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Review

Trends in Soil Science over the Past Three Decades (1992–2022) Based on the Scientometric Analysis of 39 Soil Science Journals

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Abstract: As one of the basic disciplines of agricultural, natural resource, and environmental science, soil science has played a critical role in global food security and socio-economic and ecological sustainability. The number of soil science journals and publications has increased remarkably with the development of soil science. However, there is a lack of systematic and comprehensive studies on the developmental trends of soil science based on journals and publications. In this study, 39 journals included under the soil science category in the 2022 Journal Citation Reports, and 112,911 publications in these journals from 1992 to 2022 were subjected to scientometric/bibliometric analysis to determine trends in publication, journal metrics, co-authorship, and research topics, in addition to general journal information. The results show that soil science ushered in a renaissance period with the number of publications, citations, impact factors, and CiteScore demonstrating an increasing trend. America and the Chinese Academy of Sciences had the most publications and citations. The most productive author published more than 400 articles. Soil science research focused mostly on its fundamental impact on the ecological environment based on the strongest citation bursts analysis of keywords. The analysis indicated that open access has increased in popularity. Current soil science journals still face a few common challenges, including an urgent need for a fairer evaluation mechanism on journal quality compared to the traditional use of single metrics as well as equity, diversity, and inclusion (EDI) in the whole editorial process. Artificial intelligence may bring new tools and more changes to the development of soil science. This study will help soil science researchers to better understand the development status and future trends of soil science. It will also guide authors in journal selection.

Keywords: bibliometric analysis; CiteScore; journal impact factor; open access; publications

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Citation: Jia, L.; Wang, W.; Zvomuya, F.; He, H. Trends in Soil Science over the Past Three Decades (1992–2022) Based on the Scientometric Analysis of 39 Soil Science Journals. *Agriculture* **2024**, *14*, 445. https://doi.org/10.3390/agriculture14030445

Academic Editor: Hung-Yu Lai

Received: 23 January 2024
Revised: 24 February 2024
Accepted: 6 March 2024
Published: 8 March 2024

1. Introduction

Soil is composed of organic matter, minerals, organisms, gases, and water, which are formed through a series of complex biogeochemical and physical processes [1,2]. Soil is a dynamic and diversified natural system, which is considered to be the most complex porous medium on Earth [3]. Soil supports major life activities on Earth, maintains the balance of ecosystems, and provides important services, such as water purification, carbon sequestration, and climate regulation. It supports nutrient cycling, plant growth, and the production of food, fiber, fuel, and construction materials, as well as cultural heritage and infrastructure foundations [4,5]. Soil is, therefore, extremely important for life on Earth [6].

Soil science is the study of soil as a natural phenomenon and resource. It provides an understanding of the physical, hydrological, chemical, biogeological, and mechanical mechanisms that control soil processes and spatial distribution, as well as various functional changes caused by human interference [7]. Soil science also provides the scientific basis for the rational utilization and management of land resources.

Although the importance of soil has long been recognized, soil science only started gradually developing into a solid scientific discipline during the early years of the 20th century, largely supported by international conferences [8]. The first person to recognize the need for a soil science journal was V.V. Dokuchaev, who is widely considered to be the founder of soil science. The first journal devoted exclusively to soil science (*Pochvovedenie*) was founded by soil hydrologist P.V. Ototskii from the University of St. Petersburg in Russia [9]. The first issue of the journal was published in 1899.

Following the rapid growth of the soil science knowledge base in the mid-20th century, a number of journals (including *Plant and Soil*, *European Journal of Soil Science*, *Journal of Soil and Water Conservation*, *Clays and Clay Minerals*, *Archives of Agronomy and Soil Science*, *Soil Science and Plant Nutrition*, *Acta Agriculturae Scandinavica Section B-Soil and Plant Science*, *Agrochimica*, and *Journal of Plant Nutrition and Soil Science*) were founded to accommodate the growing volume of research on different aspects of soil science. The increase in soil science knowledge has greatly promoted the development of agricultural production [10]. Concurrently, soil science output has also begun to increase substantially, with soil science journals becoming more international [11]. The development and scientific status of soil science have continued to improve since the 21st century. In December 2013, the 68th United Nations General Assembly adopted a resolution designating December 5th as World Soil Day and 2015 as the "International Year of Soils" [12], which fully reflects the increasing importance of soil science. Influenced by the continuous development and improvement of other traditional disciplines, numerous new research ideas, research methods, and techniques have been introduced [13] and interdisciplinary research is being widely performed in soil science [14].

One indicator of the growing importance of soil science is the huge increase in the number of relevant journals and publications [15]. In order to reveal the evolution of soil science, studies have been carried out based on the number of journals and publications. Hartemink et al. [9] analyzed 2079 articles from 100 volumes of the journal *Geoderma*, outlined the geographic origins of the research and authors, and discussed changes in thematic trends in soil science. Their research showed that the number of soil physics papers has increased significantly while soil chemistry has declined, reflecting some of the changes that have occurred in soil science as a whole. Minasny et al. [16] surveyed citations in 31 major soil science journals, analyzing self-citations by individuals, countries, and journals. They concluded that the self-citation rate of journals is positively correlated with their impact factor ranking, and the distribution of self-citation rates by country follows a power law trend, with China having a high self-citation rate. The self-citation rate of soil science is reasonable and comparable to other sciences [16]. Hartemink [17] collated relevant journals in soil science to investigate publication trends in soil science and open access. They found that there are about 42,000 soil science papers published annually, of which 5–20% are open access, and that the cost of publishing an open-access paper in 25 soil science journals ranges from USD $750 to 4000. Many other studies investigated the research status and development characteristics of specific themes of soil science, including soil health [18], soil nutrients/contaminants [19–21], arid soils [22], unfrozen soil water content [23,24], soil erosion modeling [25], measurement methods/techniques [26–29], machine learning in soil science and hydrology [30–32], and digital soil mapping [33]. However, most of these studies were limited to a single research element, a particular journal, or a specific research topic, which makes it difficult to accurately discern the overall development trends of soil science. Therefore, there is a need to systematically and comprehensively analyze major soil science journals.

The objective of this study was, therefore, to collate publications in 39 core soil science journals archived in the Web of Science between 1992 and 2022 and to summarize and analyze the development, influence, and trends in soil science using bibliometric analysis. The study provides soil scientists with various different soil science journals with an insight into assisting them in selecting appropriate journals for their articles. The aim of the study is to provide the reader with a reference and better understanding of the historical progress, current status, and research hotspots of soil science research.

2. Materials and Methods

The Web of Science Core Collection (WoSCC) has been widely recognized as the most authoritative scientific literature source in the world, because it comes with the required details for bibliometric analysis [26,29,34]. The 39 soil science journals selected in this study were listed in the 2022 Journal Citation Reports (JCR) of the Web of Science (Table 1). Although it may be controversial whether some journals belong to soil science, it is undeniable that they do publish papers related to soil science, so this paper uses the 2022 JCR as a criterion to consider all 39 journals listed therein as soil science journals. The journals were divided into four quartiles (i.e., Q1–Q4; Q1 is occupied by the top 25% of journals in the list, while Q2–Q4 are occupied by the 25–50%, 50–75%, and 75–100% groups, respectively) based on the up-to-date impact factor (IF, the ratio of citations of a journal in a recent 2- or 5-year window to the number of its publications in the same time window). The corresponding CiteScore (similar to IF, but for a 3-year window) for each journal was obtained from Scopus, while journal information such as publication cycles and editorial board compositions was collected from the official websites of the journals. WoSCC data for the period 1992–2022 were retrieved on 15 February 2023 for analysis. Document types selected for this study were proceedings papers, articles, and review articles, including formally indexed and early-access copies of these publications based on WOS. The "full record and citation data" of the retrieved results were exported in the BibTex and plain text file formats for bibliometric analysis. The R language package Bibliometrix [35], which uses the BibTex format, and the VOSviewer (version 1.6.19) [36] and CiteSpace (version 6.1.R6) [37] software, which utilize the plain text file format, were used to analyze and visualize the data.

Table 1. Selected information from 39 journals under the Journal Citation Report (JCR) soil science category †.

JCR Quartile	Journal Name (Full and Abbrev.) †		Region	Inaugural Issue Year	Process Duration (Weeks)			Acceptance Rate ‡	Publisher	Model	Cost per Open-Access Paper (USD)	Website
					First Decision	Review Time	Publication Time					
Q1	*Soil Biology and Biochemistry*	*SBB*	England	1969	First decision: 4.6 wk (week); Review time: 6.9 wk; Publication time: 0.9 wk			N/A ‡	Elsevier (Amsterdam, The Netherlands)	Hybrid	USD 4520 + taxes	https://www.sciencedirect.com/journal/soil-biology-and-biochemistry
	Geoderma	*GeoD*	The Netherlands	1967	First decision: 5.4 wk; Review time: 8.3 wk; Publication time: 1.8 wk			16%	Elsevier (Amsterdam, The Netherlands)	Open access (since 2023)	USD 2800 + taxes	https://www.sciencedirect.com/journal/geoderma
	Catena	*Catena*	Germany	1973	First decision: 4.6 wk; Review time: 7.7 wk; Publication time: 1.8 wk			N/A	Elsevier (Amsterdam, The Netherlands)	Hybrid	USD 3580 + taxes	https://www.sciencedirect.com/journal/catena
	Soil and Tillage Research	*STR*	The Netherlands	1980	First decision: 7 wk; Review time: 10.1 wk; Publication time: 1.7 wk			N/A	Elsevier (Amsterdam, The Netherlands)	Hybrid	USD 3970 + taxes	https://www.sciencedirect.com/journal/soil-and-tillage-research
	Biology and Fertility of Soils	*BFS*	Germany	1985	Submission to first decision (median): 0.7 wk			N/A	Springer (Berlin, Germany)	Hybrid	USD 4390 + taxes	https://www.springer.com/journal/374
	Pedosphere	*PedoS*	China mainland	1991	Publication time: 0.3 wk			N/A	Elsevier (Amsterdam, The Netherlands)/Science Press (Beijing, China)	Subscription	N/A	https://www.sciencedirect.com/journal/pedosphere
	Soil	*Soil*	Germany	2015	Submission to initial decision: 0.3 wk Public discussion: 8.1 wk; Author's revision: 13.6 wk Re-evaluation: 19.4 wk; Acceptance to publication: 23.4 wk			N/A	Copernicus (Göttingen, Germany)	Open access (since 2015)	Price per journal page: EUR 77/93 net	www.soil-journal.net/
	International Soil and Water Conservation Research	*ISWCR*	China Mainland	2013	Time to first decision: 4.1 weeks; Review time: 7 wk; Publication time: 2.6 wk			N/A	KeAi Publishing (Beijing, China)	Open access (since 2013)	USD 1200 + taxes	https://www.sciencedirect.com/journal/international-soil-and-water-conservation-research
	Biochar	*BioC*	China mainland	2019	Submission to first decision (median): 2.1 wk			N/A	Springer (Berlin, Germany)	Open access (since 2022)	USD 2490 + taxes	https://www.springer.com/journal/42773

Table 1. *Cont.*

JCR Quartile	Journal Name (Full and Abbrev.) †		Region	Inaugural Issue Year	Process Duration (Weeks)			Acceptance Rate ‡	Publisher	Model	Cost per Open-Access Paper (USD)	Website
					First Decision	Review Time	Publication Time					
Q2	*Plant and Soil*	*P & S*	The Netherlands	1948	Submission to first decision (median): 5 wk			N/A	Springer (Berlin, Germany)	Hybrid	USD 4390 + taxes	https://www.springer.com/journal/11104
	Applied Soil Ecology	*ASE*	The Netherlands	1994	First decision: 5.8 wk; Review time: 9.2 wk; Publication time: 1.6 wk			N/A	Elsevier (Amsterdam, The Netherlands)	Hybrid	USD 3830 + taxes	https://www.sciencedirect.com/journal/applied-soil-ecology
	Journal of Soils and Sediments	*JSS*	Germany	2001	Submission to first decision (median): 1.3 wk			N/A	Springer (Berlin, Germany)	Hybrid	USD 3690 + taxes	https://www.springer.com/journal/11368
	Land Degradation & Development	*LDD*	England	1989	N/A			N/A	Wiley (Hoboken, NJ, USA)	Hybrid	USD 4740 + taxes	https://www.onlinelibrary.wiley.com/journal/1099145x
	European Journal of Soil Science (was *Journal for Soil Science*)	*EJSS*	England	1949	First decision (median): 3.6 wk; Review duration (median): 9.3 wk; Publication time (median): 2.0 wk			N/A	Wiley (Hoboken, NJ, USA)	Hybrid	USD 4400 + taxes	https://www.bsssjournals.onlinelibrary.wiley.com/journal/13652389
	Nutrient Cycling in Agroecosystems (was *Fertilizer research*)	*NCA*	The Netherlands	1980	Submission to first decision (median): 1.4 wk			N/A	Springer (Berlin, Germany)	Hybrid	USD 3490 + taxes	https://www.springer.com/journal/10705
	Soil Use and Management	*SUM*	England	1985	N/A			N/A	Wiley (Hoboken, NJ, USA)	Hybrid	USD 3850 + taxes	https://www.bsssjournals.onlinelibrary.wiley.com/journal/14752743
	Journal of Soil Science and Plant Nutrition	*JSSPN*	Chile	2001	Submission to first decision (median): 1.9 wk			N/A	Springer (Berlin, Germany)	Hybrid	USD 2990 + taxes	https://www.springer.com/journal/42729
	Rhizosphere	*Rhiz*	The Netherlands	2016	First decision: 2.7 wk; Review time: 4.2 wk; Publication time: 1.1 wk			N/A	Elsevier (Amsterdam, The Netherlands)	Hybrid	USD 2880 + taxes	https://www.sciencedirect.com/journal/rhizosphere
	Geoderma Regional	*GR*	The Netherlands	2014	First decision: 8.4 wk; Review time: 10.9 wk; Publication time: 0.7 wk			N/A	Elsevier (Amsterdam, The Netherlands)	Hybrid	USD 2640 + taxes	https://www.sciencedirect.com/journal/geoderma-regional

Table 1. *Cont.*

JCR Quartile	Journal Name (Full and Abbrev.) †		Region	Inaugural Issue Year	Process Duration (Weeks)			Acceptance Rate ‡	Publisher	Model	Cost per Open-Access Paper (USD)	Website
					First Decision	Review Time	Publication Time					
Q3	*Soil Science Society of America Journal*	*SSSAJ*	USA	1921	Submission to first decision: 7 wk			35%	Wiley (Hoboken, NJ, USA)	Hybrid	USD 1350 + taxes	https://www.acsess.onlinelibrary.wiley.com/journal/14350661
	Journal of Plant Nutrition and Soil Science (was *Zeitschrift fur Pflanzenernahrung und Bodenkunde*)	*JPNSS*	Germany	1922	N/A			N/A	Wiley (Hoboken, NJ, USA)	Hybrid	USD 3660 + taxes	https://www.onlinelibrary.wiley.com/journal/15222624
	Vadose Zone Journal	*VZJ*	USA	2002	Submission to first decision (median): 7.6 wk; Final decision: 10.9 wk; Acceptance to publication (median): <5.7 wk			65%	Wiley (Hoboken, NJ, USA)	Open access (since 2018)	USD 2450 + taxes	https://www.acsess.onlinelibrary.wiley.com/journal/15391663
	Journal of Soil and Water Conservation	*JSWC*	USA	1946	Initial manuscript review decision within 10 wk; Accepted manuscripts are typically published within 26.1 to 39.1 wk from the date final files are submitted			N/A	Soil and Water Conservation Society (Ankeny, IA, USA)	Hybrid	Additional USD 750	https://www.jswconline.org/
	Clays and Clay Minerals	*CCM*	USA	1952	Submission to first decision (median): 4.3 wk			N/A	Springer (Berlin, Germany)	Hybrid	USD 2890 + taxes	https://www.springer.com/journal/42860
	Archives of Agronomy and Soil Science	*AASS*	England	1956	0 wk avg. from submission to first decision; 12.3 wk avg. from submission to first post-review decision; 1.4 wk avg. from acceptance to online publication			13%	Taylor & Francis (Oxford, UK)	Open access (since 2022)	USD 600–USD 4800 Use open access cost finder to view	https://www.tandfonline.com/journals/gags20
	European Journal of Soil Biology	*EJSB*	France	1964	Time to first decision: 2.2 wk; Review time: 3.8 wk; Publication time: 1.6 wk			N/A	Elsevier (Amsterdam, The Netherlands)	Hybrid	USD 3140 + taxes	https://www.sciencedirect.com/journal/european-journal-of-soil-biology
	Pedobiologia	*PedoB*	Germany	1961	Review time: 9.2 wk; Publication time: 0.6 wk			N/A	Elsevier (Amsterdam, The Netherlands)	Hybrid	USD 2780 + taxes	https://www.sciencedirect.com/journal/pedobiologia

Table 1. *Cont.*

JCR Quartile	Journal Name (Full and Abbrev.) †		Region	Inaugural Issue Year	Process Duration (Weeks)			Acceptance Rate ‡	Publisher	Model	Cost per Open-Access Paper (USD)	Website
					First Decision	Review Time	Publication Time					
Q3	*Arid Land Research and Management* (was *Arid Soil Research and Rehabilitation*)	*ALRM*	USA	1987	1 wk avg. from submission to first decision; 11 wk avg. from submission to first post-review decision; 2.7 wk avg. from acceptance to online publication			17%	Taylor & Francis (Oxford, UK)	Open access	USD 600–USD 4800 Use open access cost finder to view	https://www.tandfonline.com/journals/uasr20
	Soil and Water Research	*SWR*	Czech Republic	2006	N/A			N/A	Czech Academy of Agricultural Sciences (Prague, Czechia)	Open access (since 2006)	565 EUR/article or 14,000 CZK	https://www.swr.agriculturejournals.cz//
Q4	*Communications in Soil Science and Plant Analysis*	*CSSPA*	USA	1970	10 wk avg. from submission to first decision; 20.1 wk avg. from submission to first post-review decision; 1.3 wk avg. from acceptance to online publication			25%	Taylor & Francis (Oxford, UK)	Open access	USD 600–USD 4800 Use open access cost finder to view	https://www.tandfonline.com/journals/lcss20
	Eurasian Soil Science	*ESS*	Russia	1899	N/A			N/A	Pleiades Publishing (New York, NY, USA)	Hybrid	Contact the Open Research Support Team: ORSupport@springernature.com	https://www.springer.com/journal/11475
	Soil Science and Plant Nutrition	*SSPN*	Japan	1955	5.6 wk avg. from submission to first decision; 7.7 wk avg. from submission to first post-review decision; 1.3 wk avg. from acceptance to online publication			27%	Taylor & Francis (Oxford, UK)	Open access	USD 600–USD 4800 Use open access cost finder to view	https://www.tandfonline.com/journals/tssp20
	Revista Brasileira De Ciencia Do Solo	*RBCS*	Brazil	1977	N/A			N/A	Sociedade Brasileira de Ciencia do Solo (Viçosa, Brazil)	Open access (since 2003)	USD 70/100 per page	https://www.scielo.br/j/rbcs/
	Soil Research (was *Australian Journal of Soil Research*)	*SR*	Australia	1963	5.6 wk from manuscript submission to first decision; 8.4 wk from manuscript acceptance to publication			28%	CSIRO publishing (Clayton, Australia)	Hybrid	USD 2700 + taxes	https://www.publish.csiro.au/sr
	Soil Science	*SS*	USA	1916	N/A			N/A	Lippincott Williams & Wilkins (Philadelphia, PA, USA)	Subscription	N/A	https://www.journals.lww.com/soilsci/pages/default.aspx
	Canadian Journal of Soil Science	*CJSS*	Canada	1921	6.4 wk avg. from submission to first decision			47%	Canadian Science Publishing (Ottawa, ON, Canada)	Hybrid	USD 1000 + taxes	https://www.cdnsciencepub.com/journal/cjss
	Acta Agriculturae Scandinavica Section B-Soil and Plant Science	*AASSB*	Norway	1950	0.1 wk avg. from submission to first decision; 5.7 wk avg. from submission to first post-review decision; 3 wk avg. from acceptance to online publication			14%	Taylor & Francis (Oxford, UK)	Open access (since 2022)	USD 2070 + taxes	https://www.tandfonline.com/journals/sagb20

Table 1. *Cont.*

JCR Quartile	Journal Name (Full and Abbrev.) †		Region	Inaugural Issue Year	Process Duration (Weeks)			Acceptance Rate ‡	Publisher	Model	Cost per Open-Access Paper (USD)	Website
					First Decision	Review Time	Publication Time					
Q4	*Agrochimica*	*AgroC*	Italy	1956	Reviewed within 8.7 wk from the submission date; Published within 13 wk from the final acceptance			N/A	Pisa University Press (Pisa, Italy)	Subscription	N/A	https://www.pisauniversitypress.it/landing_page-le-riviste-agrochimica-1497.html
	Compost Science & Utilization	*CSU*	USA	1993	28.9 wk avg. from submission to first decision; 55.1 wk avg. from submission to first post-review decision			7%	Taylor & Francis (Oxford, UK)	Open access	USD 600–USD 4800 Use open access cost finder to view	https://www.tandfonline.com/journals/ucsu20

† Statistics were obtained from the official website of each journal as of 25 March 2023. ‡ Acceptance rates are calculated slightly differently for different publishers. For example, Elsevier calculates the acceptance rate as the total number of accepted articles expressed as a percentage of the total number of articles submitted in the same year, with withdrawn articles excluded. By comparison, Wiley expresses the number of papers accepted in a given period as a percentage of all papers for which a final decision was made in that period. † Previous names of journals: *EJSS*, *Journal for Soil Science* (1949–1994); *NCA*, *Fertilizer Research* (1980–1997); *JPNSS*, *Zeitschrift fur Pflanzenernahrung und Bodenkunde* (1967–1999); *ALRM*, *Arid Soil Research and Rehabilitation* (1987–2001); *SR*, *Australian Journal of Soil Research* (1963–2012); *SSPN*, *Soil and Plant Food* (1955–1961); *CJSS*, *Canadian Journal of Agricultural Science* (1953–1956), *Scientific Agriculture* (1921–1952); *AASSB*, *Acta Agriculturae Scandinavica* (1950–1991); and *ESS*, *Soviet Soil Science* (1899–1992), formerly known as *Pochvovedenie*. ‡ N/A indicates that no relevant data were found; wk is short for week.

The H-index, global total citations (TCs), and local total citations (LCs) were calculated using the R language package Bibliometrix [38] based on the collected data. The H-index is a hybrid quantitative evaluation of scholarly achievement, indicating that H of the published publications have been cited at least H times, and is often used to evaluate the scholarly impact of a journal or individual [39]. Global total citations indicate the number of total citations of a publication or journal cited by all other publications. The local total citations indicate the number of citations by the 39 journals investigated, which to some extent reflect the quality and impact of a research paper or a journal [40]. VOSviewer [36] was used to construct and visualize bibliometric networks by country, organization, author cooperation, and keyword co-occurrence. Keywords with the strongest citation bursts were calculated and analyzed using CiteSpace [37,41].

3. Results and Discussion

3.1. General Information of the 39 Soil Science Journals

The selected general information of the 39 soil science journals is presented in Table 1. The first soil science journal entitled "*Soil Science*" was launched in January 1916 with subsequent issues published monthly. A few other soil science journals have been in existence for over 50 years (e.g., *European Journal of Soil Science* and *Soil Science Society of America Journal*). Over 112,000 publications have been published over the last 30 years. The long history and high volume reflect the importance of the soil science discipline.

It is noteworthy that most of the 39 soil science journals published by Elsevier present review speeds and acceptance rates on their official websites. These indicators are good references for authors when choosing a target journal for their submissions. The average time until the first decision ranges from few to 28.9 weeks, and the average time until publication ranges from 0.3 to 12.9 weeks (Table 1), which are generally longer than other disciplines. For example, the average time from the first submission to the first editorial decision after formal peer review is 5.1 $\pm$ 6.0 weeks in the field of "conservation biology" [42]. However, it should be noted that these data vary from year to year and will likely increase because the soaring submission volume will inevitably increase the burden on the review process [43]. The same difficulty will likely affect the acceptance rate, including desk-rejected papers (i.e., manuscripts rejected without entering the review process). This means more submissions may have to be rejected in order to maintain acceptable journal metrics [44]. This is especially true for top-tier journals with high IF as they are generally more attractive to authors, whereas other journals may be inclined to opt for a smaller publication volume to maintain or increase their IF and CiteScore [45].

The processing time taken by the editorial board members also significantly determines the time for the review process as most of the editorial work is the volunteer work of researchers or a part-time job paid with a small honorarium. Therefore, a highly motivated editorial board is key. This is similar to reviewers who volunteer to review for journals but are generally not paid at all. This is not unique to soil science journals. To motivate the reviewers and editorial board, many incentive strategies have been adopted by journals: (1) Acknowledge reviewers or editorial board members by awarding them with excellent performance certificates or similar; (2) some open-access journals (not soil science journals) offer a discount voucher for publication fees for each review or waive the publication fee of one or two papers yearly for editorial board members. Sometimes, poor-quality review reports may be provided by discount voucher-driven reviewers; (3) most journals in China for example allocate a small budget to pay reviewers for each review report [46]. However, no report was found on how this would speed up the review process and guarantee the review quality; (4) some journals (e.g., MDPI journals, *Heliyon*) have full-time assistant editors (AEs) or reviewer selection editors (RSEs) to invite reviewers on behalf of associate editors by matching the submissions with reviewers' keywords/publications through reviewers' recommendation services of the editorial system. This reduces the time spent by associate editors in finding reviewers and the editors only need to make decisions based on the review reports, and the publication cycle is generally shorter. However, AEs and

RSEs may not have enough knowledge of a reviewer's expertise, experience, conflicts of interests, and background, so inappropriate reviewers and review reports may be included; (5) many journals have allowed readers to comment on research papers prior to or at the same time as sending them out for review [47], while other journals (e.g., *eLife*) choose an open publishing model to skip the peer review process [48]; (6) a multi-journal submission instead of the traditional single-journal submission system would save a lot of time for authors to avoid serial rounds of review after being rejected by previous journals. Multi-journal submission is considered to be plagiarism but also unfairly hoards the submissions and prevents quick dissemination [49]. For instance, Cell Press has launched the "Multi-Journal Submission" initiative (previously, "Community Review") for authors to find the right fit among 26 journals of its press for their research papers. This is a good start, and it would further benefit the authors if a cross-publisher choice of journals is available. However, authors are also expected to work together with publishers for academic integrity; and (7) Preprints, Facebook, blogs, WeChat, Threads, and other social media promotion can also effectively reduce the impact of delayed publication of papers and help to disseminate results quickly [50]. Many soil science journals, such as *Geoderma* (*GeoD*), *Vadose Zone Journal* (*VZJ*), and *Soil Science Society of America Journal* (*SSSAJ*), have dedicated editorial board members who are responsible for promoting and publicizing journal articles. Except for the first and last strategy, the others are generally not adopted by any of the 39 soil science journals but they may help if adopted.

In addition, most soil science journals use a hybrid model that allows authors to choose subscriptions and open access when publishing. Newly established journals generally choose the gold open-access model (e.g., *Soil*, *International Soil and Water Conservation Research*, and *Biochar*), which allows the published article to be freely available for online access. Some top-tier soil science journals (e.g., *Geoderma*, *Vadose Zone Journal*) have flipped from the subscription or hybrid model to the gold open-access model and more journals are planning to do so. This may indicate an increasing trend toward open access [51], partly because of the cOAlition S program [52] in Europe that requires research funded by national, regional, and international funding bodies to be published in open-access mode. A similar policy was implemented in the USA and Canada, where scientific publications and supporting data resulting from federally funded research are required to be publicly accessible upon publication [53]. As indicated by the OA2020, the implementation of open access may eventually decrease the cost of publication [54], but in the short to medium term, the article processing charge (APC, ranging from USD 600 to USD 4800, Table 1) may increase the financial burden on researchers who have limited funding opportunities, especially those from developing countries. Some society-funded journals, such as the *European Journal of Soil Science* and the *Soil Science Society of America Journal*, stick to hybrid or subscription mode, which appeal to authors who cannot afford APCs. The cost of open-access publication may change from year to year due to various factors. In general, journals with high selectivity and higher impact factor tend to charge higher APCs (Table 1), because accepted articles usually defray the cost of rejected articles [55]. Open access may lead to more citations and higher journal metrics (e.g., IF and CiteScore), and more reads or downloads. However, there is no direct research to show that OA increases the journal metrics, as there has been a decline in IF for the *Vadose Zone Journal* and *Geoderma* immediately after they switched to OA, as indicated in Section 3.3; however, the IF is affected by many factors and should not be directly linked to OA mode.

3.2. Publication Volume and Citation Metrics

There was a total of 112,911 publications in the 39 major soil science journals during 1992 and 2022 (Table 2). These included 105,106 research articles, 4786 proceedings papers, and 2108 reviews that were already published, and 858 articles plus 53 reviews that were in early access. Overall, the annual total publication volume of the journals increased over the years, averaging 2557 during 1992–2002, 3445 publications during 2003–2012, and 5034 publications during 2013–2022. *Plant and Soil* is the only journal that published over 10,000 papers during 1992–2022. Seven journals (i.e., *Soil Biology and Biochemistry*, *Geoderma*, *Catena*, *Plant and Soil*, *Soil Science Society of America Journal*, *Communications in Soil Science and Plant Analysis*, and *Eurasian Soil Science*) each published more than 5000 articles during the same period. It is noteworthy that the publication volumes for JCR Q1 and Q2 journals generally increased over the 30 years. The increase in the number of published articles, the number of journals, and the number of citations may partly reflect the demographic explosion of the last 50 years and the entry of scientists from many developing countries into the scientific market. The opposite trend was observed for Q3 and Q4 journals, although the total citations for each journal showed an increasing trend (Figure 1). Nine journals had over 100,000 citations, with *Soil Biology and Biochemistry*, *Plant and Soil*, and *Geoderma* ranking highest, as shown by their TCs (Table 2). A large portion of TCs was from the 39 journals, as indicated by the corresponding LCs. The average number of citations per article can reflect the quality or impact of the publications of the journal. *Soil Biology and Biochemistry* had the highest TC per article (TC/N = 58.5), whereas the *Soil Science Society of America Journal* had the highest LC per article (LC/N = 28.3), indicating that the journal's published articles are well recognized by their soil scientist peers. In addition, 11 journals each had over 100 publications cited more than 100 times, with the top 5 journals being *Soil Biology and Biochemistry* (241), *Plant and Soil* (206), *Soil Science Society of America Journal* (191), *Geoderma* (183), and *Soil and Tillage Research* (151).

Table 2. Citation metrics of the 39 journals under the Journal Citation Report (JCR) category of soil science between 1992 and 2022 $^{+}$.

JCR Quartile	NO.	Journal Name	Abbrev.	N	TC	LC	TC/N	LC/N	Journal H-Index
Q1	1	*Soil Biology and Biochemistry*	*SBB*	8627	504,821	219,855	58.52	25.48	241
	2	*Geoderma*	*GeoD*	7712	303,420	112,315	39.34	14.56	183
	3	*Catena*	*Catena*	6144	175,432	42,026	28.55	6.84	142
	4	*Soil and Tillage Research*	*STR*	4454	176,957	74,552	39.73	16.74	151
	5	*Biology and Fertility of Soils*	*BFS*	3394	137,836	58,816	40.61	17.33	137
	6	*Pedosphere*	*PedoS*	1673	36,985	8703	22.11	5.20	72
	7	*Soil*	*Soil*	297	6970	2163	23.47	7.28	39
	8	*International Soil and Water Conservation Research*	*ISWCR*	268	4282	1139	15.98	4.25	34
	9	*Biochar*	*BioC*	187	3133	479	16.75	2.56	25
Q2	1	*Plant and Soil*	*P & S*	10,963	452,766	131,225	41.30	11.97	206
	2	*Applied Soil Ecology*	*ASE*	4251	131,221	36,256	30.87	8.53	129
	3	*Journal of Soils and Sediments*	*JSS*	3383	58,352	12,826	17.25	3.79	80
	4	*Land Degradation & Development*	*LDD*	2947	65,258	16,867	22.14	5.72	93
	5	*European Journal of Soil Science*	*EJSS*	2515	103,670	37,821	41.22	15.04	125
	6	*Nutrient Cycling in Agroecosystems*	*NCA*	2465	74,701	17,128	30.30	6.95	104
	7	*Soil Use and Management*	*SUM*	1778	45,608	15,385	25.65	8.65	84
	8	*Journal of Soil Science and Plant Nutrition*	*JSSPN*	1695	18,891	4441	11.15	2.62	49
	9	*Rhizosphere*	*Rhiz*	556	3637	769	6.54	1.38	23
	10	*Geoderma Regional*	*GR*	476	3775	1762	7.93	3.70	25
Q3	1	*Soil Science Society of America Journal*	*SSSAJ*	6595	295,425	186,463	44.80	28.27	191
	2	*Journal of Plant Nutrition and Soil Science*	*JPNSS*	2771	65,776	17,043	23.74	6.15	90
	3	*Vadose Zone Journal*	*VZJ*	2081	55,573	12,634	26.70	6.07	87
	4	*Journal of Soil and Water Conservation*	*JSWC*	2067	43,118	14,364	20.86	6.95	87
	5	*Clays and Clay Minerals*	*CCM*	1927	61,800	15,646	32.07	8.12	101
	6	*Archives of Agronomy and Soil Science*	*AASS*	1760	16,569	4233	9.41	2.41	43
	7	*European Journal of Soil Biology*	*EJSB*	1553	40,950	10,729	26.37	6.91	77
	8	*Pedobiologia*	*PedoB*	1524	36,282	16,485	23.81	10.82	75
	9	*Arid Land Research and Management*	*ALRM*	926	11,341	1722	12.25	1.86	33
	10	*Soil and Water Research*	*SWR*	339	2976	682	8.78	2.01	24

Table 2. *Cont.*

JCR Quartile	NO.	Journal Name	Abbrev.	N	TC	LC	TC/N	LC/N	Journal H-Index
Q4	1	*Communications in Soil Science and Plant Analysis*	*CSSPA*	7086	74,665	32,437	10.54	4.58	83
	2	*Eurasian Soil Science*	*ESS*	5061	22,165	11,257	4.38	2.22	36
	3	*Soil Science and Plant Nutrition*	*SSPN*	2783	43,129	16,169	15.50	5.81	68
	4	*Revista Brasileira De Ciencia Do Solo*	*RBCS*	2662	35,306	17,643	13.26	6.63	56
	5	*Soil Research*	*SR*	2507	64,335	35,807	25.66	14.28	41
	6	*Soil Science*	*SS*	2073	57,274	54,539	27.63	26.31	97
	7	*Canadian Journal of Soil Science*	*CJSS*	1903	41,127	27,528	21.61	14.47	77
	8	*Acta Agriculturae Scandinavica Section B-Soil and Plant Science*	*AASSB*	1801	17,167	2842	9.53	1.58	43
	9	*Agrochimica*	*AgroC*	920	3304	1417	3.59	1.54	20
	10	*Compost Science & Utilization*	*CSU*	787	13,391	2930	17.02	3.72	52
			Sum	112,911	3,309,388	1,277,098	29.31	11.31	/

[+] N is the number of publications, TC is the global total citations, LC is the local total citations, H-index of a certain journal is the number of H publications in the journal that have each been cited at least H time. For *Nutrient Cycling in Agroecosystems* (*NCA*), *Journal of Plant Nutrition and Soil Science* (*JPNSS*, previously *Zeitschrift für Pflanzenernährung und Bodenkunde*), *Arid Land Research and Management* (*ALRM*), and *Soil Research* (*SR*) that changed their journal names after 1992, the N, TC, and LC data before and after the journal name change were combined.

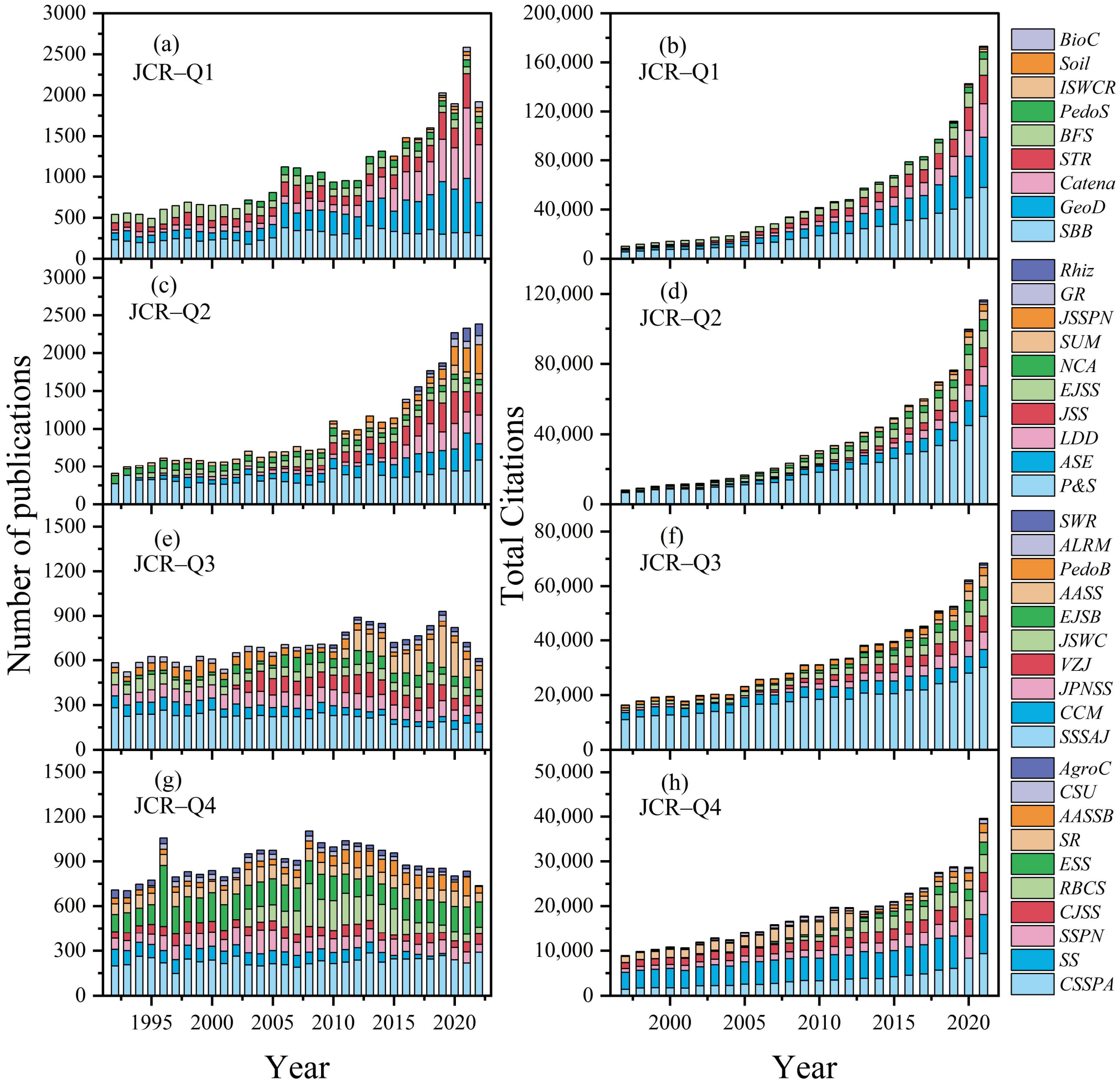

Figure 1. Annual trends of total publication volume (**a**,**c**,**e**,**g**) and total citations (**b**,**d**,**f**,**h**) for 39 soil science journals according to the rankings of Journal Citation Report (JCR) Q1–Q4 indexed by the Web of Science.

3.3. Journal Impact Factor and CiteScore Trends

Although controversial, the 2-year IF (usually called IF), 5-year IF, and CiteScores of journals are considered to be key metrics used to assess the quality and influence of journals [56]. The first two metrics are based on the Web of Science, whereas CiteScore is based on the Scopus database [57–59]. CiteScore and IF have a strong positive correlation [60] because their calculation methods are very similar. A 2-year IF can be highly influenced by a few highly cited articles. In addition, the IF is also affected by the calculation method. For instance, citations of early-access articles were first counted for the IF released in 2022, which resulted in a significant IF increase for many of the journals [61]. A 5-year IF and CiteScore on the other hand are steadier compared to 2-year IF, which may indicate that a 5-year IF and CiteScore could be better indicators of a journal's impact [58]. The same was found in other disciplines such as hydrology [62].

Overall, metrics for all the journals showed an increasing trend (Figures 2–4), with Q1 journals growing faster (Figures 2a, 3a and 4a), indicating an increase in the overall quality of soil science journals. *Soil Biology and Biochemistry* ranked highest among the 39 journals for all three metrics over the 30-year period, followed by *Geoderma* (*GeoD*) and *Biology and Fertility of Soils* (*BFS*). Notably, the recently launched journals, *Biochar* (*BioC*), *International Soil and Water Conservation Research* (*ISWCR*), and *Soil* already attained high metrics in 2022.

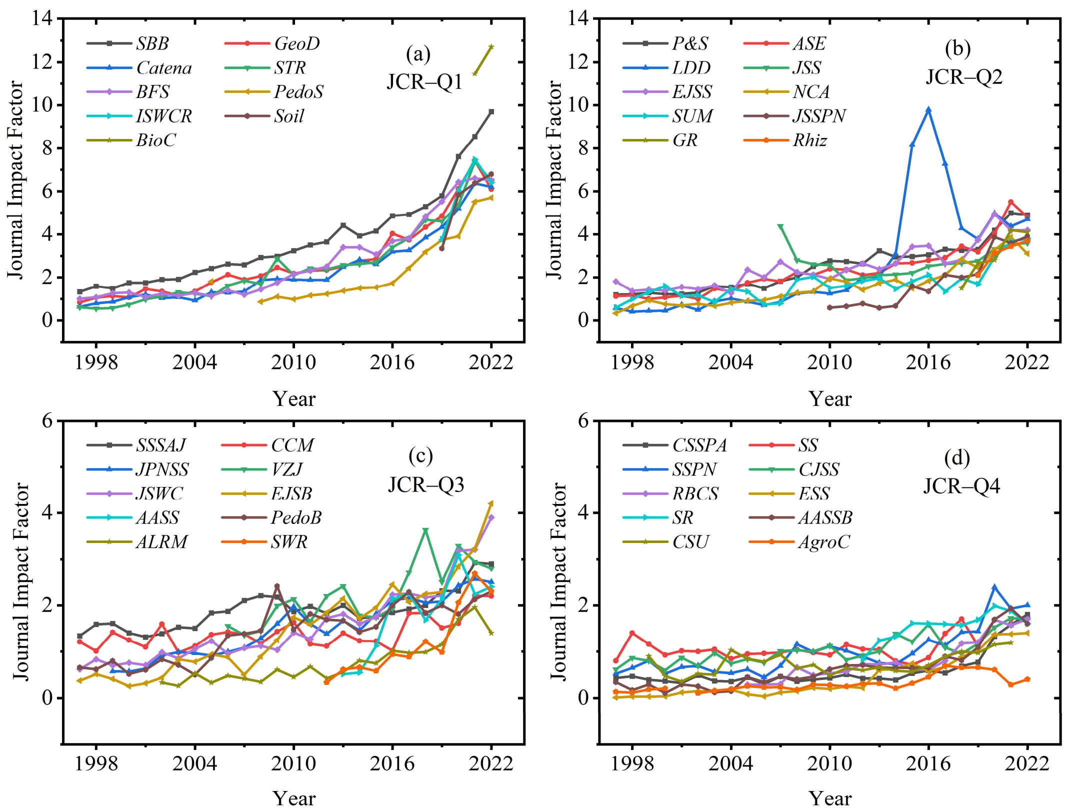

Figure 2. Annual trends in the impact factor (IF) of the 39 soil science journals with the ranks of Journal Citation Report (JCR) Q1–Q4 (**a**–**d**) indexed by the Web of Science.

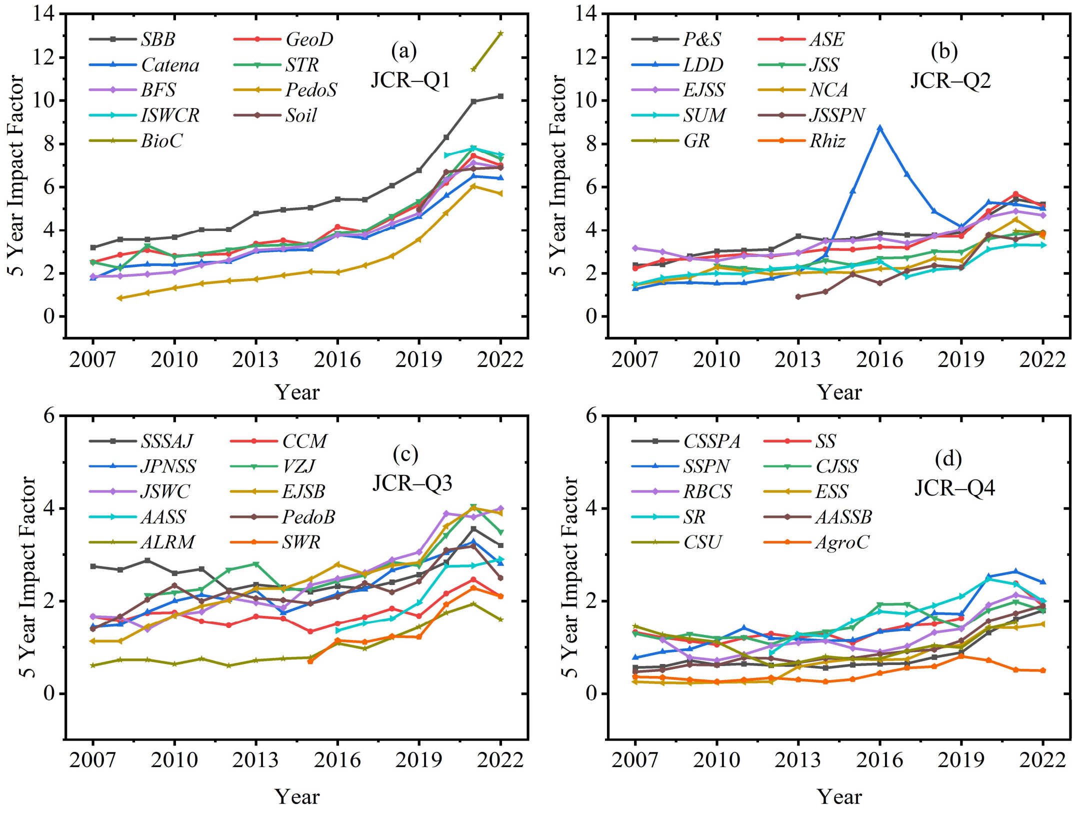

Figure 3. Annual 5-year impact factor (IF) trends of the 39 soil science journals with the ranks of Journal Citation Report (JCR) Q1–Q4 (**a**–**d**) indexed by the Web of Science.

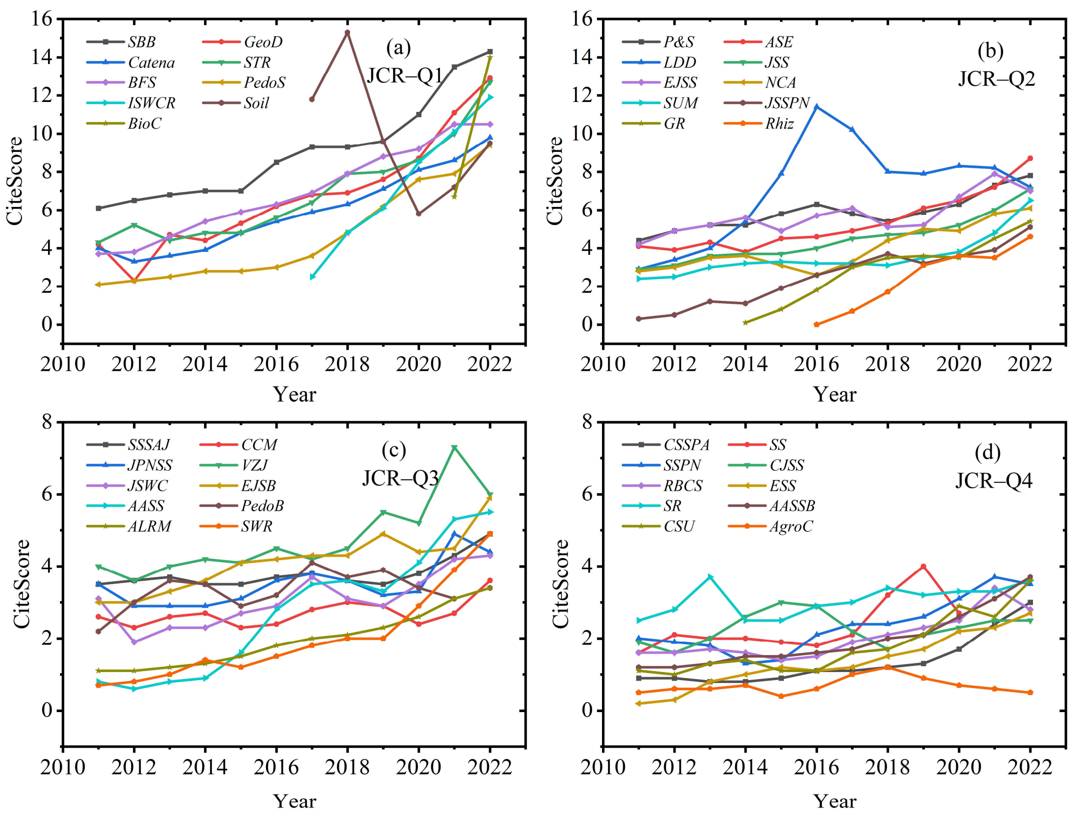

Figure 4. Annual CiteScore trends for the 39 soil science journals with the ranks of Journal Citation Report (JCR) Q1–Q4 (**a**–**d**) indexed by the Web of Science.

3.4. Bibliometric Analysis

3.4.1. Countries and Organizations

A total of 185 countries and 29,356 organizations published in the 39 soil science journals from 1992 to 2022. Among them, the USA had the greatest number of publications (22,243), followed by China (19,436), and Germany (9197) (Figure 5a). The three countries accounted for 45% of all publications in the 39 journals. Citation rankings for the top three highly cited countries were the same as those for publication volume, i.e., the USA (839,263 citations), China (454,932), and Germany (356,501) (Figure 5b). The per-article citation tally for the USA was almost double that for China and Germany, which to some extent may indicate that the USA is still the leader in soil science research. Although Vinkler [63] reported that that is no direct relationship between gross domestic product (GDP) and the information production of countries, but it is assumed that bigger economies like the USA, China, and Germany can afford to spend more on scientific research compared to other small economies.

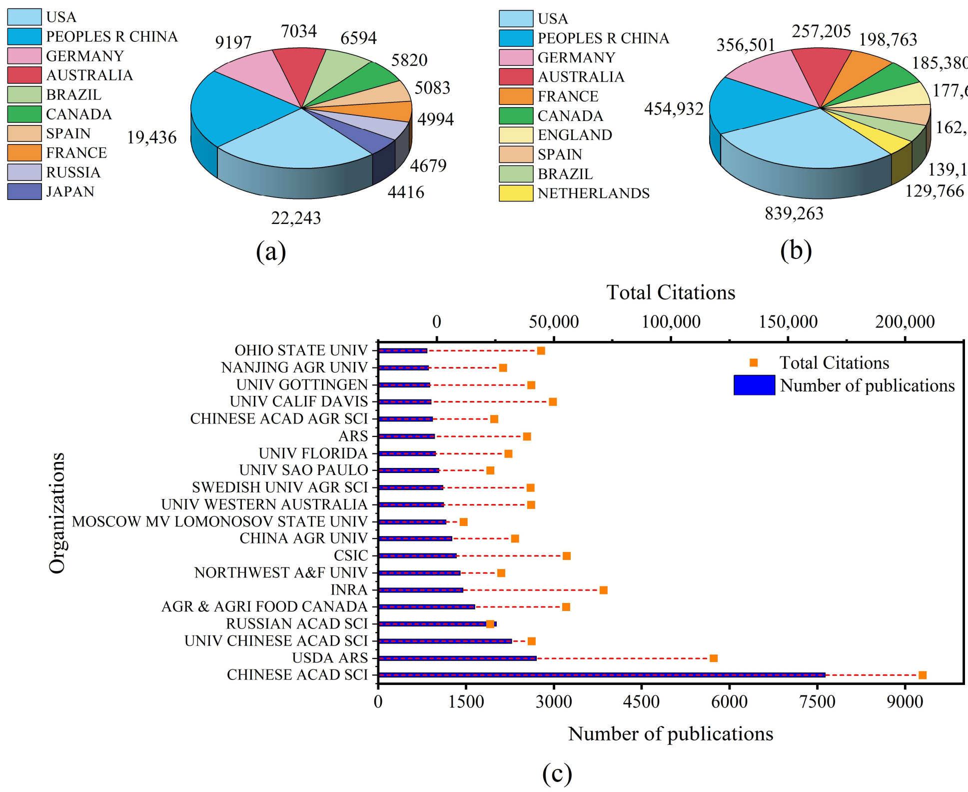

Figure 5. Number of publications by countries and organizations: (**a**) top 10 countries based on number of publications; (**b**) top 10 countries based on total citations; and (**c**) top 20 organizations based on the number of publications and citations, where the blue boxes are the number of publications (top X-axis), and the orange boxes are the total citations (bottom X-axis).

The Chinese Academy of Sciences (CAS) was the most productive organization, contributing 7634 publications, followed by the United States Department of Agriculture–Agricultural Research Service (USDA-ARS, 2703) and the University of Chinese Academy of Science (UCAS, 2281), which is part of CAS. CAS and USDA-ARS also gained the most total citations (Figure 5c), while Institut National de la Recherche Agronomique (INRA) ranked third in total citations and sixth in publication volume. The total citations of publishing organizations are positively related to the number of publications, so it is difficult to truly and objectively assess the research impact of the publishing organizations. The number of citations per publication is more reasonable than the total number of publications and citations. Among the 20 organizations, The University of California, Davis had the greatest number of citations per publication at 54.8.

More frequent international collaborations between countries and organizations are also evident (Figure 6). The USA and Germany remained the leaders in soil science research as they collaborated with the most countries, while researchers from China and the USA had the strongest ties with the largest number of co-authored publications (Figure 6a). The eight cooperation networks of organizations, indicated by eight colored clusters in Figure 6, show strong zonality, which indicates that collaborations with organizations from the same countries remained prevalent (Figure 6b).

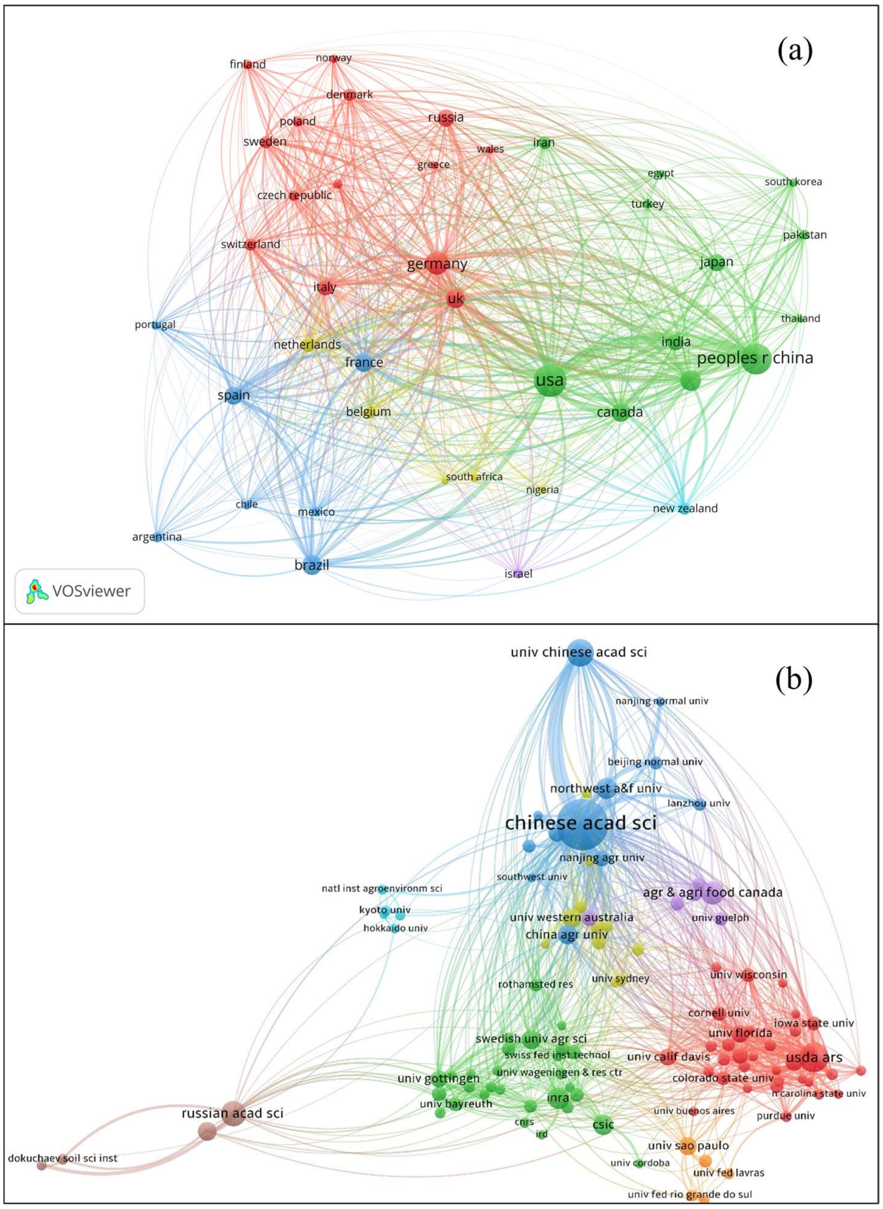

Figure 6. Cooperation networks of countries (**a**) and organizations (**b**). Using a full count in VOSviewer, each publication is restricted to a maximum of 25 countries or organizations, and each country and organization is restricted to a minimum number of 500 and 300 publications, respectively, with a total of 42 countries and 107 organizations eligible. Countries or organizations in a collaborative network are linked based on the number of co-published articles. The size of the circles and fonts reflects the number of publications, and the thickness of the connecting lines indicates the strength of cooperation. Some fonts are not shown in the figure due to overlapping labels.

3.4.2. Co-Authorship and Most Influential Publications

Out of a total of 206,161 authors, 202 published over 50 papers each. The largest linked project consisted of 150 authors (Figure 7). Each colored cluster in Figure 7 represents a group of soil scientists from similar research fields who had strong collaborations. Yakov Kuzyakov, Rattan Lal, and Qirong Shen were among the leading figures of different research groups. The authors of the green cluster represented by Dr. Rattan Lal (the Ohio State University) mainly focused on soil ecology, soil fertility, land degradation, and soil erosion [64–66]. The authors represented by Dr. Qirong Shen (Nanjing Agricultural University) in the red cluster had soil biology, fertilizers, composting, and soil fertility as their main focal areas [67–69]. The blue cluster, represented by Dr. Petra Marschner (University of Adelaide), had research interests in soil environment, rhizosphere, phosphorus, and nutrient analysis [70–72]. In the brown cluster, researchers represented by Dr. Yakov Kuzyakov (Georg-August University Gottingen) worked mostly on soil microorganisms, nutrient cycling, greenhouse gases, and litter decomposition [73–75]. The cyan cluster, represented by Dr. Robert Horton (Iowa State University) and Dr. Tusheng Ren (China Agricultural University), among others, had research interests mainly in soil physics, soil thermal properties, and the coupling of soil water and heat transport [27,28,76–79]. The yellow and purple clusters represented by Dr. Rainer Horn (Kiel University) and Dr. Davey L. Jones (Murdoch University), respectively, were associated with research interests in hydrology, hydraulics, hydrological modeling, and soil conservation [80–82], and as carbon cycling, soil inter-root biology, and isotope labeling, respectively [83–85].

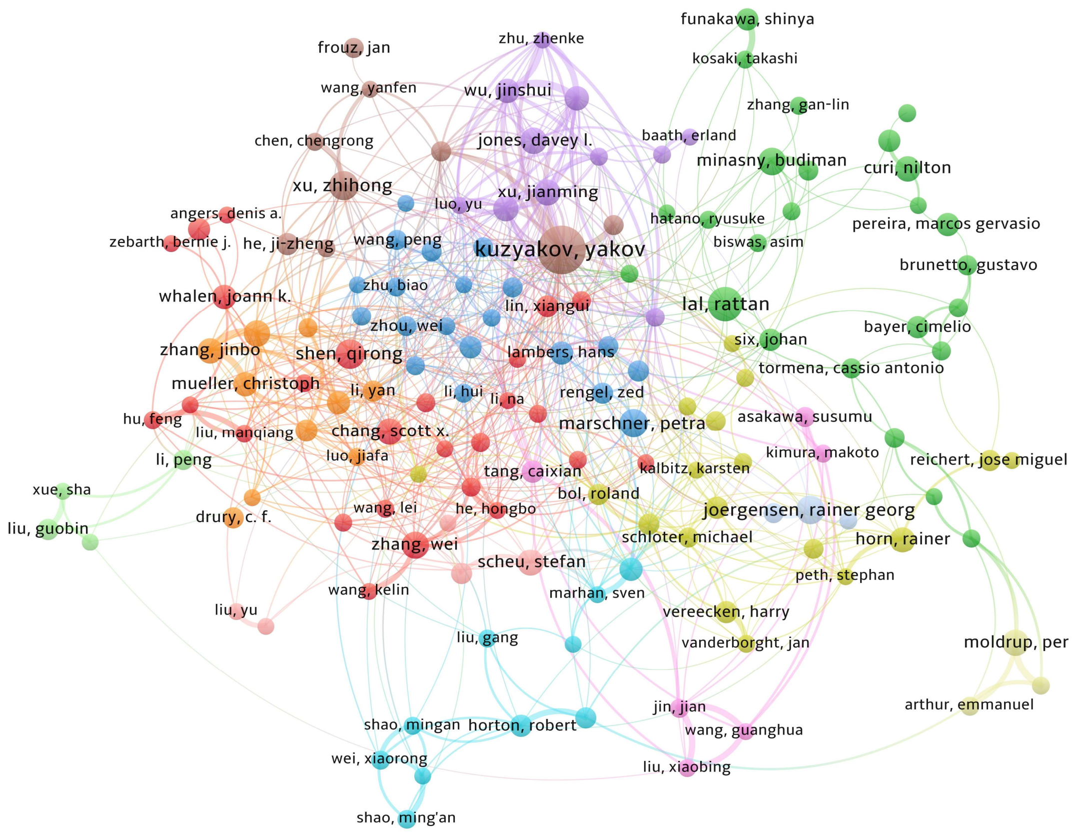

Figure 7. Co-authorship network map. The full counting method was selected in VOSviewer. Each publication is limited to a maximum of 25 authors, and each author is limited to a minimum of 50 publications; a total of 202 soil scientists met this threshold. Authors are linked according to the number of joint publications. The largest connection item consists of 150 authors (some author names are not shown in the figure due to overlapping labels). The size of circles and fonts reflects the number of publications, and the thickness of connecting lines indicates the strength of cooperation.

Dr. Yakov Kuzyakov had the most publications in the 39 soil science journals from 1992 to 2022 and also garnered the most total citations. Sixteen of his 400+ articles were among the most highly cited publications. Dr. Rattan Lal (359) and Dr. Davey L. Jones (233) ranked second and third, respectively, in the number of publications, of which five and eight, respectively, were among the most highly cited papers. The publication with the most total citations (2765) was a review paper authored by Lehmann et al. [86] and published in *Soil Biology and Biochemistry* (*SBB*) (Table 3). Lehmann, Rillig, Thies, Masiello, Hockaday, and Crowley [86] mainly discussed the influence of biochar on soil microorganisms, animals, and plants; studied the relationship between biochar characteristics and biological reactions; and discussed the influence of biochar on biogeochemical processes in soil. Six et al. [87] was the most locally cited paper (1198 citations) during the 30-year period. Six, Bossuyt, Degryze, and Denef [87] reviewed the research on the relationship between soil (micro)aggregates, soil biota, and soil organic matter dynamics; described the development history of relevant theories; and clarified the influence and interaction of major factors. Other highly cited articles focused mainly on the turnover and stabilization mechanisms of soil organic matter [66,73,88–95], soil structure [96,97], physical and chemical properties [98–105], soil carbon and total nitrogen [106–108], soil carbon sequestration [109–113], digital soil mapping [114], soil microorganisms [115–122], soil enzymes [123,124], soil rhizosphere [125–127], biochar [128–130], methane [131], and soil zinc [132]. Soil carbon, both organic and inorganic, plays a critical role in restoring soil carbon sink and preventing carbon dioxide emissions that contribute to climate change mitigation. Soil carbon studies, especially soil organic carbon (SOC, mostly related to soil organic matter, humus, microbial biomass, etc.), have, therefore, been the hotspot in soil science, because the protection of and increase in SOC storage can (1) maintain or increase soil fertility, which increases crop growth and productivity; (2) increase soil's water-holding capacity and infiltration while reducing soil erosion; and (3) increase resilience to climate change and extremes, which are all in line with the goals of United Nations Sustainable Development, the United Nations Framework Convention on Climate Change, and the United Nations Convention on Combating Desertification [133].

Table 3. Top 50 most cited publications $^{+}$.

Publication	Journal	DOI	TC	TC/Y	LC	LC/Y
Lehmann et al. (2011) [86]	*SBB*	10.1016/j.soilbio.2011.04.022	2765	230.42	655	54.58
Six et al. (2002) [66]	*P & S*	10.1023/A:1016125726789	2590	123.33	1191	56.71
Bronick and Lal (2005) [96]	*GeoD*	10.1016/j.geoderma.2004.03.005	2354	130.78	1078	59.89
Batjes (2014) [106]	*EJSS*	10.1111/ejss.12114_2	2290	254.44	1	0.11
Six et al. (2004) [87]	*STR*	10.1016/j.still.2004.03.008	2287	120.37	1198	63.05
Cambardella et al. (1994) [98]	*SSSAJ*	10.2136/sssaj1994.03615995005800050033x	2160	74.48	607	20.93
McBratney et al. (2003) [114]	*GeoD*	10.1016/S0016-7061(03)00223-4	1964	98.20	879	43.95
Lal [109]	*GeoD*	10.1016/j.geoderma.2004.01.032	1925	101.32	601	31.63
Six et al. (2000) [110]	*SBB*	10.1016/S0038-0717(00)00179-6	1864	81.04	1006	43.74
Kuzyakov et al. (2000) [73]	*SBB*	10.1016/S0038-0717(00)00084-5	1843	80.13	823	35.78
Frostegard and Baath (1996) [115]	*BFS*	10.1007/BF00384433	1834	67.93	819	30.33
von Lutzow et al. (2006) [88]	*EJSS*	10.1111/j.1365-2389.2006.00809.x	1781	104.76	787	46.29
Jones (1998) [125]	*P & S*	10.1023/A:1004356007312	1757	70.28	484	19.36
Cambardella and Elliott (1992) [89]	*SSSAJ*	10.2136/sssaj1992.03615995005600030017x	1689	54.48	955	30.81
Glaser et al. (2002) [99]	*BFS*	10.1007/s00374-002-0466-4	1673	79.67	446	21.24
Kalbitz et al. (2000) [90]	*SS*	10.1097/00010694-200004000-00001	1644	71.48	506	22.00
Vessey (2003) [126]	*P & S*	10.1023/A:1026037216893	1569	78.45	184	9.20
Hinsinger (2001) [127]	*P & S*	10.1023/A:1013351617532	1511	68.68	491	22.32
West and Post (2002) [111]	*SSSAJ*	10.2136/sssaj2002.1930	1495	71.19	553	26.33
Zelles (1999) [116]	*BFS*	10.1007/s003740050533	1489	62.04	633	26.38
Saxton and Rawls (2006) [100]	*SSSAJ*	10.2136/sssaj2005.0117	1441	84.76	191	11.24
Kirschbaum (1995) [107]	*SBB*	10.1016/0038-0717(94)00242-S	1407	50.25	385	13.75
Giller et al. (1998) [117]	*SBB*	10.1016/S0038-0717(97)00270-8	1386	55.44	262	10.48
Atkinson et al. (2010) [128]	*P & S*	10.1007/s11104-010-0464-5	1333	102.54	334	25.69

Table 3. *Cont.*

Publication	Journal	DOI	TC	TC/Y	LC	LC/Y
Rossel et al. (2006) [101]	*GeoD*	10.1016/j.geoderma.2005.03.007	1332	78.35	517	30.41
Nannipieri et al. (2003) [118]	*EJSS*	10.1046/j.1351-0754.2003.0556.x	1331	66.55	456	22.80
Liang et al. (2006) [102]	*SSSAJ*	10.2136/sssaj2005.0383	1330	78.24	318	18.71
Wrage et al. (2001) [108]	*SBB*	10.1016/S0038-0717(01)00096-7	1282	58.27	316	14.36
Chang et al. (2001) [103]	*SSSAJ*	10.2136/sssaj2001.652480x	1281	58.23	426	19.36
Le Mer and Roger (2001) [131]	*EJSB*	10.1016/S1164-5563(01)01067-6	1265	57.50	230	10.45
Westoby (1998) [134]	*P & S*	10.1023/A:1004327224729	1248	49.92	19	0.76
Kogel-Knabner (2002) [91]	*SBB*	10.1016/S0038-0717(01)00158-4	1228	58.48	470	22.38
Lehmann et al. (2003) [104]	*P & S*	10.1023/A:1022833116184	1217	60.85	319	15.95
Kuzyakov (2010) [92]	*SBB*	10.1016/j.soilbio.2010.04.003	1178	90.62	482	37.08
Fierer et al. (2003) [119]	*SBB*	10.1016/S0038-0717(02)00251-1	1170	58.50	471	23.55
Cakmak (2008) [132]	*P & S*	10.1007/s11104-007-9466-3	1150	76.67	185	12.33
Rasse et al. (2005) [113]	*P & S*	10.1007/s11104-004-0907-y	1150	63.89	442	24.56
Six et al. (2006) [112]	*SSSAJ*	10.2136/sssaj2004.0347	1147	67.47	509	29.94
Chan et al. (2007) [130]	*SR*	10.1071/SR07109	1139	71.19	265	16.56
Van Zwieten et al. (2010) [129]	*P & S*	10.1007/s11104-009-0050-x	1139	87.62	266	20.46
Six et al. (1998) [93]	*SSSAJ*	10.2136/sssaj1998.03615995006200050032x	1126	45.04	642	25.68
Lauber et al. (2008) [120]	*SBB*	10.1016/j.soilbio.2008.05.021	1123	74.87	324	21.60
Burns et al. (2013) [123]	*SBB*	10.1016/j.soilbio.2012.11.009	1117	111.70	438	43.80
Hamza and Anderson (2005) [97]	*STR*	10.1016/j.still.2004.08.009	1104	61.33	404	22.44
Saiya-Cork et al. (2002) [124]	*SBB*	10.1016/S0038-0717(02)00074-3	1087	51.76	434	20.67
Compant et al. (2010) [121]	*SBB*	10.1016/j.soilbio.2009.11.024	1079	83.00	112	8.62
Fontaine et al. (2003) [94]	*SBB*	10.1016/S0038-0717(03)00123-8	1074	53.70	507	25.35
Frostegard et al. (1993b) [125]	*SBB*	10.1016/0038-0717(93)90113-P	1072	35.73	540	18.00
Vonuexkull and Mutert (1995) [105]	*P & S*	10.1007/BF00009558	1051	37.54	190	6.79
Sollins et al. (1996) [95]	*GeoD*	10.1016/S0016-7061(96)00036-5	1047	38.78	463	17.15

+ DOI, digital object unique identifier; TC, global total citations; LC, local total citations; Y, year of publication.

Based on the statistics from the Web of Science, there were 624 highly cited papers and 10 hot papers in soil science journals as of 20 July 2023. Q1 journals published the majority of highly cited and hot papers, with *Soil Biology and Biochemistry* (*SBB*) and *Catena* ranking highest in both categories (Figure 8). It is also noteworthy that *Plant and Soil* (*P & S*) had more highly cited articles compared to all the other Q2–Q4 journals.

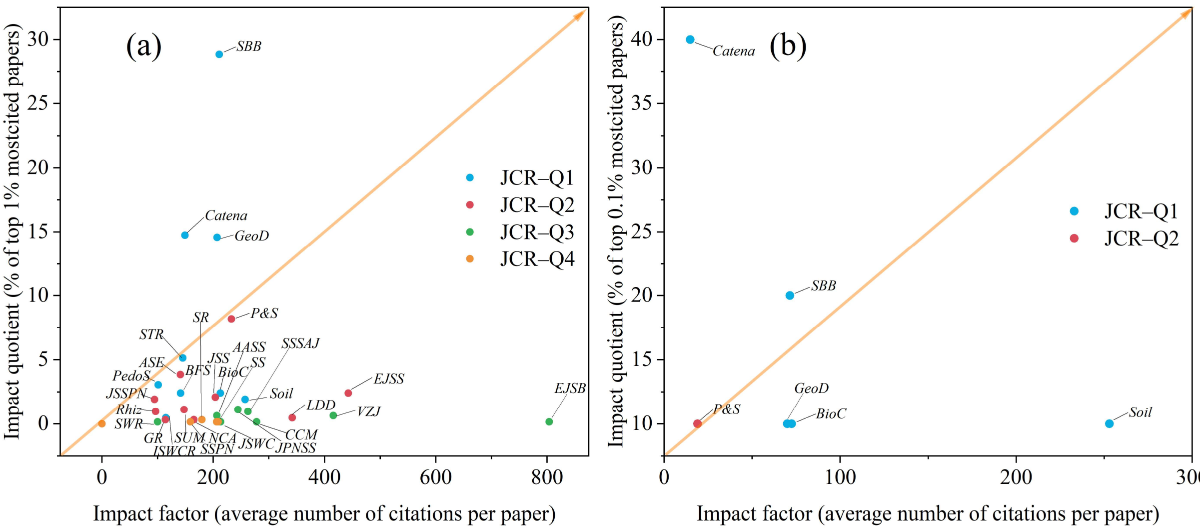

Figure 8. Journal distribution of (**a**) highly cited (top 1%) and (**b**) hot (top 0.1%) papers. Note: The X-axis is the average number of citations per highly cited/hot paper in each soil science journal based on Web of Science data, and the Y-axis is the percentage of highly cited/hot papers in each journal relative to the total number of highly cited/hot papers.

3.4.3. Co-Authorship and Most Influential Publications

From 1992 to 2022, all publications in the 39 journals contributed 160,449 keywords in the titles, abstracts, and keyword lists, of which 149 had a frequency of more than 1000

(Figure 9). These keywords consisted of five major clusters/fields, with yellow representing soil microbiology and biogeochemistry disciplines as indicated by "biodiversity" and "community structure" of "microbial community" (e.g., "fungi" and "bacteria") in the "rhizosphere" and "colonization" relationship with "root". The green cluster refers to soil chemistry, with a focus on "kinetics"/"adsorption"/"resistance" to "heavy metals" (e.g., "cadmium", "zinc", and "copper"), salinity, and phosphorus and their effects on "plant", "growth" (e.g., "wheat", "rice", and "maize"). The red cluster is related to soil management and conservation and soil physics, "land use", "management" or "tillage" effects on "physical properties" and "transport" processes, including "aggregate stability", "runoff", "infiltration", "erosion", and "model". The blue cluster represents soil nutrients, with research investigating soil carbon and "nitrogen", "turnover", "dynamics", or cycling, including "microbial biomass", "soil organic matter", "decomposition", "carbon sequestration", and "temperature" effects. These areas are related to soil "degradation", and strategies related to "biochar" and "fertilization" are usually adopted to solve these challenges.

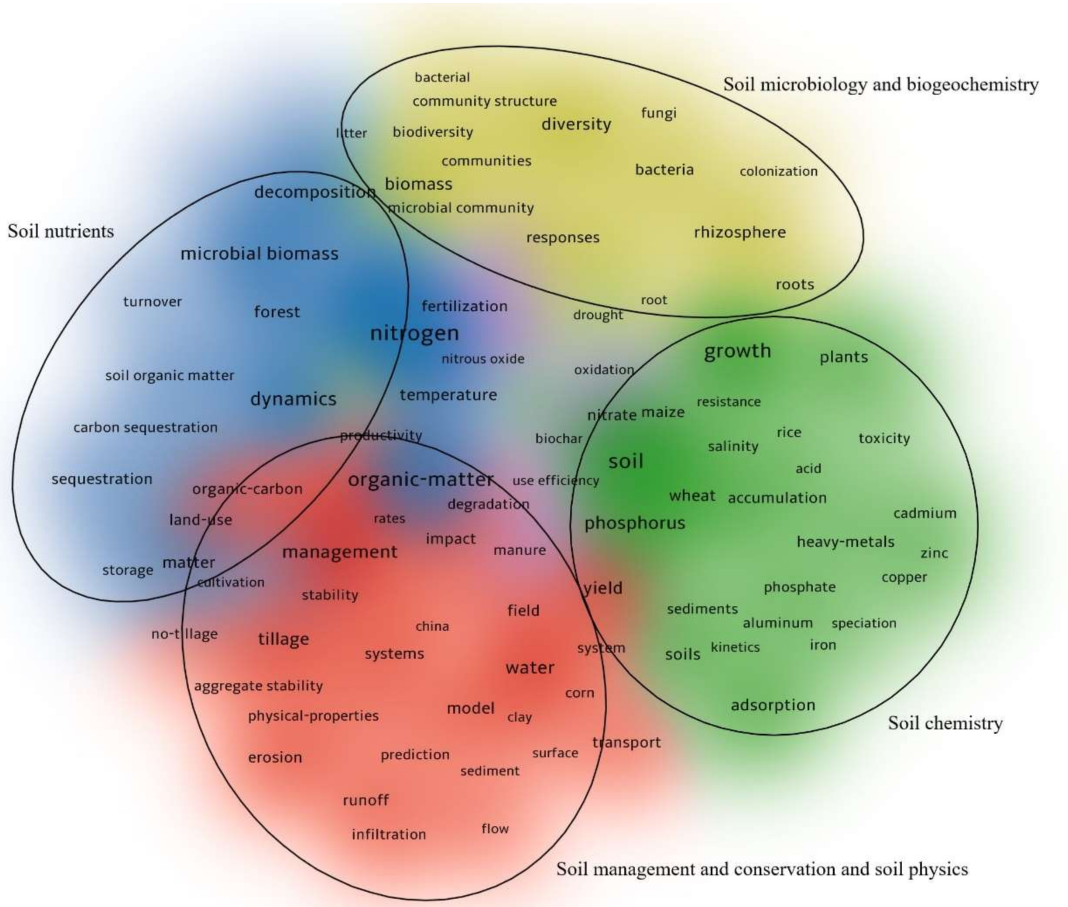

Figure 9. Density visualization of keyword co-occurrence. A total of 149 keywords had frequencies of $\geq$1000. A larger font size indicates a greater total link strength and a closer distance between keywords indicates greater relevance of the topic. Each point on the map has a color depicting the density of the surrounding elements: the greater the density, the more intense the color.

However, the research hotspots and trends may change over time (Table 4). The keywords with the strongest intensity of the early outbreaks were "aluminum" (strength of 263.34, duration of 1992–2005); "soil" (strength of 223.71, duration of 1992–2000); "nitrogen fixation" (strength of 214.72, duration of 1992–2003); "extraction" (strength of 258.23, duration of 1992–2009); "nitrification" (strength of 200.12, duration of 1992–2006); "nitrogen mineralization” (strength of 216.23, duration of 1994–2011); and “population” (strength of 217.24, duration of 1995–2010), suggesting that researchers at the time were more concerned with issues relating to soil fertility and the population. In the 21st century, the keywords “climate change” (strength of 242.51, duration of 2016–2022); “microbial community” (strength of 184.58, duration of 2016–2022); “loess plateau” (strength of 265.78, duration of 2017–2022); “bacterial community” (strength of 229.87, duration of 2017–2022); and “use efficiency” (strength of 184.81, duration of 2019–2022) are gradually becoming new research hotspots. He et al. [40] also noted a significant increase in the frequency of the keywords “loess plateau” and “climate change” since 2015 through a bibliometric analysis.

Table 4. Top 100 keywords with the strongest citation bursts $^{+}$.

Keywords	Year	Strength	Begin	End	1992–2022
aluminum	1992	263.34	1992	2005	
soil	1992	223.71	1992	2000	
nitrogen fixation	1992	214.72	1992	2003	
extraction	1992	258.23	1992	2009	
nitrification	1992	200.12	1992	2006	
denitrification	1992	149.81	1992	2009	
nitrate	1992	139.23	1992	2006	
pH	1992	114.67	1992	2005	
ammonium	1992	111.07	1992	2000	
clay	1992	90.99	1992	1997	
seedling	1992	87.39	1992	1999	
N 15	1992	81.14	1992	1997	
bacteria	1992	80.3	1992	2002	
adsorption	1992	61.62	1992	2003	
barley	1992	52.24	1992	1997	
calcium	1992	42.78	1992	1996	
nodulation	1992	42.56	1992	1995	
infection	1992	41.75	1992	1996	
fungi	1992	39.97	1992	1996	
nutrition	1992	39.08	1992	1995	
fixation	1992	37.52	1992	1994	
wheat	1992	29.91	1992	1995	
litter	1993	101.11	1993	2001	
winter wheat	1993	43.78	1993	1998	
movement	1993	37.08	1993	1995	
acid soil	1993	26.22	1993	1995	
manganese	1993	22.74	1993	1994	
nitrogen mineralization	1992	216.23	1994	2011	
oxide	1994	26.07	1994	1996	
systems	1994	27.24	1994	2013	
population	1992	217.24	1995	2010	
zinc	1992	151.25	1995	2010	
rotation	1995	44.19	1995	1999	
chemistry	1995	26.8	1995	2000	
dissolution	1995	25.91	1995	1996	
pasture	1996	48.73	1996	2000	
transformation	1992	150.94	1997	2007	
extraction method	1997	47.29	1997	2001	
oxidation	1997	29.07	1997	1998	
field	1992	25.8	1998	2000	
sorption	1992	100.27	1999	2008	
humic substance	1993	36.25	1999	2000	
loess	2000	73	2000	2003	
surface	1992	34.42	2000	2001	
iron	1992	78.04	2001	2005	
rate	1992	65.23	2001	2004	
kinetics	1992	31.24	2001	2002	

Table 4. *Cont.*

Keywords	Year	Strength	Begin	End	1992–2022
copper	1992	67.71	2002	2005	
toxicity	1992	100.52	2003	2007	
release	1993	34.44	2003	2004	
cultivation	1992	28.61	2003	2004	
grassland	2004	24.37	2004	2013	
infiltration	1992	107.19	2004	2011	
turnover	1992	66.38	2005	2007	
corn	1992	50.36	2005	2007	
carbon dioxide	2001	108.17	2006	2010	
residue	1996	58.19	2006	2007	
sewage sludge	1992	44.82	2006	2007	
manure	2004	128.74	2008	2017	
acid	1992	48.05	2008	2009	
spatial variability	2003	72.7	2009	2011	
water content	2000	52.45	2009	2010	
cadmium	1996	40.61	2010	2011	
no tillage	2007	148.31	2011	2016	
carbon sequestration	2009	67.83	2011	2022	
flow	1992	41.29	2011	2012	
hydraulic conductivity	1992	23.87	2011	2013	
nitrous oxide	1996	42.59	2012	2015	
plant growth	2010	95.38	2014	2022	
emission	1997	63.31	2014	2015	
productivity	2010	95.65	2015	2022	
moisture	1996	93.37	2015	2020	
arbuscular mycorrhizal fungi	2005	81.7	2015	2017	
climate change	2010	242.51	2016	2022	
microbial community	2005	184.58	2016	2022	
biodiversity	2008	110.87	2016	2022	
land use change	2016	77.07	2016	2017	
crop	1992	39.27	2016	2019	
soil erosion	1998	26.08	2016	2018	
loess plateau	2017	265.78	2017	2022	
bacterial community	2017	229.87	2017	2022	
amendment	2015	118.07	2017	2019	
china	2017	103.43	2017	2018	
climate	2013	180.11	2018	2022	
prediction	2014	152.55	2018	2022	
organic carbon	1995	145.27	2018	2022	
community structure	2008	76.06	2018	2022	
storage	2008	69.09	2018	2019	
aggregate stability	2001	56.62	2018	2019	
maize	1993	29.46	2018	2019	
use efficiency	2019	184.81	2019	2022	
impact	2002	136.36	2019	2022	
stabilization	2014	81.88	2019	2020	
response	1998	71.46	2019	2022	
abundance	2017	139.99	2019	2022	
enzyme activity	1999	49.54	2019	2022	
bacterial	2020	176.55	2020	2022	
diversity	1999	96.31	2020	2022	
N_2O emission	2020	93.46	2020	2022	
soil property	2009	89.86	2020	2022	
agricultural soil	2008	67.93	2020	2022	

+ In the CiteSpace software, the top 80 levels of the most cited or occurring items were selected from each time slice (one year). Year indicates the year when the keyword first appeared, Begin and End indicate the starting and ending years of the citation burst for the keyword, respectively, and Strength indicates the emergence intensity. The red line represents the specific epochal stage when the keyword became a hotspot for academic research, light blue indicates that the node of the citation burst has not yet appeared, and dark blue indicates that the node has started to appear.

Soil is a natural "medium" for the growth and reproduction of microorganisms. The study of microbial communities in soils has been a hot research topic in recent years. In addition, the development of molecular genetic methods and their application to soils have also been an important factor in driving these research topics. Understanding the factors that influence the structural and functional diversity of inter-root microbial communities is crucial for ecosystem function and nutrient cycling. In the early stages of soil science, farmland soil research dominated by soil fertility gradually developed into problem-oriented research with the ecological environment as the core, and there has been increasing interest in soil process research dominated by soil organisms.

3.5. Emerging Issues on Soil Science Publications

3.5.1. Research Performance Assessment in Countries and Organizations

In the context of today's research performance assessment, the evaluation of journal quality has become even more important [135]. Researchers need to know the rankings of journals in order to choose the top-ranked journals. Publishers and editors also pay attention to journal rankings because top journals are more likely to attract submissions from senior authors. Over many years, the IF has been the most commonly used metric for assessing the quality of journals, albeit with controversy [136]. The 5-year IF, CiteScore [137], H-index [138], Scimago Journal Rank (SJR) [139], Source Normalized Impact per Paper (SNIP) [140], Eigenfactor [141], Almetrics [142], and the Chinese Academy of Sciences quartiles (average three-year IF and divided journals into four quartiles, with Q1 occupied by top 5% journals, Q2 by 6–20%, Q3 by 21–50%, and Q4 by 51–100%) have been developed to give more reliable and stable journal metrics. These metrics take into account different factors and, therefore, have their own pros and cons; the singular use of any one as an assessment criterion would be controversial if universities, research institutes, and other organizations relied too much on these metrics to assess researchers' career development and grant applications, etc. As a result, there is a lack of a more recognized evaluation mechanism for assessing the quality of journals today. Related studies have shown that most metrics, while appearing to be highly correlated, can actually make a large difference in the ranking of journals and that none of the metrics so far is superior [135].

Therefore, the research community needs to recognize the limitations of these indicators and adopt a more diverse and integrated evaluation approach in order to assess the quality and impact of journals in a more comprehensive and unbiased way. The Declaration on Research Assessment (DORA) is an initiative that aims to improve the fairness and science of research assessment [143]. DORA emphasizes that assessment should be based on a variety of metrics and methodologies rather than relying solely on a single metric such as IF. It advocates a change in the culture of research assessment and encourages a more holistic and unbiased approach to evaluation. Ten years since its launch, DORA has become a global initiative covering all disciplines and all stakeholders [144]. DORA may be an effective solution to the current problem of assessing the quality of journals.

3.5.2. Equity, Diversity, and Inclusion

In addition to considering the country of origin and affiliations of authors, equity, diversity, and inclusion (EDI) are also important issues for scientific publications, contributing authors, reviewers, the journal editorial board, as well as journals and publishers. Previous studies have discussed EDI in soil science [145–147] and concluded that there was a persistent lack of EDI in soil science, including instances of racism [148] and a lack of gender equality [146].

In addition, APCs associated with the OA journals present inequities for researchers from underdeveloped countries or less funded scientists [149]; although, generally there is a special policy for them. The APC limits the accessibility and visibility of their research results by their research peers [150,151]. Publishers may charge significantly higher fees required to operate the OA journals and make profits because they do not pay extra to the authors, the editorial board, and reviewers. In addition, there is still a need to maintain subscription-mode journals so that researchers can make choices.

Moreover, peer review plays a key role in publications [152]. However, doubts about the objectivity, fairness, and integrity of the search for reviewers have made "peer review" controversial [153]. Therefore, EDI should be taken into account when seeking reviewers. On the other hand, journals have more difficulty in finding reviewers because most reviewers are volunteer reviewers and have a heavy workload [154], especially when the volume of submissions increased during and after the COVID-19 pandemic outbreak.

Furthermore, journals should also diversify their editorial board members by considering EDI [155]. Among the 39 soil science journals, only some journals from Elsevier give the gender ratio and country of origin of their editorial board members (Table 5). It can be seen that current soil science journals have realized the importance of EDI, but female scientists are still underrepresented [156], which may reflect the lower populations of female scientists engaged in soil science research and work [157]. In addition, editors are mainly from developed countries, and underdeveloped countries are underrepresented according to the Elsevier report.

Table 5. Gender and country composition of editorial board members of nine soil science journals published by Elsevier.

Journal Name	Abbrev.	Gender Diversity of Editors	Editorial Board by Country/Region
Soil Biology and Biochemistry	*SBB*	50% men; 50% women Data represent responses from 67% of 18 editors	95 members in 21 countries/regions
Geoderma	*GeoD*	63% men; 38% women Data represent responses from 83% of 29 editors	122 members in 25 countries/regions
Catena	*Catena*	67% men; 28% women; 6% prefer not to disclose Data represent responses from 82% of 22 editors	58 members in 20 countries/regions
Soil and Tillage Research	*STR*	86% men; 14% women Data represent responses from 70% of 10 editors	49 members in 21 countries/regions
Applied Soil Ecology	*ASE*	50% men; 50% women Data represent responses from 75% of 8 editors	65 members in 23 countries/regions
Rhizosphere	*Rhiz*	N/A †	40 members in 20 countries/regions
Geoderma Regional	*GR*	N/A	54 members in 26 countries/regions
European Journal of Soil Biology	*EJSB*	N/A	65 members in 21 countries/regions
Pedobiologia	*PedoB*	N/A	52 members in 18 countries/regions

† N/A indicates that no relevant data were found.

The 39 journals come from 15 different countries and are issued by 15 different publishers (Table 1). It is important to note that there is not an exact one-to-one correspondence between these publishers and countries, as journals from some countries do not necessarily choose their own publishers for distribution. The United States, The Netherlands, Germany, and England are the major research centers in the field of soil science, and they have founded two-thirds of the high-quality soil science journals. Elsevier (The Netherlands), Springer (Germany), and Wiley (USA) are the three most recognized international publishers in the field of soil science, with more than half of the journals published by them. They also promote the development and exchange of soil science research in different countries through international cooperation, academic exchanges, and peer review [158]. The impact of these factors on the authors' publications was not taken into account because information such as the gender and ethnicity of the authors could not be identified in all publications based on the Web of Science search, and the languages were all in English.

3.5.3. Artificial Intelligence-Based Research in Soil Science

Artificial intelligence (AI), including machine learning (ML) and deep learning, has rapidly increased its application in various scientific fields over the past decade [159]. A total of 680 articles related to AI were found in the 39 soil science journals over the past three decades and it shows a significant increasing trend in the number of publications, especially in the last decade (Figure 10). With the rapid development of AI, we can foresee its great potential and importance in solving soil-related questions pertaining to soil management [160], digital soil mapping [161], predicting soil quality [162], assessing soil contamination, and optimizing agricultural production [163]. Researchers are able to utilize large amounts of soil data and models to make soil management decisions, solve soil-related problems, and improve the accuracy of agricultural production and soil quality assessments, for example, with AI. It is expected that the future may see more applications of AI in the field of soil science.

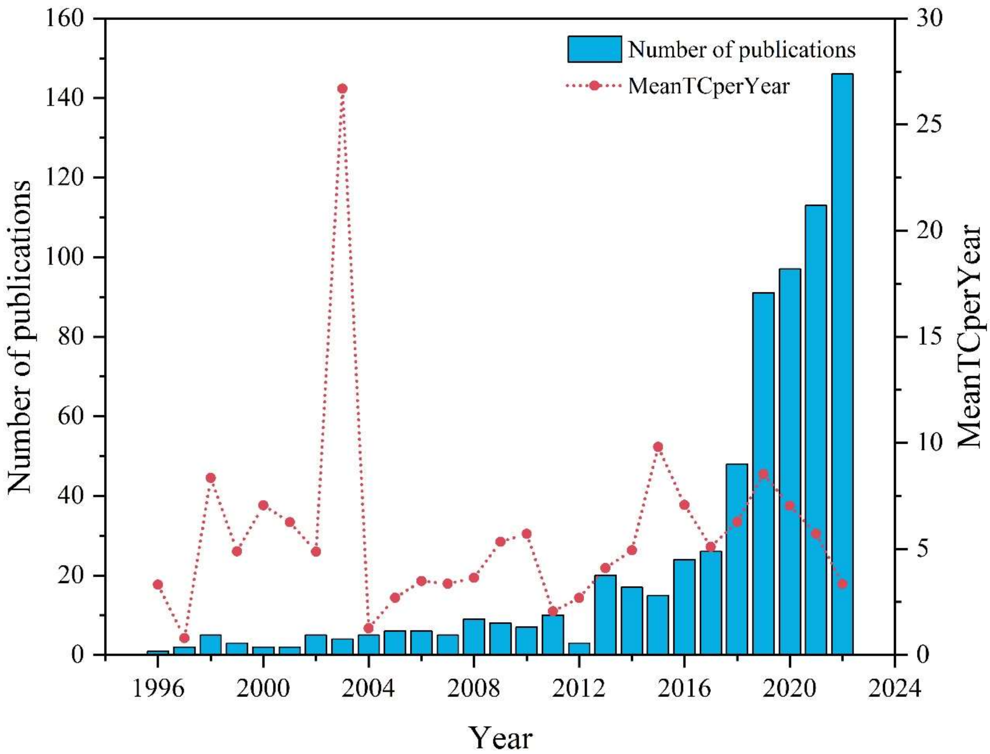

Figure 10. Annual trends in the number of publications and average citation frequency per article (MeanTCperYear) about artificial Intelligence (AI) and machine learning (ML) in 39 soil science journals.

Traditionally, non-English-speaking authors would turn to language editing services or academic writing tools and applications to refine scientific presentation or proofreading [164]. However, these services are usually expensive. AI-based writing tools (e.g., ChatGPT, GPT4, LLaMA series, ChatGLM series, PaLM series, Gemini, AlphaGo, Inflection, and Falcon) can facilitate scientific writing [165,166] but it is important to note that AI-based tools should not replace real authors or human creativity. As a result, journals such as *Nature and Science* have banned the inclusion of these AI tools as co-authors or their direct use for generating papers or assignments [167].

4. Conclusions and Perspectives

We performed a scientometric analysis of 39 soil science journals with 112,911 relevant publications from 1992 to 2022 archived in the Web of Science Core Collection to reveal the developmental history and research trends of soil science. The results showed an increase in high-quality publication volume and citations for Q1 and Q2 journals of the 2022 Journal Citation Report, while there was a decreasing trend for publication volume for Q3 and Q4 journals, although the cumulative citations were increasing. Journals operating under the open-access model are increasing, but journals should provide authors with the option to publish their work for free (subscription mode) in order to reduce the financial burden on authors with limited funding. Single journal metrics may not well represent a journal's quality and impact, and more comprehensive assessment measures, such as the Declaration on Research Assessment (DORA) are encouraged. The USA and Germany are the research leaders for soil science, together with China contributing 45% of the publications. Collaborations in soil science also increased but mainly remained intranational or intracontinental, although international collaborations are also booming. We identified the most productive contributors (i.e., authors, organizations, and countries), 50 highly cited papers, five major research areas, and the research trends over the past 30 years based on a keyword analysis. It is also suggested that Journals, publishers, editorial boards, and reviewers should give due consideration to equity, diversity, and inclusion.

Author Contributions: Conceptualization, H.H. and L.J.; methodology, L.J.; software, L.J.; validation, W.W., H.H. and F.Z.; data curation, W.W.; writing—original draft preparation, L.J.; writing—review and editing, L.J., H.H. and F.Z.; visualization, L.J.; supervision, H.H. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Data Availability Statement: The datasets used or analyzed during the current study are available from the corresponding author upon reasonable request.

Acknowledgments: The authors thank Jiahui Yang for the advice and help given with writing and graphing. The authors also greatly appreciate the valuable and insightful comments by the editor and anonymous reviewers.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Abrahams, P.W. Soils: Their implications to human health. *Sci. Total Environ.* **2002**, *291*, 1–32. [CrossRef] [PubMed]
2. Totsche, K.U.; Amelung, W.; Gerzabek, M.H.; Guggenberger, G.; Klumpp, E.; Knief, C.; Lehndorff, E.; Mikutta, R.; Peth, S.; Prechtel, A.; et al. Microaggregates in soils. *J. Plant Nutr. Soil Sci.* **2018**, *181*, 104–136. [CrossRef]
3. Young, I.M.; Crawford, J.W. Interactions and Self-Organization in the Soil-Microbe Complex. *Science* **2004**, *304*, 1634–1637. [CrossRef]
4. Pronk, G.J.; Heister, K.; Vogel, C.; Babin, D.; Bachmann, J.; Ding, G.-C.; Ditterich, F.; Gerzabek, M.H.; Giebler, J.; Hemkemeyer, M.; et al. Interaction of minerals, organic matter, and microorganisms during biogeochemical interface formation as shown by a series of artificial soil experiments. *Biol. Fertil. Soils* **2017**, *53*, 9–22. [CrossRef]
5. Andrea, F.; Bini, C.; Amaducci, S. Soil and ecosystem services: Current knowledge and evidences from Italian case studies. *Appl. Soil Ecol.* **2018**, *123*, 693–698. [CrossRef]
6. Doula, M.K.; Sarris, A. Chapter 4—Soil Environment. In *Environment and Development*; Poulopoulos, S.G., Inglezakis, V.J., Eds.; Elsevier: Amsterdam, The Netherlands, 2016; pp. 213–286.
7. Wilding, L.P.; Lin, H. Advancing the frontiers of soil science towards a geoscience. *Geoderma* **2006**, *131*, 257–274. [CrossRef]
8. van Baren, H.; Hartemink, A.E.; Tinker, P.B. 75 years The International Society of Soil Science. *Geoderma* **2000**, *96*, 1–18. [CrossRef]
9. Hartemink, A.E.; McBratney, A.B.; Cattle, J.A. Developments and trends in soil science: 100 volumes of Geoderma (1967–2001). *Geoderma* **2001**, *100*, 217–268. [CrossRef]
10. Tinker, P.B. Soil science in a changing world. *J. Soil Sci.* **1985**, *36*, 1–8. [CrossRef]
11. Brevik, E.C.; Hartemink, A.E. Early soil knowledge and the birth and development of soil science. *Catena* **2010**, *83*, 23–33. [CrossRef]
12. Rojas, R.V.; Caon, L. The international year of soils revisited: Promoting sustainable soil management beyond 2015. *Environ. Earth Sci.* **2016**, *75*, 1184. [CrossRef]
13. Brevik, E.C.; Calzolari, C.; Miller, B.A.; Pereira, P.; Kabala, C.; Baumgarten, A.; Jordán, A. Soil mapping, classification, and pedologic modeling: History and future directions. *Geoderma* **2016**, *264*, 256–274. [CrossRef]
14. Landa, E.R.; Brevik, E.C. Soil science and its interface with the history of geology community. *Earth Sci. Hist.* **2015**, *34*, 296–309. [CrossRef]
15. Hartemink, A.E.; McBratney, A. A soil science renaissance. *Geoderma* **2008**, *148*, 123–129. [CrossRef]

16. Minasny, B.; Hartemink, A.E.; McBratney, A. Individual, country, and journal self-citation in soil science. *Geoderma* **2010**, *155*, 434–438. [CrossRef]
17. Hartemink, A.E. Open access publishing and soil science—Trends and developments. *Geoderma Reg.* **2019**, *18*, e00231. [CrossRef]
18. Liu, Y.; Wu, K.; Zhao, R. Bibliometric analysis of research on soil health from 1999 to 2018. *J. Soils Sediments* **2020**, *20*, 1513–1525. [CrossRef]
19. Zhang, D.; Dyck, M.; Filipović, L.; Filipović, V.; Lv, J.; He, H. Hyperaccumulators for Potentially Toxic Elements: A Scientometric Analysis. *Agronomy* **2021**, *11*, 1729. [CrossRef]
20. Pan, X.Y.; Lv, J.L.; Dyck, M.; He, H.L. Bibliometric Analysis of Soil Nutrient Research between 1992 and 2020. *Agriculture* **2021**, *11*, 223. [CrossRef]
21. He, D.; Bristow, K.; Filipović, V.; Lv, J.; He, H. Microplastics in Terrestrial Ecosystems: A Scientometric Analysis. *Sustainability* **2020**, *12*, 8739. [CrossRef]
22. Oliveira, J.D.; Pereira, M.G. Global soil science research on drylands: An analysis of research evolution, collaboration, and trends. *J. Soils Sediments* **2021**, *21*, 3856–3867. [CrossRef]
23. Feng, S.N.; Zhang, H.; Lv, J.L.; Dyck, M.; Wu, Q.B.; He, H.L. A Scientometric Review of Research Status on Unfrozen Soil Water. *Water* **2021**, *13*, 708. [CrossRef]
24. Feng, S.; Chen, J.; Jones, S.B.; Flerchinger, G.; Dyck, M.; Filipovic, V.; Hu, Y.; Si, B.; Lv, J.; Wu, Q.; et al. Miscellaneous methods for determination of unfrozen water content in frozen soils. *J. Hydrol.* **2024**, *631*, 130802. [CrossRef]
25. Bezak, N.; Mikos, M.; Borrelli, P.; Alewell, C.; Alvarez, P.; Anache, J.A.A.; Baartman, J.; Ballabio, C.; Biddoccu, M.; Cerda, A.; et al. Soil erosion modelling: A bibliometric analysis. *Environ. Res.* **2021**, *197*, 111087. [CrossRef] [PubMed]
26. Zhang, H.; He, H.; Gao, Y.; Mady, A.; Filipović, V.; Dyck, M.; Lv, J.; Liu, Y. Applications of Computed Tomography (CT) in environmental soil and plant sciences. *Soil Tillage Res.* **2023**, *226*, 105574. [CrossRef]
27. He, H.; Dyck, M.F.; Horton, R.; Ren, T.; Bristow, K.L.; Lv, J.; Si, B. Development and Application of the Heat Pulse Method for Soil Physical Measurements. *Rev. Geophys.* **2018**, *56*, 567–620. [CrossRef]
28. He, H.; Dyck, M.F.; Horton, R.; Li, M.; Jin, H.; Si, B. Chapter Five—Distributed Temperature Sensing for Soil Physical Measurements and Its Similarity to Heat Pulse Method. In *Advances in Agronomy*; Sparks, D.L., Ed.; Academic Press: Cambridge, MA, USA, 2018; Volume 148, pp. 173–230.
29. He, H.; Dyck, M.; Lv, J. The Heat Pulse Method for Soil Physical Measurements: A Bibliometric Analysis. *Appl. Sci.* **2020**, *10*, 6171. [CrossRef]
30. Li, K.; Horton, R.; He, H. Application of machine learning algorithms to model soil thermal diffusivity. *Int. Commun. Heat Mass Transf.* **2023**, *149*, 107092. [CrossRef]
31. Wang, X.W.; Yang, Y.Z.; Lv, J.L.; He, H.L. Past, present and future of the applications of machine learning in soil science and hydrology. *Soil Water Res.* **2023**, *18*, 67–80. [CrossRef]
32. Zhao, T.; Liu, S.; Xu, J.; He, H.; Wang, D.; Horton, R.; Liu, G. Comparative analysis of seven machine learning algorithms and five empirical models to estimate soil thermal conductivity. *Agric. For. Meteorol.* **2022**, *323*, 109080. [CrossRef]
33. Agyeman, P.C.; Ahado, S.K.; Boruvka, L.; Biney, J.K.M.; Sarkodie, V.Y.O.; Kebonye, N.M.; Kingsley, J. Trend analysis of global usage of digital soil mapping models in the prediction of potentially toxic elements in soil/sediments: A bibliometric review. *Environ. Geochem. Health* **2021**, *43*, 1715–1739. [CrossRef] [PubMed]
34. Yang, J.H.; Wu, G.L.; Jiao, J.Y.; Dyck, M.; He, H.L. Freeze-thaw induced landslides on grasslands in cold regions. *Catena* **2022**, *219*, 106650. [CrossRef]
35. Aria, M.; Cuccurullo, C. bibliometrix: An R-tool for comprehensive science mapping analysis. *J. Informetr.* **2017**, *11*, 959–975. [CrossRef]
36. van Eck, N.J.; Waltman, L. Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics* **2010**, *84*, 523–538. [CrossRef] [PubMed]
37. Chen, C.M. CiteSpace II: Detecting and visualizing emerging trends and transient patterns in scientific literature. *J. Am. Soc. Inf. Sci. Technol.* **2006**, *57*, 359–377. [CrossRef]
38. Rodríguez-Soler, R.; Uribe-Toril, J.; De Pablo Valenciano, J. Worldwide trends in the scientific production on rural depopulation, a bibliometric analysis using bibliometrix R-tool. *Land Use Policy* **2020**, *97*, 104787. [CrossRef]
39. Durieux, V.; Gevenois, P.A. Bibliometric Indicators: Quality Measurements of Scientific Publication. *Radiology* **2010**, *255*, 342–351. [CrossRef]
40. He, Z.; Gong, K.; Zhang, Z.; Dong, W.; Feng, H.; Yu, Q.; He, J. What is the past, present, and future of scientific research on the Yellow River Basin?—A bibliometric analysis. *Agric. Water Manag.* **2022**, *262*, 107404. [CrossRef]
41. Chen, C.; Ibekwe-SanJuan, F.; Hou, J. The structure and dynamics of cocitation clusters: A multiple-perspective cocitation analysis. *J. Am. Soc. Inf. Sci. Technol.* **2010**, *61*, 1386–1409. [CrossRef]
42. Nguyen, V.M.; Haddaway, N.R.; Gutowsky, L.F.G.; Wilson, A.D.M.; Gallagher, A.J.; Donaldson, M.R.; Hammerschlag, N.; Cooke, S.J. How Long Is Too Long in Contemporary Peer Review? Perspectives from Authors Publishing in Conservation Biology Journals. *PLoS ONE* **2015**, *10*, e0132557. [CrossRef]
43. Kovanis, M.; Porcher, R.; Ravaud, P.; Trinquart, L. The Global Burden of Journal Peer Review in the Biomedical Literature: Strong Imbalance in the Collective Enterprise. *PLoS ONE* **2016**, *11*, e0166387. [CrossRef]

44. Cicchetti, D.V. The reliability of peer review for manuscript and grant submissions: A cross-disciplinary investigation. *Behav. Brain Sci.* **1991**, *14*, 119–135. [CrossRef]
45. Fang, H. A modification of citation-based journal indexes. *Scientometrics* **2023**, *128*, 1119–1132. [CrossRef]
46. Zhang, X. Effect of reviewer's origin on peer review: China vs. non-China. *Learn. Publ.* **2012**, *25*, 265–270. [CrossRef]
47. Qeios. Qeios Publishing Policy. Available online: https://www.qeios.com/publishing-policy#how-reviewing-process-works (accessed on 29 May 2023).
48. Mulligan, A.; Hall, L.; Raphael, E. Peer review in a changing world: An international study measuring the attitudes of researchers. *J. Am. Soc. Inf. Sci. Technol.* **2013**, *64*, 132–161. [CrossRef]
49. Gruda, D. Dear journals: Stop hoarding our papers. *Nature Careers Community*, 10 October 2023. [CrossRef]
50. Donahue, M.Z. An Avid New Audience for Preprints—Extremists: Preprints can speed scientific communication but offer fuel for nefarious agendas. *BioScience* **2021**, *71*, 1004–1010. [CrossRef]
51. Flury, M.; Lakshmi, V.; Lu, N.; Vanderborght, J. Editorial: Open Access on the move. *Vadose Zone J.* **2023**, *22*, e20237. [CrossRef]
52. European Science Foundation. Plan S: Making Full and Immediate Open Access a Reality. Available online: https://www.coalition-s.org (accessed on 29 May 2023).
53. The White House. Breakthroughs for All: Delivering Equitable Access to America's Research [Office of Science and Technology Policy Blog]. Available online: https://www.whitehouse.gov/ostp/news-updates/2022/08/25/breakthroughs-for-alldelivering-equitable-access-to-americas-research (accessed on 29 May 2023).
54. Schimmer, R.; Geschuhn, K.K.; Vogler, A. *Disrupting the Subscription Journals' Business Model for the Necessary Large-Scale Transformation to Open Access*; ScienceOpen Research: Burlington, MA, USA, 2015; pp. 1–7. [CrossRef]
55. Siler, K. Demarcating spectrums of predatory publishing: Economic and institutional sources of academic legitimacy. *J. Assoc. Inf. Sci. Technol.* **2020**, *71*, 1386–1401. [CrossRef]
56. Roldan-Valadez, E.; Salazar-Ruiz, S.Y.; Ibarra-Contreras, R.; Rios, C. Current concepts on bibliometrics: A brief review about impact factor, Eigenfactor score, CiteScore, SCImago Journal Rank, Source-Normalised Impact per Paper, H-index, and alternative metrics. *Ir. J. Med. Sci.* **2019**, *188*, 939–951. [CrossRef] [PubMed]
57. Van Noorden, R. Controversial impact factor gets a heavyweight rival. *Nature* **2016**, *540*, 325–326. [CrossRef]
58. Atayero, A.A.; Popoola, S.I.; Egeonu, J.; Oludayo, O. Citation analytics: Data exploration and comparative analyses of CiteScores of Open Access and Subscription-Based publications indexed in Scopus (2014–2016). *Data Brief* **2018**, *19*, 198–213. [CrossRef] [PubMed]
59. Fang, H. Analysis of the new scopus CiteScore. *Scientometrics* **2021**, *126*, 5321–5331. [CrossRef]
60. Okagbue, H.I.; Teixeira da Silva, J.A. Correlation between the CiteScore and Journal Impact Factor of top-ranked library and information science journals. *Scientometrics* **2020**, *124*, 797–801. [CrossRef]
61. Quaderi, N. The Road to Journal Citation Reports 2021: New Content and a New Metric. Available online: https://clarivate.com/blog/the-road-to-journal-citation-reports-2021-new-content-and-a-new-metric/ (accessed on 29 May 2023).
62. Clark, M.P.; Hanson, R.B. The citation impact of hydrology journals. *Water Resour. Res.* **2017**, *53*, 4533–4541. [CrossRef]
63. Vinkler, P. Correlation between the structure of scientific research, scientometric indicators and GDP in EU and non-EU countries. *Scientometrics* **2008**, *74*, 237–254. [CrossRef]
64. Lal, R. Soil carbon sequestration impacts on global climate change and food security. *Science* **2004**, *304*, 1623–1627. [CrossRef] [PubMed]
65. Minasny, B.; Malone, B.P.; McBratney, A.B.; Angers, D.A.; Arrouays, D.; Chambers, A.; Chaplot, V.; Chen, Z.S.; Cheng, K.; Das, B.S.; et al. Soil carbon 4 per mille. *Geoderma* **2017**, *292*, 59–86. [CrossRef]
66. Six, J.; Conant, R.T.; Paul, E.A.; Paustian, K. Stabilization mechanisms of soil organic matter: Implications for C-saturation of soils. *Plant Soil* **2002**, *241*, 155–176. [CrossRef]
67. Shen, Q.R.; Ran, W.; Cao, Z.H. Mechanisms of nitrite accumulation occurring in soilnitrification. *Chemosphere* **2003**, *50*, 747–753. [CrossRef]
68. Whalen, J.K.; Chang, C.; Clayton, G.W.; Carefoot, J.P. Cattle manure amendments can increase the pH of acid soils. *Soil Sci. Soc. Am. J.* **2000**, *64*, 962–966. [CrossRef]
69. Liu, M.Q.; Hu, F.; Chen, X.Y.; Huang, Q.R.; Jiao, J.G.; Zhang, B.; Li, H.X. Organic amendments with reduced chemical fertilizer promote soil microbial development and nutrient availability in a subtropical paddy field: The influence of quantity, type and application time of organic amendments. *Appl. Soil Ecol.* **2009**, *42*, 166–175. [CrossRef]
70. Marschner, P.; Yang, C.H.; Lieberei, R.; Crowley, D.E. Soil and plant specific effects on bacterial community composition in the rhizosphere. *Soil Biol. Biochem.* **2001**, *33*, 1437–1445. [CrossRef]
71. Lambers, H.; Raven, J.A.; Shaver, G.R.; Smith, S.E. Plant nutrient-acquisition strategies change with soil age. *Trends Ecol. Evol.* **2008**, *23*, 95–103. [CrossRef]
72. Rengel, Z. Availability of Mn, Zn and Fe in the rhizosphere. *J. Soil Sci. Plant Nutr.* **2015**, *15*, 397–409. [CrossRef]
73. Kuzyakov, Y.; Friedel, J.K.; Stahr, K. Review of mechanisms and quantification of priming effects. *Soil Biol. Biochem.* **2000**, *32*, 1485–1498. [CrossRef]
74. He, J.; Shen, J.; Zhang, L.; Zhu, Y.G.; Zheng, Y.; Xu, M.; Di, H.J. Quantitative analyses of the abundance and composition of ammonia-oxidizing bacteria and ammonia-oxidizing archaea of a Chinese upland red soil under long-term fertilization practices. *Environ. Microbiol.* **2007**, *9*, 2364–2374. [CrossRef] [PubMed]

75. Frouz, J. Effects of soil macro- and mesofauna on litter decomposition and soil organic matter stabilization. *Geoderma* **2018**, *332*, 161–172. [CrossRef]
76. Ge, N.N.; Wei, X.R.; Wang, X.; Liu, X.T.; Shao, M.A.; Jia, X.X.; Li, X.Z.; Zhang, Q.Y. Soil texture determines the distribution of aggregate-associated carbon, nitrogen and phosphorous under two contrasting land use types in the Loess Plateau. *Catena* **2019**, *172*, 148–157. [CrossRef]
77. Lu, S.; Ren, T.S.; Gong, Y.S.; Horton, R. An improved model for predicting soil thermal conductivity from water content at room temperature. *Soil Sci. Soc. Am. J.* **2007**, *71*, 8–14. [CrossRef]
78. Ochsner, T.E.; Horton, R.; Ren, T.H. A new perspective on soil thermal properties. *Soil Sci. Soc. Am. J.* **2001**, *65*, 1641–1647. [CrossRef]
79. Ren, T.S.; Ochsner, T.E.; Horton, R. Development of Thermo-Time Domain Reflectometry for Vadose Zone Measurements. *Vadose Zone J.* **2003**, *2*, 544–551. [CrossRef]
80. Horn, R.; Peng, X.H.; Fleige, H.; Dorner, J. Pore rigidity in structured soils-only a theoretical boundary condition for hydraulic properties? *Soil Sci. Plant Nutr.* **2014**, *60*, 3–14. [CrossRef]
81. Vereecken, H.; Huisman, J.A.; Bogena, H.; Vanderborght, J.; Vrugt, J.A.; Hopmans, J.W. On the value of soil moisture measurements in vadose zone hydrology: A review. *Water Resour. Res.* **2008**, *44*, W00D06. [CrossRef]
82. Vanderborght, J.; Vereecken, H. Review of dispersivities for transport modeling in soils. *Vadose Zone J.* **2007**, *6*, 29–52. [CrossRef]
83. Jones, D.L.; Nguyen, C.; Finlay, R.D. Carbon flow in the rhizosphere: Carbon trading at the soil-root interface. *Plant Soil* **2009**, *321*, 5–33. [CrossRef]
84. Zhu, Z.K.; Zeng, G.J.; Ge, T.D.; Hu, Y.J.; Tong, C.L.; Shibistova, O.; He, X.H.; Wang, J.; Guggenberger, G.; Wu, J.S. Fate of rice shoot and root residues, rhizodeposits, and microbe-assimilated carbon in paddy soil—Part 1: Decomposition and priming effect. *Biogeosciences* **2016**, *13*, 4481–4489. [CrossRef]
85. Yuan, H.Z.; Zhu, Z.K.; Liu, S.L.; Ge, T.D.; Jing, H.Z.; Li, B.Z.; Liu, Q.; Lynn, T.M.; Wu, J.S.; Kuzyakov, Y. Microbial utilization of rice root exudates: C-13 labeling and PLFA composition. *Biol. Fertil. Soils* **2016**, *52*, 615–627. [CrossRef]
86. Lehmann, J.; Rillig, M.C.; Thies, J.; Masiello, C.A.; Hockaday, W.C.; Crowley, D. Biochar effects on soil biota—A review. *Soil Biol. Biochem.* **2011**, *43*, 1812–1836. [CrossRef]
87. Six, J.; Bossuyt, H.; Degryze, S.; Denef, K. A history of research on the link between (micro)aggregates, soil biota, and soil organic matter dynamics. *Soil Tillage Res.* **2004**, *79*, 7–31. [CrossRef]
88. von Lutzow, M.; Kogel-Knabner, I.; Ekschmitt, K.; Matzner, E.; Guggenberger, G.; Marschner, B.; Flessa, H. Stabilization of organic matter in temperate soils: Mechanisms and their relevance under different soil conditions—A review. *Eur. J. Soil Sci.* **2006**, *57*, 426–445. [CrossRef]
89. Cambardella, C.A.; Elliott, E.T. Particulate soil organic-matter changes across a grassland cultivation sequence. *Soil Sci. Soc. Am. J.* **1992**, *56*, 777–783. [CrossRef]
90. Kalbitz, K.; Solinger, S.; Park, J.H.; Michalzik, B.; Matzner, E. Controls on the dynamics of dissolved organic matter in soils: A review. *Soil Sci.* **2000**, *165*, 277–304. [CrossRef]
91. Kogel-Knabner, I. The macromolecular organic composition of plant and microbial residues as inputs to soil organic matter. *Soil Biol. Biochem.* **2002**, *34*, 139–162. [CrossRef]
92. Kuzyakov, Y. Priming effects: Interactions between living and dead organic matter. *Soil Biol. Biochem.* **2010**, *42*, 1363–1371. [CrossRef]
93. Six, J.; Elliott, E.T.; Paustian, K.; Doran, J.W. Aggregation and soil organic matter accumulation in cultivated and native grassland soils. *Soil Sci. Soc. Am. J.* **1998**, *62*, 1367–1377. [CrossRef]
94. Fontaine, S.; Mariotti, A.; Abbadie, L. The priming effect of organic matter: A question of microbial competition? *Soil Biol. Biochem.* **2003**, *35*, 837–843. [CrossRef]
95. Sollins, P.; Homann, P.; Caldwell, B.A. Stabilization and destabilization of soil organic matter: Mechanisms and controls. *Geoderma* **1996**, *74*, 65–105. [CrossRef]
96. Bronick, C.J.; Lal, R. Soil structure and management: A review. *Geoderma* **2005**, *124*, 3–22. [CrossRef]
97. Hamza, M.A.; Anderson, W.K. Soil compaction in cropping systems—A review of the nature, causes and possible solutions. *Soil Tillage Res.* **2005**, *82*, 121–145. [CrossRef]
98. Cambardella, C.A.; Moorman, T.B.; Novak, J.M.; Parkin, T.B.; Karlen, D.L.; Turco, R.F.; Konopka, A.E. Field-scale variability of soil properties in central iowa soils. *Soil Sci. Soc. Am. J.* **1994**, *58*, 1501–1511. [CrossRef]
99. Glaser, B.; Lehmann, J.; Zech, W. Ameliorating physical and chemical properties of highly weathered soils in the tropics with charcoal—A review. *Biol. Fertil. Soils* **2002**, *35*, 219–230. [CrossRef]
100. Saxton, K.E.; Rawls, W.J. Soil water characteristic estimates by texture and organic matter for hydrologic solutions. *Soil Sci. Soc. Am. J.* **2006**, *70*, 1569–1578. [CrossRef]
101. Rossel, R.A.V.; Walvoort, D.J.J.; McBratney, A.B.; Janik, L.J.; Skjemstad, J.O. Visible, near infrared, mid infrared or combined diffuse reflectance spectroscopy for simultaneous assessment of various soil properties. *Geoderma* **2006**, *131*, 59–75. [CrossRef]
102. Liang, B.; Lehmann, J.; Solomon, D.; Kinyangi, J.; Grossman, J.; O'Neill, B.; Skjemstad, J.O.; Thies, J.; Luizao, F.J.; Petersen, J.; et al. Black Carbon increases cation exchange capacity in soils. *Soil Sci. Soc. Am. J.* **2006**, *70*, 1719–1730. [CrossRef]
103. Chang, C.W.; Laird, D.A.; Mausbach, M.J.; Hurburgh, C.R. Near-infrared reflectance spectroscopy-principal components regression analyses of soil properties. *Soil Sci. Soc. Am. J.* **2001**, *65*, 480–490. [CrossRef]

104. Lehmann, J.; da Silva, J.P.; Steiner, C.; Nehls, T.; Zech, W.; Glaser, B. Nutrient availability and leaching in an archaeological Anthrosol and a Ferralsol of the Central Amazon basin: Fertilizer, manure and charcoal amendments. *Plant Soil* **2003**, *249*, 343–357. [CrossRef]
105. Vonuexkull, H.R.; Mutert, E. Global extent, development and economic impact of acid soils. *Plant Soil* **1995**, *171*, 1–15. [CrossRef]
106. Batjes, N.H. Total carbon and nitrogen in the soils of the world. *Eur. J. Soil Sci.* **2014**, *65*, 10–21. [CrossRef]
107. Kirschbaum, M.U.F. The temperature dependence of soil organic matter decomposition, and the effect of global warming on soil organic C storage. *Soil Biol. Biochem.* **1995**, *27*, 753–760. [CrossRef]
108. Wrage, N.; Velthof, G.L.; van Beusichem, M.L.; Oenema, O. Role of nitrifier denitrification in the production of nitrous oxide. *Soil Biol. Biochem.* **2001**, *33*, 1723–1732. [CrossRef]
109. Lal, R. Soil carbon sequestration to mitigate climate change. *Geoderma* **2004**, *123*, 1–22. [CrossRef]
110. Six, J.; Elliott, E.T.; Paustian, K. Soil macroaggregate turnover and microaggregate formation: A mechanism for C sequestration under no-tillage agriculture. *Soil Biol. Biochem.* **2000**, *32*, 2099–2103. [CrossRef]
111. West, T.O.; Post, W.M. Soil organic carbon sequestration rates by tillage and crop rotation: A global data analysis. *Soil Sci. Soc. Am. J.* **2002**, *66*, 1930–1946. [CrossRef]
112. Six, J.; Frey, S.D.; Thiet, R.K.; Batten, K.M. Bacterial and fungal contributions to carbon sequestration in agroecosystems. *Soil Sci. Soc. Am. J.* **2006**, *70*, 555–569. [CrossRef]
113. Rasse, D.P.; Rumpel, C.; Dignac, M.F. Is soil carbon mostly root carbon? Mechanisms for a specific stabilisation. *Plant Soil* **2005**, *269*, 341–356. [CrossRef]
114. McBratney, A.B.; Santos, M.L.M.; Minasny, B. On digital soil mapping. *Geoderma* **2003**, *117*, 3–52. [CrossRef]
115. Frostegard, A.; Baath, E. The use of phospholipid fatty acid analysis to estimate bacterial and fungal biomass in soil. *Biol. Fertil. Soils* **1996**, *22*, 59–65. [CrossRef]
116. Zelles, L. Fatty acid patterns of phospholipids and lipopolysaccharides in the characterisation of microbial communities in soil: A review. *Biol. Fertil. Soils* **1999**, *29*, 111–129. [CrossRef]
117. Giller, K.E.; Witter, E.; McGrath, S.P. Toxicity of heavy metals to microorganisms and microbial processes in agricultural soils: A review. *Soil Biol. Biochem.* **1998**, *30*, 1389–1414. [CrossRef]
118. Nannipieri, P.; Ascher, J.; Ceccherini, M.T.; Landi, L.; Pietramellara, G.; Renella, G. Microbial diversity and soil functions. *Eur. J. Soil Sci.* **2003**, *54*, 655–670. [CrossRef]
119. Fierer, N.; Schimel, J.P.; Holden, P.A. Variations in microbial community composition through two soil depth profiles. *Soil Biol. Biochem.* **2003**, *35*, 167–176. [CrossRef]
120. Lauber, C.L.; Strickland, M.S.; Bradford, M.A.; Fierer, N. The influence of soil properties on the structure of bacterial and fungal communities across land-use types. *Soil Biol. Biochem.* **2008**, *40*, 2407–2415. [CrossRef]
121. Compant, S.; Clement, C.; Sessitsch, A. Plant growth-promoting bacteria in the rhizo- and endosphere of plants: Their role, colonization, mechanisms involved and prospects for utilization. *Soil Biol. Biochem.* **2010**, *42*, 669–678. [CrossRef]
122. Frostegard, A.; Baath, E.; Tunlid, A. Shifts in the structure of soil microbial communities in limed forests as revealed by phospholipid fatty-acid analysis. *Soil Biol. Biochem.* **1993**, *25*, 723–730. [CrossRef]
123. Burns, R.G.; DeForest, J.L.; Marxsen, J.; Sinsabaugh, R.L.; Stromberger, M.E.; Wallenstein, M.D.; Weintraub, M.N.; Zoppini, A. Soil enzymes in a changing environment: Current knowledge and future directions. *Soil Biol. Biochem.* **2013**, *58*, 216–234. [CrossRef]
124. Saiya-Cork, K.R.; Sinsabaugh, R.L.; Zak, D.R. The effects of long term nitrogen deposition on extracellular enzyme activity in an Acer saccharum forest soil. *Soil Biol. Biochem.* **2002**, *34*, 1309–1315. [CrossRef]
125. Jones, D.L. Organic acids in the rhizosphere—A critical review. *Plant Soil* **1998**, *205*, 25–44. [CrossRef]
126. Vessey, J.K. Plant growth promoting rhizobacteria as biofertilizers. *Plant Soil* **2003**, *255*, 571–586. [CrossRef]
127. Hinsinger, P. Bioavailability of soil inorganic P in the rhizosphere as affected by root-induced chemical changes: A review. *Plant Soil* **2001**, *237*, 173–195. [CrossRef]
128. Atkinson, C.J.; Fitzgerald, J.D.; Hipps, N.A. Potential mechanisms for achieving agricultural benefits from biochar application to temperate soils: A review. *Plant Soil* **2010**, *337*, 1–18. [CrossRef]
129. Van Zwieten, L.; Kimber, S.; Morris, S.; Chan, K.Y.; Downie, A.; Rust, J.; Joseph, S.; Cowie, A. Effects of biochar from slow pyrolysis of papermill waste on agronomic performance and soil fertility. *Plant Soil* **2010**, *327*, 235–246. [CrossRef]
130. Chan, K.Y.; Van Zwieten, L.; Meszaros, I.; Downie, A.; Joseph, S. Agronomic values of greenwaste biochar as a soil amendment. *Aust. J. Soil Res.* **2007**, *45*, 629–634. [CrossRef]
131. Le Mer, J.; Roger, P. Production, oxidation, emission and consumption of methane by soils: A review. *Eur. J. Soil Biol.* **2001**, *37*, 25–50. [CrossRef]
132. Cakmak, I. Enrichment of cereal grains with zinc: Agronomic or genetic biofortification? *Plant Soil* **2008**, *302*, 1–17. [CrossRef]
133. Bossio, D.A.; Cook-Patton, S.C.; Ellis, P.W.; Fargione, J.; Sanderman, J.; Smith, P.; Wood, S.; Zomer, R.J.; von Unger, M.; Emmer, I.M.; et al. The role of soil carbon in natural climate solutions. *Nat. Sustain.* **2020**, *3*, 391–398. [CrossRef]
134. Westoby, M. A leaf-height-seed (LHS) plant ecology strategy scheme. *Plant Soil* **1998**, *199*, 213–227. [CrossRef]
135. Mingers, J.; Yang, L. Evaluating journal quality: A review of journal citation indicators and ranking in business and management. *Eur. J. Oper. Res.* **2017**, *257*, 323–337. [CrossRef]

136. Mingers, J.; Leydesdorff, L. A review of theory and practice in scientometrics. *Eur. J. Oper. Res.* **2015**, *246*, 1–19. [CrossRef]
137. Teixeira da Silva, J.A.; Memon, A.R. CiteScore: A cite for sore eyes, or a valuable, transparent metric? *Scientometrics* **2017**, *111*, 553–556. [CrossRef]
138. Engqvist, L.; Frommen, J.G. The *h*-index and self-citations. *Trends Ecol. Evol.* **2008**, *23*, 250–252. [CrossRef]
139. Falagas, M.E.; Kouranos, V.D.; Arencibia-Jorge, R.; Karageorgopoulos, D.E. Comparison of SCImago journal rank indicator with journal impact factor. *FASEB J.* **2008**, *22*, 2623–2628. [CrossRef]
140. Leydesdorff, L.; Opthof, T. Scopus's source normalized impact per paper (SNIP) versus a journal impact factor based on fractional counting of citations. *J. Am. Soc. Inf. Sci. Technol.* **2010**, *61*, 2365–2369. [CrossRef]
141. Fersht, A. The most influential journals: Impact Factor and Eigenfactor. *Proc. Natl. Acad. Sci. USA* **2009**, *106*, 6883–6884. [CrossRef]
142. Brown, M. Is Almetrics an Acceptable Replacement for Citation Counts and the Impact Factor? *Ser. Libr.* **2014**, *67*, 27–30. [CrossRef]
143. Gagliardi, A.R.; Chen, R.H.C.; Boury, H.; Albert, M.; Chow, J.; DaCosta, R.S.; Hoffman, M.; Keshavarz, B.; Kontos, P.; Liu, J.; et al. DORA-compliant measures of research quality and impact to assess the performance of researchers in biomedical institutions: Review of published research, international best practice and Delphi survey. *PLoS ONE* **2023**, *18*, e0270616. [CrossRef]
144. Boufarss, M.; Laakso, M. Open Sesame? Open access priorities, incentives, and policies among higher education institutions in the United Arab Emirates. *Scientometrics* **2020**, *124*, 1553–1577. [CrossRef]
145. Grunwald, S.; Daroub, S. A 360° perspective of women in soil science focused on the U.S. *Front. Soil Sci.* **2023**, *3*, 1072758. [CrossRef]
146. Dawson, L.; Brevik, E.C.; Reyes-Sánchez, L.B. International gender equity in soil science. *Eur. J. Soil Sci.* **2021**, *72*, 1929–1939. [CrossRef]
147. Carter, T.L.; Jennings, L.L.; Pressler, Y.; Gallo, A.C.; Berhe, A.A.; Marín-Spiotta, E.; Shepard, C.; Ghezzehei, T.; Vaughan, K.L. Towards diverse representation and inclusion in soil science in the United States. *Soil Sci. Soc. Am. J.* **2021**, *85*, 963–974. [CrossRef]
148. Berhe, A.A.; Ghezzehei, T.A. Race and racism in soil science. *Eur. J. Soil Sci.* **2021**, *72*, 1292–1297. [CrossRef]
149. Kurt, S. Why do authors publish in predatory journals? *Learn. Publ.* **2018**, *31*, 141–147. [CrossRef]
150. Klebel, T.; Ross-Hellauer, T. The APC-barrier and its effect on stratification in open access publishing. *Quant. Sci. Stud.* **2023**, *4*, 22–43. [CrossRef]
151. Maqsood, A.; Akbar Sial, T.; Iqbal, Q. Researchers' Accessibility to the Library Resources: A Comparative Study of Developed and Developing Countries. *J. Inf. Manag. Pract. JIMP* **2023**, *3*, 39–58. [CrossRef]
152. Ali, P.A.; Watson, R. Peer review and the publication process. *Nurs. Open* **2016**, *3*, 193–202. [CrossRef] [PubMed]
153. Resnik, D.B.; Elmore, S.A. Ensuring the Quality, Fairness, and Integrity of Journal Peer Review: A Possible Role of Editors. *Sci. Eng. Ethics* **2016**, *22*, 169–188. [CrossRef] [PubMed]
154. Golden, M.; Schultz, D.M. Quantifying the Volunteer Effort of Scientific Peer Reviewing. *Bull. Am. Meteorol. Soc.* **2012**, *93*, 337–345. [CrossRef]
155. Wolbring, G.; Nguyen, A. Equity/Equality, Diversity and Inclusion, and Other EDI Phrases and EDI Policy Frameworks: A Scoping Review. *Trends High. Educ.* **2023**, *2*, 168–237. [CrossRef]
156. Ceci, S.J.; Williams, W.M. Understanding current causes of women's underrepresentation in science. *Proc. Natl. Acad. Sci. USA* **2011**, *108*, 3157–3162. [CrossRef]
157. Vaughan, K.; Van Miegroet, H.; Pennino, A.; Pressler, Y.; Duball, C.; Brevik, E.C.; Berhe, A.A.; Olson, C. Women in Soil Science: Growing Participation, Emerging Gaps, and the Opportunities for Advancement in the USA. *Soil Sci. Soc. Am. J.* **2019**, *83*, 1278–1289. [CrossRef]
158. Keesstra, S.D.; Bouma, J.; Wallinga, J.; Tittonell, P.; Smith, P.; Cerdà, A.; Montanarella, L.; Quinton, J.N.; Pachepsky, Y.; van der Putten, W.H.; et al. The significance of soils and soil science towards realization of the United Nations Sustainable Development Goals. *SOIL* **2016**, *2*, 111–128. [CrossRef]
159. Cioffi, R.; Travaglioni, M.; Piscitelli, G.; Petrillo, A.; De Felice, F. Artificial Intelligence and Machine Learning Applications in Smart Production: Progress, Trends, and Directions. *Sustainability* **2020**, *12*, 492. [CrossRef]
160. Liakos, K.G.; Busato, P.; Moshou, D.; Pearson, S.; Bochtis, D. Machine Learning in Agriculture: A Review. *Sensors* **2018**, *18*, 2674. [CrossRef]
161. Nabiollahi, K.; Taghizadeh-Mehrjardi, R.; Shahabi, A.; Heung, B.; Amirian-Chakan, A.; Davari, M.; Scholten, T. Assessing agricultural salt-affected land using digital soil mapping and hybridized random forests. *Geoderma* **2021**, *385*, 114858. [CrossRef]
162. Fathizad, H.; Ardakani, M.A.H.; Heung, B.; Sodaiezadeh, H.; Rahmani, A.; Fathabadi, A.; Scholten, T.; Taghizadeh-Mehrjardi, R. Spatio-temporal dynamic of soil quality in the central Iranian desert modeled with machine learning and digital soil assessment techniques. *Ecol. Indic.* **2020**, *118*, 106736. [CrossRef]
163. Padarian, J.; Minasny, B.; McBratney, A.B. Machine learning and soil sciences: A review aided by machine learning tools. *SOIL* **2020**, *6*, 35–52. [CrossRef]
164. Strobl, C.; Ailhaud, E.; Benetos, K.; Devitt, A.; Kruse, O.; Proske, A.; Rapp, C. Digital support for academic writing: A review of technologies and pedagogies. *Comput. Educ.* **2019**, *131*, 33–48. [CrossRef]
165. Dong, Y.; Yu, X.; Alharbi, A.; Ahmad, S. AI-based production and application of English multimode online reading using multi-criteria decision support system. *Soft Comput.* **2022**, *26*, 10927–10937. [CrossRef]

166. Teubner, T.; Flath, C.M.; Weinhardt, C.; van der Aalst, W.; Hinz, O. Welcome to the Era of ChatGPT et al. *Bus. Inf. Syst. Eng.* **2023**, *65*, 95–101. [CrossRef]
167. Editorials, N. Tools such as ChatGPT threaten transparent science; here are our ground rules for their use. *Nature* **2023**, *613*, 10–38.