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Citation beneficiaries of discipline-specific mega-journals: who and how much

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The emergence of mega-journals (MJs) has influenced scholarly communication. One concrete manifestation of this impact is that more citations have been generated. Citations are the foundation of many evaluation metrics to assess the scientific impact of journals, disciplines, and regions. We focused on searching for citation beneficiaries and quantifying the relative benefit at the journal, discipline and region levels. More specifically, we examined the distribution and contribution to citation-based metrics of citations generated by the five discipline-specific mega-journals (DSMJs) categorized as Environmental Sciences (ES) on Web of Science (WoS) from Clarivate Analytics in 2021: *Sustainability, International Journal of Environmental Research and Public Health, Environmental Science and Pollution Research, Journal of Cleaner Production* and *Science of the Total Environment*. Analysis of the distribution of citing data of the five DSMJs shows a pattern with wide coverage but skewness by region and the WoS category; that is, papers in the five DSMJs contributed 26.66% of their citations in 2021 to Mainland China and 22.48% to the ES. Moreover, 15 journals within the ES had their JIFs boosted by more than 20%, benefitting from the high citing rates of the five DSMJs. More importantly, the analysis provides clear evidence that DSMJs can contribute to JIF scores throughout a discipline through their volume of references. Overall, DSMJs can widely impact scholarly evaluation because they contribute citation benefits and improve the evaluation index performance of different scientific entities at different levels. Considering the important application of citation indicators in the academic evaluation system and the increase in citations, it is important to reconsider the real research impact that citations can reflect.

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Introduction

With the development of open access (OA) publishing and the success of PLOS ONE, a growing number of publishers have created journals termed "mega journals" (MJs) that aim for annual publication volumes of hundreds if not thousands of articles. According to Björk's research (2015), to qualify as a mega-journal, a title should have a large volume, broad scope, soundness-only peer review and OA based on article processing charges (APCs). It is widely acknowledged that MJs are closely related to a considerable journal size (Busby 2015), which implies that a MJ features "a magnitude larger than an average journal in a particular field" (Zhang 2006), although other subjective criteria are under discussion. The emergence of MJs has attracted the attention of the academic community and received many comments on their impact on scholarly communication, which refers to the system through which research and other scholarly writings are created, evaluated for quality, disseminated to the scholarly community, and preserved for future use (Finlay et al. 2015). However, it is essential to recognize that publishing and citation practices vary significantly between different academic disciplines. Thus, further investigation is warranted to understand the specific impact of MJs in diverse disciplines on scholarly communication within those fields. Moreover, it is crucial to note that there exists notable diversity in the disciplinary composition of various MJs, leading to faster diffusion in certain scientific fields (Siler et al. 2020). This diversity and its implications prompt us to focus our research on a distinct category of MJs termed "discipline-specific mega-journals" (DSMJs). DSMJs are characterized by their substantial publication volume within a particular subject area, setting them apart from the broader scope of previous studies on general MJs.

The assessment of scientific research is an important facet of the entire academic communication system. In the context of research evaluation, citation-based indicators or metrics are applied to measure and compare the scientific performance of various scientific entities. Examples include the use of the journal impact factor (JIF) in the assessment of communication artifacts such as scholarly journals (Borgman and Furner 2002), cross-disciplinary citations in the analysis of interdisciplinary influences of a specific subject (Truc 2022) and citation performance to illuminate the scientific impact of nations (Smith et al. 2014; Li et al. 2023). More specifically, despite the controversy about their capacity to indicate research quality, these citation-based metrics are adopted as tools for authors to make decisions about publication outlets and are used by institutions in review, promotion, and tenure processes (Althouse et al. 2009; Niles et al. 2020; Pontika et al. 2022). Taking journal evaluation as an example, a journal that performs well in an evaluation (likely manifested as highly ranked in a field) benefits itself substantially and reputationally. Overall, when a citation is generated, a "benefit" is generated and "gained" by the cited journal, and its discipline and affiliated country/region in terms of a citation-based evaluation. In bibliometrics, the relationship between the generation and acquisition of citation benefits is often expressed as "referring/citing" and "cited". Nevertheless, a gap in present studies to date is that MJs in a specific discipline exist as a separate and significant source of citations, which we believe is an important aspect of their impact on scientific communication. A great deal of research has focused on the impact of MJs, but a new concern is how the existence of DSMJs, despite being in a specific discipline, impacts assessment in the scholarly communication system. From this perspective, this study aims to answer the following questions:

(1) Who benefits and to what extent from mega-journals with a specific disciplinary scope (DSMJs) at the discipline/region level?

(2) Within a specific discipline, if there are journals with considerable outputs, who (which journal) has benefitted from them and to what extent?

Given field differences in citations (Ioannidis and Thombs 2019; Larivière and Sugimoto 2019) and the wide usage of established subject categories such as the WoS category in the evaluation of science, we selected a representative field from the WoS category list and screened DSMJs. The DSMJs in this paper meet the first principle of general MJs, i.e., publication outputs ranking at the top position within a discipline. Therefore, in this paper, the DSMJs studied are all relative to the full list of journals in a specific WoS category. This approach allows us to investigate factors related to MJs' influence on the citation-based evaluation, with a specific focus on the disciplinary context. In terms of benefits, this study treats citations as benefits generated from DSMJs and "gained" by the cited journal, and its discipline and affiliated country/region that epitomizes the return of evaluation indicators. Moreover, at the journal evaluation level, the JIF score is calculated as the quotient of citations to citable items published in the two preceding years during the index year divided by the total number of citable items published in the two preceding years (Fischer and Steiger 2018). This citation-based metric, which prevails in scholarly communication, offers a measurable way to identify benefits by quantifying the increase in indicators. Bibliometrics provides the possibility of quantifying the impact of DSMJs on academic evaluation systems, specifically citation benefits to other scientific entities, i.e., journals, disciplines and regions. Therefore, a bibliometric and citation analysis method was used to serve the following two purposes: (1) first, to examine what disciplines and countries/regions achieve increased scores from the high rate of citations generated by DSMJs and to what extent and (2) to ascertain what journals benefit from being cited by DSMJs within the same discipline and to what extent.

The remainder of this paper is organized as follows. In Section 2, we provide materials and methods, i.e., the journal selection, the data collection and the equation designed to quantify how DSMJs contribute to JIFs and Immediacy Index scores. In Section 3, the empirical results are introduced. In Section 4, we discuss our results and offer some directions for further investigation. The final section is the conclusion.

Materials and methods

DSMJ selection. "Environmental Sciences" (ES), one of the subject fields from the WoS categories that reported 126,235 citable items and ranked second in all 254 categories in Journal Citation Reports™ (JCR) in 2021, was chosen in this paper. The top five journals with the most outputs in ES were selected and examined. Specifically, according to the number of 'Web of Science Documents' in 2021 from Clarivate InCites^{TM}, we chose the top five journals, i.e., *Sustainability* (Sustainability), *International Journal of Environmental Research and Public Health* (IJERPH), *Science of the Total Environment* (STOTEN), *Environmental Science and Pollution Research* (ESPR) and *Journal of Cleaner Production* (JCP). In the preliminary retrieval from JCR, five DSMJs published 43,210 articles in 2021 and 2,547,355 references, with more than 58.95 references per paper (see Table 1).

Data collection. To analyze the citing data, we obtained articles published in 2021 and their corresponding references by retrieving the five DSMJs in "Publication Titles" in the Web of Science^{TM} (WoS) core collection, which includes the Science Citation Index Expanded (SCIE), the Social Science Citation Index (SSCI), the Arts & Humanities Citation Index (AHCI) and the Emerging Sources Citation Index (ESCI). We filtered out

Table 1 Articles and references from five DSMJs in 2021.

	Sustainability	IJERPH	STOTEN	ESPR	JCP
Number of Articles	12,714	11,697	8597	5330	4872
Number of References	768,268	588,862	574,165	322,553	293,507
References per Article	60.4	50.3	66.8	60.5	60.2

Table 2 The yearly distribution of references published in 2019–2021.

	Number of references				
Publication year	Sustainability	IJERPH	STOTEN	ESPR	JCP
2019	59,492	43,903	63,551	35,374	40,933
2020	76,766	74,651	67,444	40,343	36,638
2021	39,065	32,341	20,004	18,209	9973
Total references	175,323	150,895	150,999	93,926	87,544

journal articles published between 2019 and 2021 in references (see Table 2) and exported them with author information (affiliated countries/regions), field information corresponding to journal classification, and journal information. At the discipline/region level, the quantification of the degree of benefits from DSMJs was based on the total number of citations that entities gained, while for a single journal, we chose two representative metrics in the JCR, the JIF and Immediacy Index (II), as the calculated basis. The II indicates how quickly articles in a journal are cited and can provide a supplemental perspective for evaluating journals specializing in cutting-edge research. Therefore, we matched the amount to 13,725 cited journals with their total citations, total articles, counts of citable items, and JCR data, including JIFs and II scores (for calculations, see Eqs. (1) and (2).

From Clarivate^{TM}, the 2021 JIF is calculated using Eq. (1), and the 2021 II is calculated using Eq. (2).

$$\mathrm{JIF} = \frac{A}{B} \tag{1}$$

A = Citations in 2021 to items published in 2019 and 2020; B = Number of citable items in 2019 and 2020

$$\text{Immediacy Index} = \frac{C}{D} \tag{2}$$

C = Citations in 2021 to items published in 2021; D = Number of citable items in 2021

Quantitation method. Figure 1 illustrates a reference-citation relationship between papers of the five DSMJs and cited journals. Taking a cited journal, the *Journal of Hazardous Materials*, as an example, we use Eqs. (3) and (4) to calculate how much DSMJs benefitted the JIF and the II of this journal in 2021, respectively.

$$\text{DSMJ's contribution to the JIF} = \frac{\mathrm{E}}{\mathrm{F}} * 100\% = 10.07\% \tag{3}$$

E = Citations in 2021 to citable items published in 2019 (1647) and 2020 (3228) from DSMJs;
F = Total citations in 2021 to citable items published in 2019 (13216) and 2020 (35217)

$$\text{DSMJ's contribution to the Immediacy Index} = \frac{G}{H} * 100\% = 10.47\% \tag{4}$$

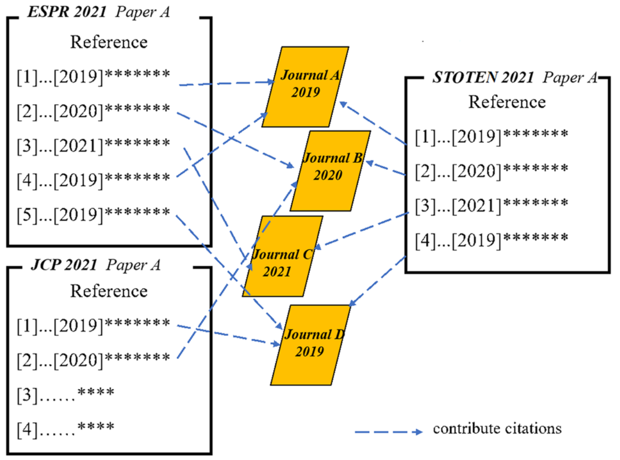

Fig. 1 Illustration of a reference-citation relationship of MJs. We give an example of how citations of the cited journals are contributed by papers of MJs. Limited to the citing data in Fig., the bibliometric analysis is as follows: Journal A wins 3 citations from MJs; Journal B wins 3 citations from MJs; Journal C wins 2 citations from MJs; and Journal D wins 3 citations from MJs. Therefore, MJs contributed 11 citations in 2021 to Journals A, B, C and D during 2019–2021.

G = Citations in 2021 to citable items published in 2021 (1967) from DSMJs;
H = Total citations in 2021 to citable items published in 2021 (18782)

Analysis and results

In our research, citations are a proxy for benefits in quantitative scientific evaluation, which are generated by DSMJs and gained by cited publications, and indirect "beneficiaries". In 2021, the five DSMJs referenced amounted to 658,687 times to articles published in 2019–2021, corresponding to 13,725 journal beneficiaries. In the following analysis, we first identified the discipline beneficiaries that corresponded to research categories provided by the WoS by presenting the distribution of DSMJs' citation benefits among subject fields and the contribution to the total citation of each field. Then, the distribution of DSMJs' citation benefits among countries/regions was displayed to trace country/region beneficiaries. Finally, to identify beneficiaries at the journal level within this ES field and to further quantify the degree of benefits, we utilized the contribution indicators pertain to journal assessment.

Discipline beneficiaries. The cited documents can be divided into different research fields based on the WoS category to which their source publications belong. Those categories reflect the different subject content of the articles and correspond to the journal categories in the JCR. Note that 5073 journals were classified as "multiple", which means multiple categories. We extracted their "most representative" category, where they obtained a better JIF percentile, for analysis at the disciplinary level. Those 658,687 citations to publications in 2019–2021 were distributed across 247 different categories out of the 254 indexed by WoS (see Supplementary Table S4 online). Specifically, in Table 3, we display the top 20 WoS categories with the number of journals and their citation counts based on aggregation by category. ES, with 172 cited journals and 148,102 citations contributed by DSMJs, is the highest-ranking subject field, followed by Public, Environmental & Occupational Health and Green & Sustainable Science & Technology. In addition to the categories related to the environment, DSMJs cited substantial

Table 3 Top 20 WoS categories of cited journals ordered by "Citations from DSMJs".

Rank	Category	Number of journals	Citations from DSMJs	Percentage of total citations from DSMJs
1	Environmental Sciences	172	148,102	22.48%
2	Public, Environmental & Occupational Health	261	35,700	5.42%
3	Green & Sustainable Science & Technology	20	34,221	5.20%
4	Multidisciplinary Sciences	95	21,442	3.26%
5	Energy & Fuels	49	20,461	3.11%
6	Engineering, Environmental	20	17,841	2.71%
7	Water Resources	72	15,564	2.36%
8	Medicine, General & Internal	237	14,727	2.24%
9	Environmental Studies	63	12,373	1.88%
10	Economics	399	11,269	1.71%
11	Engineering, Chemical	75	10,922	1.66%
12	Management	239	9553	1.45%
13	Construction & Building Technology	55	9372	1.42%
14	Business	173	8431	1.28%
15	Geosciences, Multidisciplinary	119	7924	1.20%
16	Psychiatry	138	7227	1.10%
17	Meteorology & Atmospheric Sciences	57	7022	1.07%
18	Education & Educational Research	471	6129	0.93%
19	Chemistry, Multidisciplinary	124	5876	0.89%
20	Engineering, Civil	99	5751	0.87%

multidisciplinary literature, accounting for 3.26% of the citation benefits to the "Multidisciplinary Sciences".

In the second step, we performed the contribution calculation, calculating the percentage of citations from the five DSMJs to the total citations received by each category of journals (PCC). Specifically, journals A, B and C were classified as "Energy & Fuels" and indexed in WoS. If papers published in 2019–2021 from A, B and C were cited 1000 times in total in 2021 and among these, 10 were cited by the five DSMJs, the PCC of "Energy & Fuels" was 1%. This calculation is a proxy indicator of DSMJs' contribution to the citation benefits that each discipline gained. Because the number of citations has been extensively transformed into other various bibliometric indicators in research performance evaluation, it is often applied at the field level. Similarly, we considered the 2021 citations gained by publications published in 2019–2021. There were 4658 journals missing values in the JIF, the II or citable item fields because of the database or our collection process and resulting missing total citations in 2019–2021, which are required for benefits calculation. Thus, the remaining 600,231 references (91.13% of the 658,687 references) and corresponding 9067 journals were left for analysis at the discipline level. In Table 4, ES with 802,169 total citations, of which 18.33% benefitted from five DSMJs, lagging behind the 25.55% gained by Environmental Studies.

Region beneficiaries. The corresponding author's region is often considered the home base or origin of the study or paper (Ho 2012), and it plays a crucial role in determining the regional impact of the research. In this study, the addresses of corresponding authors available from the WoS database were used to identify regions with which the corresponding authors were affiliated. Note that 63,628 paper entries (9.6% of the 658,687 references) lacked information in the corresponding author address field and were purged from this subsection. In addition, some corresponding authors listed more than one institutional affiliation in the publication data. Specifically, for every 36,136 citations (6.1% of the total), benefits were shared by multiple regions. At the region level, there were 634,669 citation benefits left to be analyzed. Table 5 displays the number of citation benefits that each region received (total and from the five DSMJs), the percentage and the PCC.

According to the affiliation data of the corresponding authors, 595,059 references pertained to 182 countries/regions, and 634,669 regional citation benefits were generated (see Supplementary Table S5 online). Table 5 partly describes the regional distribution of the 595,059 corresponding authors and displays the top 20 regional beneficiaries in terms of the comparative number of citations gained from DSMJs. The share of regions in citation benefits generated by DSMJs was skewed to China and the USA, which gained 26.66% and 11.35% of total DSMJ citation benefits in 2021. Note that when performing the quantification of the degree of benefits, we utilized the InCites^{TM} dataset to obtain the number of times cited of publications in 2019–2021 belonging to the regions with which corresponding authors were affiliated as "total citations" (updated through the week of January 31st, 2023). We performed the contribution calculation by calculating the percentage of citations from the five DSMJs to the total number of citations of each region recorded by the WoS (PCC). As shown in the PCC column, the four countries (Spain, Turkey, Poland, Portugal) in the top 20 citation benefits from DSMJs were the only four regions whose PCCs were greater than or equal to the average PCC, 1.25%.

Journal beneficiaries within a specific discipline. In the previous section, we showed the contribution of the five DSMJs to the different subject fields, which was highly beneficial to ES. Next, we quantified the contribution of DSMJs to other journals within the discipline to determine the specified journal beneficiaries. From the data collection of 9067 journals mentioned in the previous section, we selected 243 journals belonging to ES. To determine which journals benefitted the most from citations from the five DSMJs, we calculated the two elaborated metrics mentioned above, the "contribution to JIF" and the "contribution to Immediacy Index" (see Tables 6 and 7), to quantify how DSMJs contributed to the cited journals within the same discipline.

In Table 6, we show the beneficiaries based on the II. Only citations to items published in 2021 were used for the analysis. Sustainability is the journal that was cited most often, receiving 6416 citations to citable items in 2021 from the five DSMJs. According to Eq. (4), the five DSMJs contributed to increasing the II of Sustainability by 44.46%. This was followed by ESPR, which received 4524 citation benefits from the five DSMJs. The five DSMJs contributed to increasing the II of ESPR by 60.81%.

In Table 7, we mainly focus on the beneficiaries of JIF. Citations to items published in 2019–2020 were used to analyze the change in 2021 JIFs. From the five DSMJs' citations, STONEN

Table 4 Top 20 categories with their PCCs ordered by "Citations from DSMJs".

Rank	Category	Total citations	Citations from DSMJs	PCC[a]
1	Environmental Sciences	802,169	147,042	18.33%
2	Environmental Studies	142,370	36,369	25.55%
3	Public, Environmental & Occupational Health	342,602	34,313	10.02%
4	Multidisciplinary Sciences	1,105,730	18,593	1.68%
5	Engineering, Chemical	476,368	18,400	3.86%
6	Water Resources	124,394	14,499	11.66%
7	Economics	141,043	12,919	9.16%
8	Medicine, General & Internal	640,381	12,844	2.01%
9	Engineering, Civil	201,817	10,235	5.07%
10	Energy & Fuels	240,456	9880	4.11%
11	Geosciences, Multidisciplinary	236,372	9841	4.16%
12	Management	98,725	7092	7.18%
13	Toxicology	97,230	6985	7.18%
14	Marine & Freshwater Biology	89,972	6841	7.60%
15	Meteorology & Atmospheric Sciences	107,793	6615	6.14%
16	Psychiatry	128,935	5543	4.30%
17	Agricultural Engineering	51,469	5453	10.59%
18	Operations Research & Management Science	83,135	5323	6.40%
19	Ecology	102,061	4978	4.88%
20	Engineering, Electrical & Electronic	496,533	4917	0.99%

[a]PCC at the discipline level is defined as citations in 2021 from the five DSMJs to the journals classified as the same category to items published in 2019–2021 divided by all citations in 2021 to items published in these journals in 2019–2021.

Table 5 Top 20 regions of cited journals ordered by the number of Citations from DSMJs.

Rank	Region	Citations from DSMJs		Total citations	PCC[a]
		Number	(%) of Total citation benefits generated by DSMJs		
1	Mainland China	169,176	26.66	18,312,524	0.92%
2	USA	72,048	11.35	14,378,829	0.50%
3	UK	31,579	4.98	3,819,125	0.83%
4	Italy	28,038	4.42	2,439,109	1.15%
5	Spain	26,093	4.11	1,638,307	1.59%
6	Australia	22,080	3.48	2,119,467	1.04%
7	India	20,014	3.15	2,595,686	0.77%
8	Germany	18,679	2.94	3,008,848	0.62%
9	Canada	15,031	2.37	1,889,928	0.80%
10	South Korea	14,256	2.25	1,826,517	0.78%
11	Iran	12,874	2.03	1,402,454	0.92%
12	Brazil	12,815	2.02	1,062,951	1.21%
13	Netherlands	10,278	1.62	1,170,454	0.88%
14	France	10,252	1.62	1,672,742	0.61%
15	Turkey	9,078	1.43	728,699	1.25%
16	Poland	8,491	1.34	676,581	1.25%
17	Japan	8,449	1.33	1,756,333	0.48%
18	Sweden	7,610	1.20	702,536	1.08%
19	Portugal	6,906	1.09	419,138	1.65%
20	Taiwan	6,747	1.06	652,230	1.03%

[a]PCC at the region level is calculated by dividing the citations from DSMJs by all citations of that region received (the total citations) provided in InCites. To obtain the total cites from InCites, the cited items' author position was limited to "corresponding" only.

benefited the most, receiving 140,940 citations from the five DSMJs to its items published in 2019–2020. The five DSMJs contributed to increasing the JIF of STOTEN by 22.62%. This was followed by JCP, which received 99,460. The five DSMJs contributed to increasing the JIF score of JCP by 25.71%. Sustainability ranked third with 69,045 citations contributed by the five DSMJs, for which the JIF score was increased by 31.17%.

Self-citations and intracitations of DSMJs. From the above analysis, we can see that the five DSMJs' citations widely contributed to different regions and disciplines and markedly increased the JIFs and II scores of journals within the same subject field. Taking a further step, we separately calculated the self-citations and coupling citations of the five DSMJs in 2021, as shown in Table 8 and Fig. 2. In Sustainability, there were 22,188 self-citations (accounting for 32.14% of the total citations) and 8.33% from the other four. In IJERPH, 17.99% of the total citations benefitted from self-citation and 6.43% from the other four. In STOTEN, there were 22,093 self-citations and 16,205 citations from others (accounting for 11.5% of the total citations) to items published in 2021. In ESPR, 9821 citations were from self-citation (accounting for 23.28% of the total citations) to items published in 2021 and 11.32% were from intracitations. In JCP, there were 15,241 self-citations (accounting for 15.32% of the total citations) and 15,083 citations from the other four DSMJ citations (accounting for 15.16% of the total citations) to items published in 2021.

Discussion

In 2006, the launch of PLoS ONE by the Public Library of Science introduced the mega-journal as a new type of scientific publication, significantly impacting scholarly communication (Lăzăroiu 2017). Specifically, MJs have emerged as vital channels for disseminating academic research, partly owing to their favorable performance in bibliometric evaluations (Solomon 2014; Wakeling et al. 2017). JCR 2020 metrics reveal that MJs contribute a 26.5% article share and excellent distribution in the JIF quartile (Kim and Park 2022). MJs relying on bibliometric measures as proxies for scientific influence and research performance, noticeably impact scholarly assessment processes. However, it is essential to consider that this influence extends beyond the MJ category and affects other areas, including relatively traditional journals and preferred disciplines, with implications that extend beyond merely elevating their positions.

Table 6 Top 20 journals whose 2021 II benefitted the most.

Rank[a]	Journal name	Citable items in 2021	Citations to citable items in 2021	2021 immediacy index	DSMJs' citations to citable items in 2021	Five DSMJs' contribution to the II (%)
1	Air Quality Atmosphere and Health	165	104	0.630	86	82.73
2	Critical Reviews in Environmental Science and Technology	74	156	2.108	119	76.29
3	Archives of Environmental & Occupational Health	74	23	0.311	15	65.18
4	Environment Development and Sustainability	872	925	1.061	578	62.47
5	Environmental Science and Pollution Research	5794	7439	1.284	4524	60.81
6	Environmental and Ecological Statistics	46	98	2.130	54	55.11
7	Isotopes in Environmental and Health Studies	34	4	0.118	2	49.85
8	Human and Ecological Risk Assessment	59	90	1.525	44	48.90
9	Water Environment Research	163	106	0.650	48	45.30
10	Sustainability	13,769	14,430	1.048	6416	44.46
11	Environmental Geochemistry and Health	366	281	0.768	120	42.69
12	Environmental Forensics	57	31	0.544	13	41.92
13	International Journal of Mining Reclamation and Environment	32	12	0.375	5	41.67
14	International Journal of Life Cycle Assessment	137	172	1.255	71	41.29
15	Journal of Industrial Ecology	119	157	1.319	63	40.14
16	Journal of Material Cycles and Waste Management	188	88	0.468	35	39.78
17	Land Degradation & Development	280	230	0.821	87	37.85
18	Global Nest Journal	73	11	0.151	4	36.29
19	Ecotoxicology	168	79	0.470	28	35.46
20	Waste Management & Research	193	187	0.969	66	35.29

[a]Journals are in descending order by the last column "Five DSMJs' Contribution to the II (%)".

Table 7 The top 20 journals with 2021 JIF scores that benefited the most.

Rank[a]	Journal name	Citable items in 2019–2020	Citations to citable items in 2019–2020	2021 JIF	DSMJs' citations to citable items 2019–2020	Five DSMJs' contribution to the 2021 JIF (%)
1	Environmental and Ecological Statistics	52	123	2.365	42	34.15
2	Carbon Management	94	331	3.52	111	33.55
3	Sustainability	17,754	69,045	3.889	21,522	31.17
4	International Journal of Life Cycle Assessment	322	1,693	5.257	479	28.30
5	Journal of Environmental Informatics	48	491	10.22	138	28.13
6	Journal of Cleaner Production	8983	99,460	11.072	25,574	25.71
7	Resources Conservation and Recycling	891	12,221	13.716	3,071	25.13
8	Journal of Integrative Environmental Sciences	22	69	3.143	17	24.59
9	Mountain Research and Development	38	57	1.506	14	24.46
10	Environmental Science and Pollution Research	8129	42,190	5.190	10,071	23.87
11	Journal of Industrial Ecology	256	1844	7.202	419	22.73
12	Science of the Total Environment	13,107	140,940	10.753	31,875	22.62
13	Biology and Environment-Proceedings of the Royal Irish Academy	23	9	0.393	2	22.13
14	Natural Resources Forum	41	112	2.732	24	21.43
15	Environmental Pollution	3694	36,896	9.988	7481	20.28
16	Ecological Indicators	1977	12,382	6.263	2456	19.84
17	Ecological Economics	575	3758	6.536	740	19.69
18	Marine Pollution Bulletin	1775	12,427	7.001	2439	19.63
19	Journal of Atmospheric Chemistry	23	77	3.360	15	19.41
20	Environmental Sciences Europe	236	1294	5.481	243	18.79

[a]Journals are in descending order by the last column "Five DSMJs' Contribution to the 2021 JIF (%)".

Table 8 Self-citation and intracitation in the five DSMJs in 2021.

The cited journal	Citations from					Total citations[a]
	Sustainability	IJERPH	STOTEN	ESPR	JCP	
Sustainability	22,188	1988	729	1213	1820	69,045
IJERPH	2278	12,050	863	857	307	67,000
STOTEN	3209	2226	22,093	7073	3697	140,940
ESPR	1184	638	1963	9821	989	42,190
JCP	6920	1168	2849	4146	15,241	99,460

[a]Total Citations refer to the cited journals' total number of citations received in 2021 regardless of the citing sources.

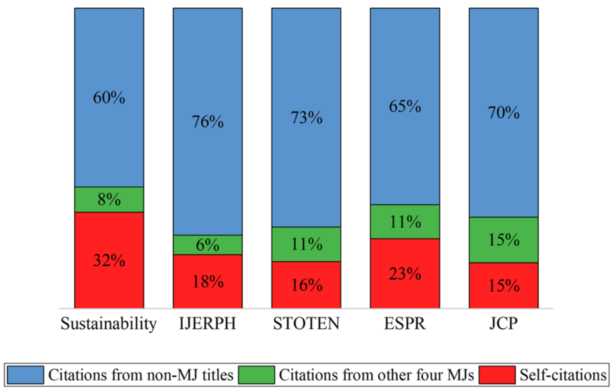

Fig. 2 The proportion of self-citations, intracitations and other journal citations in the five DSMJs' citations in 2021 to items published in 2019–2021. This figure focuses on the five DSMJs' citations in 2021 to their own items published in 2019–2021, which include two types of notable citations, i.e., DSMJs' self-citations and intracitations, represented by each slice of the bar chart.

This paper adopts a new perspective to investigate the impact of MJs' discipline-specific counterparts (DSMJs) on scholarly evaluation, specifically in terms of their citing contribution to citation-based indicators. Based on their shared characteristic of considerable publication volume, we conduct exploratory research with a disciplinary context. Through our analysis of five DSMJs in Environmental Sciences, we demonstrate that the substantial number of articles in DSMJs results in significant citation benefits, benefiting both the journals themselves and their subject fields. Specifically, self-citation in these DSMJs increased citation rates by 15.32–32.14%. Within the same field, 15 journals increased their 2021 JIFs by more than 20% because of citations that benefitted from the DSMJs. It is broadly accepted that because the mean JIF of the journals in each discipline and the range of values that the JIFs take can differ greatly and that JIFs are comparable only within the same discipline, but processes of evaluation sometimes normalize the JIFs for scientific disciplines for comparison (Podlubny 2005; Van Leeuwen and Moed 2002; Van Leeuwen et al. 2003; Sombatsompop and Markpin 2005; de Moya-Anegón et al. 2005). Hence, in the evaluation of science, as revealed in the scientific classification, a rise in the overall JIF of journals belonging to the same discipline enhances disciplinary visibility. The disciplinary scope of our sampled journals is further validated by the fact that Environmental Science received the largest share of DSMJs' citations according to our analysis of the subject field distribution. On the other hand, the reference distribution also implied the multidisciplinarity of DSMJs corresponding to Environmental Science since there was a considerable share of Multidisciplinary Sciences. At the disciplinary level, for Environmental Science, 18.33% of citations received in 2021 were contributed by the DSMJs.

The number of citations is a key variable often used for comparing scientific impact among countries. This metric is combined in indicators like citations per publication (Vinkler 2010) and the citation impact (the average number of citations a set of documents received) in InCite^{TM}, aiding the identification of countries and institutions with the best performance for funding strategies (Leydesdorff et al. 2019). Citations generated by the DSMJs are distributed across regions and hence also generate explicit gains for each region based on regional measures of research impact. Because publication authorship plays an important role as a measure of regional research capacity (Smith et al. 2014), we credited a region with a publication if the corresponding authors were affiliated with institutions from that region. Mainland China led with 169,176 citation benefits from DSMJs in 2021. However, a high share of DSMJ citations does not necessarily translate into significant citation benefits. Even though there was some skewness in the regional distribution of citations generated by DSMJs (for example, 26.66 and 11.35% of the references have corresponding authors affiliated with Mainland China and the USA, respectively), these contributions do not stand out due to these countries' own scientific impact, accounting for 0.92 and 0.5% of total times cited, respectively. Furthermore, 1.59, 1.25, 1.25 and 1.65% of the total citations of Spain, Turkey, Poland and Portugal, four countries with substantial citations, were contributed by DSMJs, while none of the other 16 top regional beneficiaries exceeded the average PCC. The average PCC, 1.25%, also provides a specific grasp of the DSMJs' citation contribution to all regions as a whole. However, it is important to note that our study has not fully addressed certain crucial issues related to using corresponding authorship as a measure of regional citation beneficiaries. Specifically, this measurement may not fully account for the role of international cooperation within research teams. The regional affiliations of other authors involved in an article, particularly in cases with multiple authors, have not been explicitly considered in our analysis. To gain a comprehensive understanding of regional citation beneficiaries in scholarly evaluation, we recognize the need for future research to explore this aspect and its implications further.

Overall, DSMJs, focused on a specific discipline have generated substantial citation benefits for scholarly evaluation, giving beneficiaries at the above levels increases in citation metrics. However, for the overall scholarly evaluation, the increase in overall citation volume raises concerns about the applicability of the present citation-based measure to compare the impact of papers, researchers, and journals (Fire and Guestrin 2019). Our study found that one scientific entity that receives the greatest share of DSMJs' citation distribution does not gain the most benefit. For entities facing a large number of citations from DSMJs, their overall citation impact plays a role in stability. Another point worth noting is that, the rapid diffusion of MJs has occurred more in some scientific fields than others (Siler et al. 2020). Our research on distribution at the discipline level and its contribution to subject fields demonstrates that DSMJs significantly impact their respective disciplines, leading to potential bias in the evaluation system based on the advantages of specific disciplines. Although citations are not necessarily the same as scholarly contributions, they are a useful proxy for them (Björk and Catani 2016). Considering the rapid development of mega-journals, their emergence in specific subject areas (Gong et al. 2020), and the broad but skewed impact on citation-based evaluation systems, it is worth rethinking the MJ model from the perspective of what is most conducive to the development of science to improve the quality of academic exchanges, make benefits reasonable, and further address some of their critiques. Of course, empirical support from various disciplines is needed to further validate these concerns.

Conclusion

MJs have become an established part of the scholarly communication landscape, offering a nontraditional publishing model that distinguishes them from traditional journals. Our study is dedicated to understanding their impact on scholarly communication by quantifying the influence of DSMJs on scholarly evaluation. We carefully examined the benefits that many scientific entities derive from the citations generated by these journals at the journal, discipline, and region levels. MJs expanded into specific subject areas, and their broad yet skewed impact on citation-based evaluation systems. It becomes essential to focus on enhancing the quality of academic exchanges, ensuring equitable benefits, and addressing some of the critiques associated with this nontraditional publishing approach.

Data availability

All data analyzed are contained in the paper and its supplementary information files.

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References

Althouse BM, West JD, Bergstrom CT, Bergstrom T (2009) Differences in impact factor across fields and over time. J Am Soc Inf Sci Technol 60(1):27–34

Björk B-C (2015) Have the "mega-journals" reached the limits to growth? PeerJ 3:e981

Björk B-C, Catani P (2016) Peer review in megajournals compared with traditional scholarly journals: Does it make a difference? Learn Publ 29:9–12

Borgman CL, Furner J (2002) Scholarly communication and bibliometrics. Annu Rev Inform Sci Technol 36(1):1–53

Busby L (2015) A matter of size. Ser Libr 69(3-4):233–239

de Moya-Anegón F, Vargas-Quesada B, Chinchilla-Rodríguez Z, Corera-Álvarez E, Herrero-Solana V, Munoz-Fernández FJ (2005) Domain analysis and information retrieval through the construction of heliocentric maps based on ISI-JCR category cocitation. Inf Process Manag 41(6):1520–1533

Finlay C, Tsou A, Sugimoto C (2015) Scholarly communication as a core competency: prevalence, activities, and concepts of scholarly communication librarianship as shown through job advertisements. J Librariansh Sch Commun 3(1):1221–1236

Fire M, Guestrin C (2019) Over-optimization of academic publishing metrics: observing Goodhart's Law in action. GigaScience 8(6):giz053

Fischer I, Steiger HJ (2018) Dynamics of journal impact factors and limits to their inflation. J Sch Publ 50(1):26–36

Gong Y, Ma TC, Xu YY, Yang R, Gao LJ, Wu SH, Li J, Yue ML, Liang HG, He X, Yun T (2020) Early research on COVID-19: a bibliometric analysis. The Innovation 1(2):100027

Ho YS (2012) Top-cited articles in chemical engineering in Science Citation Index Expanded: a bibliometric analysis. Chin J Chem Eng 20(3):478–488

Ioannidis JPA, Thombs BD (2019) A user's guide to inflated and manipulated impact factors. Eur J Clin Invest 49(9):e13151

Kim SJ, Park KS (2022) Changes in article share and growth by publisher and access type in Journal Citation Reports 2016, 2018, and 2020. Sci Ed 9(1):30–36

Larivière V, Sugimoto CR (2019) The journal impact factor: a brief history, critique, and discussion of adverse effects. In: Glänzel W, Moed HF, Schmoch U, Thelwall M (eds) Springer handbook of science and technology indicators. Springer Handbooks. Springer, Cham, p 3–24

Lăzăroiu G (2017) Do mega-journals constitute the future of scholarly communication? Educ Philos Theory 49(11):1047–1050

Leydesdorff L, Bornmann L, Wagner CS (2019) The relative influences of government funding and international collaboration on citation impact. J Assoc Inf Sci Technol 70(2):198–201

Li J, Yang X, Lu XL, Wu DS (2023) Making journals more international: Language subject differences and impact performance. Learn Publ https://doi.org/10.1002/leap.1567

Niles MT, Schimanski LA, McKiernan EC, Alperin JP (2020) Why we publish where we do: faculty publishing values and their relationship to review, promotion and tenure expectations. PLoS ONE 15(3):e0228914. https://doi.org/10.1371/journal.pone.0228914

Podlubny I (2005) Comparison of scientific impact expressed by the number of citations in different fields of science. Scientometrics 64(1):95–99

Pontika N, Klebel T, Correia A, Metzler H, Knoth P, Ross-Hellauer T (2022) Indicators of research quality, quantity, openness, and responsibility in institutional review, promotion, and tenure policies across seven countries. Quant Sci Stud 3(4):888–911. https://doi.org/10.1162/qss_a_00224

Siler K, Larivière V, Sugimoto CR (2020) The diverse niches of megajournals: specialism within generalism. Assoc Inf Sci Technol 71:800–816. https://doi.org/10.1002/asi.24299

Smith E, Hunt M, Master Z (2014) Authorship ethics in global health research partnerships between researchers from low or middle income countries and high income countries. BMC Med Ethics 15:42. https://doi.org/10.1186/1472-6939-15-42

Smith MJ, Weinberger C, Bruna EM, Allesina S (2014) The scientific impact of nations: journal placement and citation performance. PLoS One 9(10):e109195. https://doi.org/10.1371/journal.pone.0109195

Solomon DJ (2014) A survey of authors publishing in four megajournals. PeerJ 2014(2):e365

Sombatsompop N, Markpin T (2005) Making an equality of ISI impact factors for different subject fields. J Am Soc Inf Sci Technol 56(7):676–683

Truc A (2022) Interdisciplinary influences in behavioral economics: a bibliometric analysis of cross-disciplinary citations. J Econ Methodol 29(3):217–251

Van Leeuwen T, Moed H (2002) Development and application of journal impact measures in the Dutch science system. Scientometrics 53(2):249–266

Van Leeuwen T, Visser M, Moed H, Nederhof T, Van Raan A (2003) The Holy Grail of science policy: exploring and combining bibliometric tools in search of scientific excellence. Scientometrics 57(2):257–280

Vinkler P (2010) The evaluation of research by scientometric indicators. Chandos Publishing, Oxford

Wakeling S, Spezi V, Fry J, Creaser C, Pinfield S, Willett P (2017) Open access megajournals: the publisher perspective (Part 1: Motivations). Learn Publ 30(4):301–311

Zhang ZQ (2006) The making of a mega-journal in taxonomy. Zootaxa 1385:67–68

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Author contributions

JL contributed to design of the work, wrote and revised the manuscript; QL performed data analysis, wrote and revised the manuscript; XL contributed to data collection and curation; DW contributed to the conception and design of the work, collected data and supervised the development of the research. All authors contributed to manuscript revision and approved the final manuscript.

Competing interests

The authors declare no competing interests.

Additional information

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