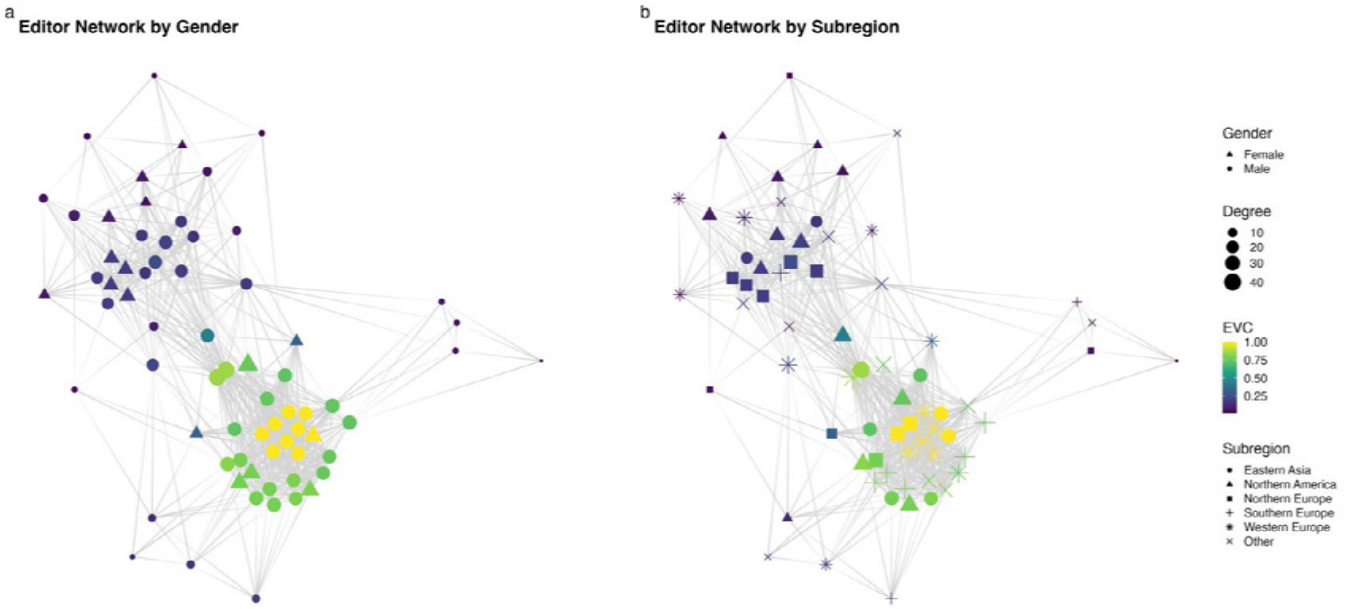
journal, 2.95% hold positions on two editorial boards, and 0.37% serve as "super-interlocking editors," holding roles on three or more boards. The observed interlocking density for sustainability science falls between that reported in prior studies of other disciplines: 2.3% in economics and 8.7% in information and library sciences (Baccini & Barabesi, 2009, 2011).

Gender disparities underscore the uneven distribution of editorial influence: among the 71 interlocking editors, 16 (22.5%) are women. This underrepresentation is even more pronounced at the highest leadership levels: the three individuals who are simultaneously interlocking editors and Editors-in-Chief are all men. In the network core (Figure 1a), represented by nodes with the highest eigenvector centrality scores, the majority of editors are also men.

Subregional analysis reveals the extent of geographic concentration among interlocking editors (Figure 1b). Within the giant component of 69 interlocking editors, four regions account for a majority: Western Europe (n = 14, 20%), Northern America (n = 13, 19%), Northern Europe (n = 12, 17%), and Eastern Asia (n = 10, 14%). The remaining editors are distributed across Southern Europe (n = 8), with minimal representation from Australia and New Zealand (n = 2), Western Asia (n = 2), South-eastern Asia (n = 2), Western Africa (n = 2), Southern Asia (n = 1), Central America (n = 1), South America (n = 1), and Eastern Europe (n = 1). This distribution demonstrates stark regional inequalities: Latin America contributes only two editors across Central and South America, while Africa is represented by just two editors from Western Africa. Most significantly, the editors with the highest eigenvector centrality scores—those holding the most prestigious positions in the network core (Figure 1b)—are concentrated in Western and Northern Europe (especially the Netherlands, Germany, and the United Kingdom) and Eastern Asia (particularly China).

Figure 1

Network of editors based on shared journals. (a) Gender. (b) Geographic region.



Note. Node color indicates symbolic capital (eigenvector centrality); node size represents degree strength (number of co-editorship ties). Node shape corresponds to (a) gender and (b) UN M49 subregion. Layout = Fruchterman–Reingold.

3.3 RQ2: Journal–Journal Network (Communities)

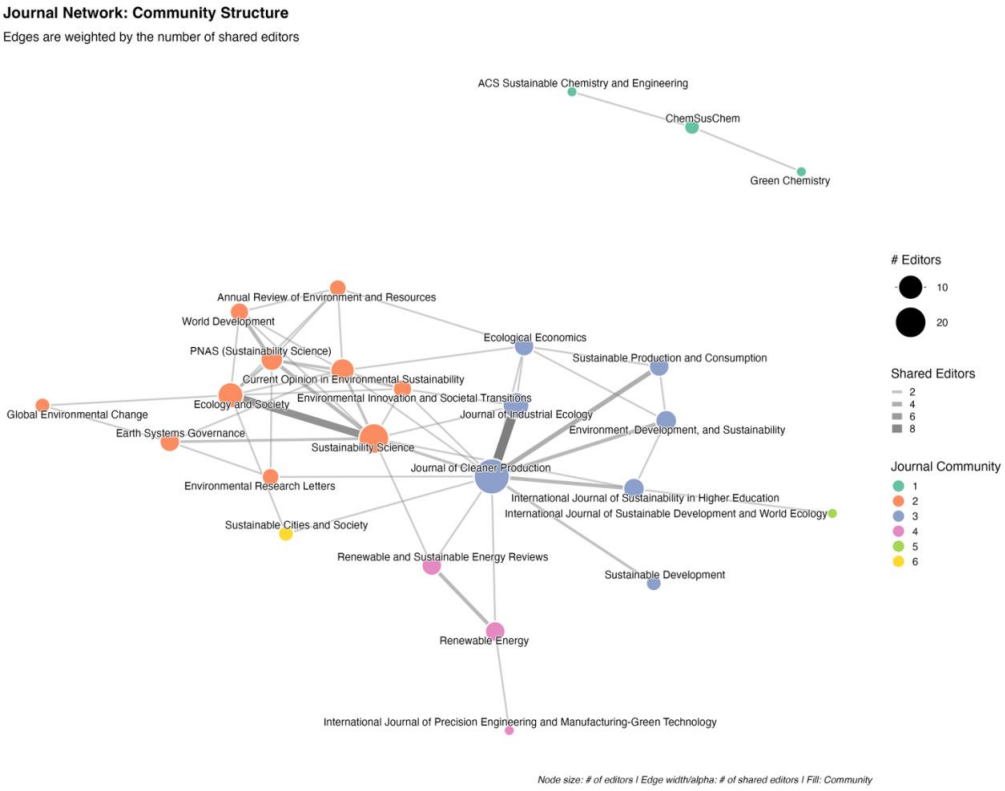
Figure 2 illustrates the journal co-membership network, showing that editorial governance in sustainability science is not fully decentralized but instead organized into distinct, interconnected communities. Two major clusters dominate the field. The first, centered on *Journal of Cleaner Production*, *Journal of Industrial Ecology*, *Ecological Economics*, and *Sustainable Production and Consumption*, reflects a community oriented toward industrial ecology, circular economy, and environmental economics. This cluster also incorporates *Environment, Development, and Sustainability* and *International Journal of Sustainability in Higher Education*, linking applied sustainability and educational domains to production-oriented research.

The second major cluster includes *Sustainability Science*, *Ecology and Society*, *PNAS* (Sustainability Science section), *Annual Review of Environment and Resources*, and *World Development*. This group reflects the influence of socio-ecological systems research, resilience science, and environmental governance. Journals such as *Current Opinion in Environmental Sustainability*, *Environmental Research Letters*, and *Earth System Governance* also align with this cluster, indicating points of convergence between resilience-oriented scholarship and governance perspectives.

Beyond these two dominant blocs, several smaller communities are visible. One links *Renewable Energy* and *Renewable and Sustainable Energy Reviews*, oriented toward energy transitions. Another brings together chemistry-focused journals, including *Green Chemistry*, *ChemSusChem*, and *ACS Sustainable Chemistry and Engineering*, which remain more peripheral and less integrated into interdisciplinary sustainability science. Finally, *Sustainable Cities and Society* and *International Journal of Sustainable Development & World Ecology* appear as distinct single-journal clusters, reflecting more specialized editorial niches.

Figure 2

Network of journals based on shared editors.



Note. Edges are weighted by the number of shared editors. Node size represents the number of affiliated editors; node color indicates community membership as detected by the Leiden algorithm (resolution = 0.2). Layout = Fruchterman–Reingold.

3.4 Board-Level Inequality and Journal Typology

Journal-level measures shed light on how symbolic capital is organized within editorial communities. Median eigenvector centrality (EVC) captures the typical level of symbolic capital held by a board's members, while the Gini coefficient reflects the degree of inequality in its distribution. Together, these measures indicate not only which journals

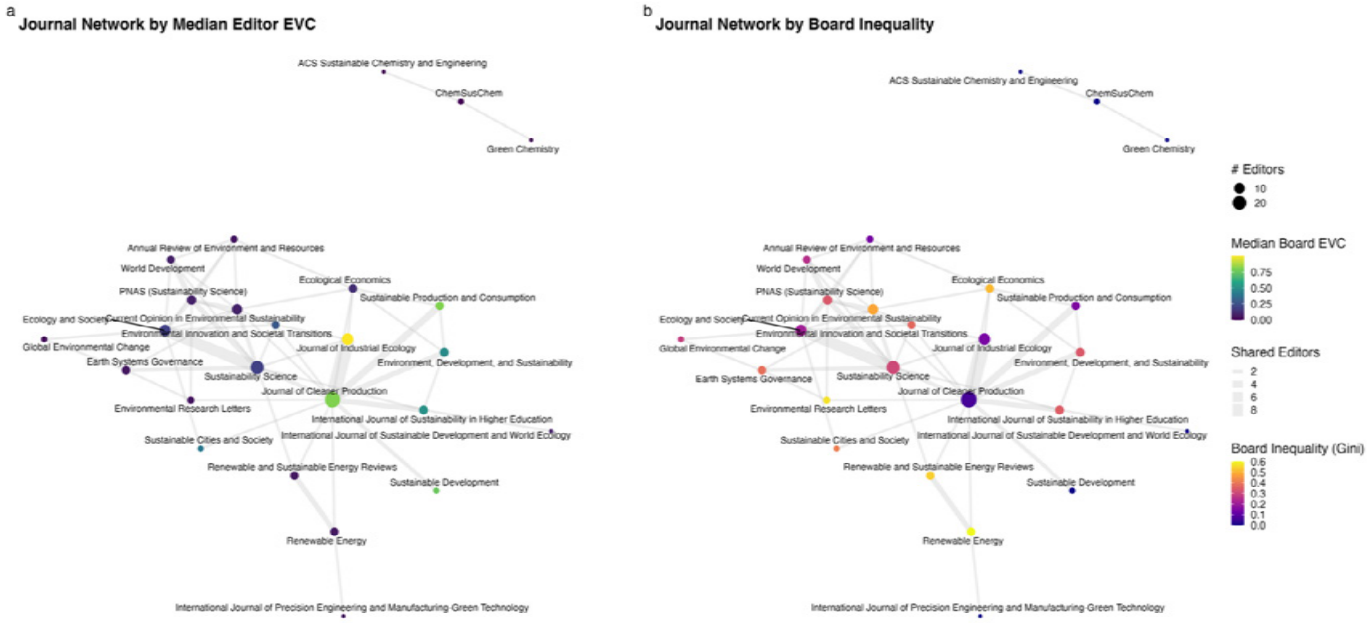
occupy central positions in the interlocking editorial field but also how symbolic capital is distributed internally.

Figure 3a displays symbolic capital across journals, measured by median EVC. Leading sustainability publications such as *Journal of Cleaner Production*, *Sustainability Science*, and *Ecology and Society* show relatively high symbolic capital, positioning them close to the intellectual core (Clark & Harley, 2020; Schirone, 2023b). Figure 3b complements this view by visualizing inequality through the Gini coefficient.

These measures reveal important contrasts. *Ecological Economics*, *International Journal of Sustainability in Higher Education*, *Environment, Development and Sustainability*, and *Environmental Innovation and Societal Transitions* combine relatively high symbolic capital concentrated in fewer editors. By contrast, *Journal of Cleaner Production*, *Journal of Industrial Ecology*, *Sustainable Production and Consumption*, *Sustainability Science*, and *Ecology and Society* hold comparable symbolic capital yet maintain flatter structures of editorial interlocks. Similar differences emerge among less central journals: *World Development* and *PNAS* distribute influence relatively evenly, whereas *Environmental Research Letters*, *Renewable and Sustainable Energy Reviews*, *Renewable Energy*, and *Earth System Governance* rely heavily on one or two central figures. For very small boards ($n \leq 3$), Gini values are not substantively meaningful and should be interpreted with caution.

Figure 3

Symbolic capital and inequality across journals. (a) Median symbolic capital. (b) Within-board inequality.



Note. Panel (a) shows the median eigenvector centrality of editors, representing the concentration of symbolic capital at the journal level. Panel (b) shows the Gini coefficient of within-board eigenvector centrality, indicating inequality in the distribution of symbolic capital among editors. Gini values for boards with $n \leq 3$ should be interpreted with caution.

These findings reveal that symbolic capital concentration alone fails to characterize editorial authority; internal distribution within each editorial board is equally important. To analyze both dimensions systematically, median EVC and Gini coefficients were integrated into a two-dimensional typology (Table 2) that distinguishes four structural configurations of editorial governance:

- **Dispersed Core** (e.g., *Journal of Cleaner Production*, *Journal of Industrial Ecology*, *Sustainable Production and Consumption*, *Sustainability Science*, *Ecology and Society*): central journals with high symbolic capital that is broadly distributed among editors.

- **Concentrated Core** (e.g., *Ecological Economics*, *International Journal of Sustainability in Higher Education*, *Environment, Development and Sustainability*, *Environmental Innovation and Societal Transitions*): central journals with high symbolic capital concentrated among a small subset of editors.

- **Dispersed Periphery** (e.g., *World Development*, *PNAS*): peripheral journals with low symbolic capital broadly distributed among editors.

- **Concentrated Periphery** (e.g., *Environmental Research Letters*, *Renewable and Sustainable Energy Reviews*, *Renewable Energy*, *Earth System Governance*): peripheral journals with low symbolic capital concentrated among a small subset of editors.

This typology provides a systematic basis for comparing editorial governance across journals, showing that governance is shaped by both network position and the internal distribution of prestige. Notably, journals with similar centrality scores can differ substantially in how they concentrate or distribute editorial influence.

Table 2

Typology of Editorial Boards

Symbolic capital (Median eigenvector centrality)	**Inequality of symbolic capital** (Gini): **Low**	**Inequality of symbolic capital** (Gini): **High**
High	**Dispersed Core**: High symbolic capital; broadly shared among editors.	**Concentrated Core**: High symbolic capital; concentrated in a few editors.
Low	**Dispersed Periphery**: Low symbolic capital; shared collectively.	**Concentrated Periphery**: Low symbolic capital; reliant on one or two editors.

Note. Median eigenvector centrality indicates the typical level of symbolic capital within a board; the Gini coefficient captures inequality in its distribution.

4. Discussion

Editorial interlocks represent an underexplored mechanism through which symbolic capital operates in academic fields. This study extends existing knowledge about how scholarly authority becomes institutionalized and reproduced through editorial governance. Previous bibliometric research has documented editorial networks and their structural properties (Baccini & Barabesi, 2009, 2011; Santos & Mendonça, 2022), while other work has examined how prestige accumulates through citations, authorship patterns, and acknowledgments (Cronin, 2005), with recent studies expanding this view to include altmetrics and social media visibility (Desrochers et al., 2018). Yet this body of work has primarily focused on textual traces of academic achievement. This study shifts attention from these textual forms to governance-based prestige embedded within editorial networks.

Editorial positions create persistent networks that generate and distribute recognition through prestige by association. While citations accumulate recursively through the Matthew

effect (Merton, 1968)—where highly cited papers attract more citations—this process remains transactional, with each citation adding incrementally to visibility. Collaborative authorship similarly operates through discrete contributions that build reputation over time. Editorial governance, by contrast, produces recursive accumulation through the network positions that editors occupy in board networks. Each appointment derives value from both its individual prestige and its connections to other prestigious appointments, creating a structural multiplier effect (Bourdieu, 1988). This positional recursion represents the process of "consecration" (Bourdieu, 2000, p. 240): editorial constellations anchored in journals, institutions, and individuals already recognized as prestigious amplify recognition through networked prestige rather than individual achievement alone. Each editorial appointment gains value not only from its formal title but from its association with already-consecrated positions. Eigenvector centrality provides a methodological innovation for capturing this process, moving beyond simple counts of positions to reveal how network location structures differential access to recognition.

This recursive accumulation helps explain the disproportionate concentration of editorial symbolic capital among scholars on Western-dominated and male-dominated editorial boards. Access to these prestigious networks amplifies existing advantages, ensuring that those embedded in such boards continue to accumulate symbolic capital, while scholars from the Global South and underrepresented gender groups face structural barriers to comparable recognition. These dynamics reinforce broader inequities in academic governance and narrow the epistemic diversity of perspectives that shape research agendas.

Editorial networks exhibit unique characteristics compared to other forms of academic organization (Ni et al., 2013). While bibliometric methods like P-Rank have been developed to integrate papers, authors, and journals into unified prestige indicators across heterogeneous scholarly networks (Yan et al., 2011), research shows that interlocking editorship, co-authorship networks, and co-citation patterns overlap only partially, with editorial networks displaying the weakest correlations to the other two (Baccini et al., 2020). This indicates that editorial prominence follows different logics than intellectual prominence. Findings from library and information science Ni et al. (2013) and subsequent work across economics and statistics Baccini et al. (2020) confirms this pattern of partial independence between editorial governance and intellectual networks. Two distinct dimensions can thus be analytically distinguished. *Intellectual prominence* reflects how central a journal is within its knowledge domain, historically measured through citations and co-citation patterns (Garfield,

1972; Small, 1973). *Editorial prominence*, by contrast, captures a journal's position within interlocking governance networks.

Sustainability science illustrates this divergence (**RQ2**). Co-citation analysis identifies *ACS Sustainable Chemistry & Engineering* as a crucial bridge to chemistry communities and confirms the *Journal of Cleaner Production* as a central hub (Schirone, 2023b). Editorial interlock analysis, however, reveals a contrasting pattern: journals oriented toward chemistry remain marginal within governance networks, and *PNAS* (Sustainability Science section) occupies a weakly connected position despite its global recognition (Milojević, 2020). These findings demonstrate that *intellectual prominence* and *editorial prominence* constitute distinct dimensions of symbolic capital—a journal may be frequently cited yet lack well-connected editors in the wider governance network.

The concentration of editorial prominence reflects geographic and institutional biases that extend beyond citation-based measures of intellectual prominence, revealing how recognition operates through social mechanisms beyond the knowledge dynamics of the field. These results provide a direct answer to **RQ1**, showing that editorial prominence is systematically concentrated along geographic, institutional, and gendered lines.

Board appointments may appear to represent merit-based recognition of scholarly achievement, yet they perform a more complex function: transforming different forms of capital into symbolic capital. Scientific capital (publications, citations, intellectual recognition) and social capital (professional networks, institutional affiliations) do not automatically confer authority; they gain force only when recognized according to the rules of the academic field (Bourdieu, 2004). Through processes of institutional consecration and peer recognition, these forms of capital are transformed into symbolic authority, granting scholars legitimacy and influence derived from both individual achievements and institutional position within network structures.

Editorial power operates, therefore, through consecration: authority stems from occupying positions within *consecrated networks* of already prestigious journals, institutions, and individuals. Editorial board membership thus becomes a conversion mechanism, transforming scholarly credentials into capital that carries institutional weight and enabling further accumulation through prestige by association and network effects.

These patterns reveal how structural inequalities become institutionalized in editorial governance. Western institutions dominate interlocking positions, women remain substantially underrepresented, and super-interlocking editors concentrate disproportionate influence within small elite circles. Editorial networks simultaneously reflect existing

academic hierarchies and actively constrain epistemic diversity by limiting which voices shape disciplinary norms and research agendas. Standard academic procedures—journal prestige rankings, citation-based reputation systems, and network-based recruitment—inadvertently reinforce these geographic and institutional concentrations of authority, creating self-perpetuating cycles of exclusion.

These dynamics raise fundamental concerns about knowledge production (Collyer, 2016; Nielsen & Andersen, 2021). The concentration of editorial prominence determines who shapes research agendas and which knowledge claims gain legitimacy within academic fields. In sustainability science, these dynamics carry special weight. The field explicitly commits to integrating diverse knowledge systems and addressing global challenges (Lang et al., 2012; Wearne & Riedy, 2024). Yet editorial networks dominated by men from Western institutions systematically exclude crucial perspectives, including contributions from the Global South, Indigenous knowledge traditions, and local environmental practices (Chambers et al., 2021; Norström et al., 2020). These imbalances conflict with recent discussions of sustainability science as a form of post-normal science, given post-normal science's emphasis on *extended peer communities*—the inclusion of stakeholders, practitioners, and local or Indigenous groups as legitimate knowledge co-producers in contexts of uncertainty and contested values (Ravetz, 1999, 2018). Importantly, these underrepresentation patterns are not confined to sustainability science but also emerge in the environmental sciences (Dada et al., 2022; Lobo-Moreira et al., 2023) and other disciplines (Larivière et al., 2013; Liu et al., 2023).

The typology of Concentrated and Dispersed Core and Periphery journals reveals additional complexity. Journals with comparable levels of editorial prominence can nevertheless exhibit markedly different internal distributions of authority. These differences reflect cumulative appointment practices, disciplinary traditions, and institutional hierarchies, rather than deliberate editorial strategies. Editorial prominence, therefore, operates through two partially independent mechanisms: a journal's position within the interlocking network and the internal organization of its board. Recognizing this dual mechanism challenges single-dimensional models of editorial governance.

5. Limitations and Future Directions

Several limitations should be acknowledged. The analysis covers 30 journals, offering broad but not exhaustive coverage—particularly of regional journals, which may exhibit different editorial dynamics. Moreover, the study offers a cross-sectional snapshot; a longitudinal design could capture temporal shifts in editorial board composition and assess whether editorial power is becoming more inclusive.

The gender analysis was limited to a binary framework due to constraints in available data and current classification tools, and does not capture non-binary or gender-diverse identities. Future research incorporating more nuanced gender classifications would provide a more complete understanding of diversity patterns in editorial governance.

Methodologically, network analysis does not establish causality (Peel et al., 2022). Future research could complement these quantitative approaches with qualitative methods—such as interviews with editors—to better understand how editorial boards shape field organization and intersect with peer review models and journal impact strategies.

The challenges in data collection and name disambiguation mentioned in Section 2.2 highlight the need for greater standardization in scholarly publishing. Implementing standardized practices—such as mandating ORCID integration for editorial board members—would enable more reliable analyses of editorial hierarchies and knowledge governance. Further development of openly accessible editormetric tools would contribute to Open Science goals and enable more systematic monitoring of representation patterns in editorial governance (Leonelli, 2023).

Despite focusing on sustainability science, the methodological framework remains transferable to other fields with established editorial board systems and meaningful interlock patterns. However, future research needs field-specific adaptations where editorial governance structures differ significantly from those observed here.

6. Conclusions

This study establishes editorial interlocks as a distinct form of symbolic capital institutionalized within the governance structures of academic publishing. By operationalizing Bourdieu's concept of symbolic capital through eigenvector centrality and inequality measures (Bourdieu, 1991), it extends existing bibliometric accounts of symbolic capital in academia (Cronin, 2005; Desrochers et al., 2018) to include the prestige of journals' gatekeepers (Ni et al., 2013). In doing so, it advances editormetrics as an emerging domain within bibliometrics and information science by providing systematic, reproducible

tools for analyzing how symbolic capital and inequality are structured in editorial governance.

Empirically, the analysis of sustainability science journals reveals pronounced concentrations of editorial prestige. Board positions are disproportionately occupied by scholars based in Western Europe and North America, affiliated with a handful of elite universities, and overwhelmingly men: women represent only 22.5% of interlocking editors and hold none of the editor-in-chief roles in this group. Most significantly, editors with the highest symbolic capital—those occupying the most prestigious network positions as measured by eigenvector centrality—are located almost exclusively in Western and Northern Europe (especially the Netherlands, Germany, and the United Kingdom) and Eastern Asia (particularly China). Latin America and Africa are nearly absent from interlocking positions, with only two editors each. This geographic monopoly of the most prestigious network positions fundamentally challenges sustainability science's stated commitments to global inclusivity and diverse knowledge systems, revealing persistent tensions between normative ideals and actual governance practices.

The findings highlight the broader implications of editorial governance for equity and epistemic diversity in scholarly communication. Concentrations of authority among a small elite risk narrowing the perspectives that shape research agendas, while more dispersed configurations suggest possibilities for more inclusive governance. By making symbolic capital in editorial networks both visible and measurable, this framework enables critical reflection on how authority is organized, reproduced, and potentially rebalanced across academic fields. Future work might build on this foundation by exploring how alternative models of editorial organization could mitigate structural inequalities and foster more diverse forms of scholarly governance.

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Data Availability Statement

The data underlying this study were collected from publicly available sources (journal websites, ORCID profiles, and institutional pages). Due to research ethical considerations and to avoid the identification of individual editors, the complete dataset cannot be shared. The associated GitHub repository (https://github.com/marcoschirone/editorial-board-network-analysis), archived at Zenodo (https://doi.org/10.5281/zenodo.17348636), provides a sample dataset, the full reproducible workflow (R scripts, configuration files, and visualization code), and the outputs of the analysis (tables, figures, summary statistics, and robustness checks).

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Correction to Article II (to appear in *Scientometrics*)

Correction to: Schirone, M. (2024). The formation of a field: Sustainability science and its leading journals. *Scientometrics, 129*, 401–429. https://doi.org/10.1007/s11192-023-04877-1

In the originally published version of this article, two errors occurred:

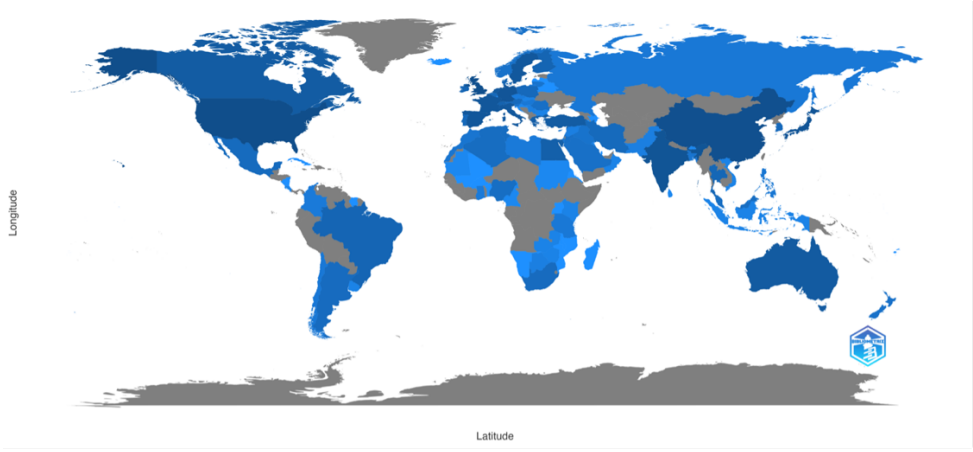
1. Figure Error: Figure 6a was inadvertently replaced with a duplicate of Figure 6b during production. The correct version of Figure 6a is provided below.

2. Textual Correction: On page 403, the phrase “Field Bourdieu (1991b) states...” should read: “Bourdieu (1991b) states...”

These errors do not affect the scientific conclusions, interpretations, or implications of the article. The corrected figure restores the intended visual evidence for the analysis in the relevant section, while the typographical revision is a minor linguistic correction.

The authors and the publisher regret these oversights.

Figure 6a



Note. The map is based on a threshold of at least 50 co-authorship links between countries. The shade of blue in which a country is represented is correlated with the number of papers associated with an author's affiliation in that country.

Sustainability science aims to transform how knowledge is produced and disseminated to address global environmental and social challenges. Yet as it institutionalises, it confronts what this thesis calls the ***transformation paradox:*** how can a field committed to transdisciplinarity and transformation avoid reproducing the hierarchies of academia?

This thesis examines the emergence and development of sustainability science, and the role of its journals, through the lens of Bourdieu's sociology. Drawing on bibliometric mapping, network analysis, and qualitative content analysis of editorials, it traces how authority, recognition, and legitimacy are structured in this research field. The analysis identifies three historical phases—Foundation (1993–2002), Introspection (2003–2012), and Diversification (2013–2022)—each marked by shifts in epistemic orientation and the redistribution of symbolic capital. Editorial discourse functions as a central site of symbolic struggle, where competing visions of sustainability science—and rival claims to definitional authority—are articulated, contested, and selectively legitimated.

Scholarly journals and editorial networks, the study shows, are not neutral infrastructures but key sites where recognition is distributed and knowledge contributions become visible. While sustainability science promotes inclusivity and transformation, its institutionalisation does not escape the influence of established academic structures. By reconceptualising scholarly communication as the reproduction of symbolic capital, the thesis shows why transformation in academia and scholarly publishing may remain constrained, even in fields committed to transdisciplinarity and transformation.

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