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Review

Research Trend Analysis in Environmental Studies Category Based on Essential Science Indicators during 2011-2021: A Bibliometric Analysis

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Abstract

Based on the Essential Science Indicators database, this study analyzed 2,536 top papers in the subject category of Environmental Studies about eleven years from 2011 to 2021, which included 2,524 highly cited papers and 66 hot papers and belonged to 45 Web of Science categories and 35 research areas. All the top papers written in English, were from 10,495 authors, 3,129 organizations and 119 countries or regions, and published in 112 journals and two book series. The top five Journals are Energy Policy, Nature Climate Change, Tourism Management, Global Environmental Change-Human and Policy Dimensions and Landscape and Urban Planning. Top five countries were USA, Peoples R China, England, Germany and Australia with more than 307 papers. The top five organizations were University of California System, Chinese Academy of Sciences, University of London, Commonwealth Scientific Industrial Research Organisation CSIRO, Wageningen University Research. The top five authors were Shahbaz, Muhammad; Sovacool, Benjamin K.; Van Vuuren, Detlef P.; Liu, Yansui; Verburg, Peter H. All keywords were separated into eight clusters for different research topic. Visualizations offer exploratory information on the current state in a scientific field or discipline as well as indicate possible developments in the future.

Keywords: bibliometric analysis, Essential Science Indicators (ESI), environmental studies, top papers, VOSviewer

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Introduction

According to category description for Environmental Studies in Scope Notes of Social Science Citation Index (SSCI), it covers resources that are multidisciplinary in nature. These include environmental policy, regional science, planning and law, management of natural resources, energy policy, and environmental psychology.

Bibliometrics technique has been adopted in Web of Science category of Environmental Studies, such as, global trends in urban agriculture research [1], building information modelling for post-disaster reconstruction [2], water-energy-food nexus and climate change adaptation [3], COVID crisis and tourism sustainability [4], technology transfer in the context of sustainable development [5], sustainable agricultural development assessment [6], global research on contaminated soil remediation [7], soil and landscape stability, sensitivity and resistivity [8], gender issues within climate change research [9], circular economy, degrowth and green growth as pathways for research on sustainable development goals [10], sustainable supply chain management towards disruption and organizational ambidexterity [11], mapping the evolution and current trends in climate change adaptation science [12], the role of micro-mobility in shaping sustainable cities [13], corporate social responsibility and sustainability [14], using Q-methodology in environmental sustainability research [15], circular economy business models [16], land degradation [17], life cycle assessment research [18], agroecosystem services research [19].

Top papers are the sum of hot papers and highly cited papers, based on Clarivate Analytics' Essential Science Indicators (ESI). Bibliometrics technique has been adopted in highly cited papers in the field of Economics and Business based on the Essential Science Indicators database [20], highly cited papers in operations research and management science from 2008 to 2017 [21], characteristics of fuzzy research [22], highly cited papers in environmental sciences [23], comparative evaluation of top papers outputs of OIC member countries [24]. Sun and Yuan have analyzed the top papers in Library and Information Science [25], top papers in Agronomy category [26], research trend and status of forestry based on Essential Science Indicators during 2010-2020 [27].

The purpose of this paper was to use bibliometric methods to analyze top papers in the subject category of Environmental Studies during 11 years period from 2011 to 2021. Co-authorship network visualization of author and countries, co-occurrence network visualization of all keywords were done by VOSviewer.

Materials and Methods

Essential Science Indicators (ESI)

Article counts for ESI are derived from Web of Science (WoS) core collection of Science Citation Index Expanded (SCIE) and Social Science Citation Index (SSCI) over an 11-year period. Here, the database has been updated as of March 10, 2022, to cover an 11 year period from January 1, 2011 to December 31, 2021.

Data Collection

Data collection was completed on the single day on March 29, 2022 to avoid the bias. Firstly, it was conducted an advanced search in the WoS category of Environmental Studies. Then, the results were refined the highly cited papers and hot papers. There were 2,536 top papers from WoS core collection which were downloaded and saved as plain text format by selecting the export format "full records and cited references", and then imported into VOSviewer (version 1.6.18, 2022, Leiden University, Leiden, the Netherlands) for further citation analysis. The impact factors (IF 2021 and IF 5 year) were taken from the Journal Citation Report (JCR 2021) that was updated at the end of June 2022.

VOSviewer

In this work, VOSviewer (www.vosviewer.com) were used to show the international collaboration between the authors, countries and the research trends through author keywords, keywords plus and all keywords [28]. The default parameters values of the VOSviewer are usually used in the analysis [29].

Results and Discussion

Document Types and Language of Publication

From WoS Index, all of 2,536 top papers were identified in SSCI (2,534, 99.921%), SCIE (1481, 58.399%), Book Citation Index- Social Sciences & Humanities (BKCI-SSH, 16, 0.631%), Book Citation Index-Sciences (BKCI-S, 12, 0.473%), Conference Proceeding Citation Index- Social Science & Humanities (CPCI-SSH, 7, 0.276%), Conference Proceeding Citation Index-Science (CPCI-S, 5, 0.179%), Arts & Humanities Citation Index (A & HCI, 2, 0.079%).

The document types of all 2,536 top papers were articles (2,273, 89.629%), review articles (263, 10.371%), and also included book chapters (16, 0.631%), proceedings papers (7, 0.276%), Early Access (4, 0.158%). Among the total 2,536 top papers, there were 66 hot papers and 2,524 highly cited papers that means 54 hot papers are both the hot papers

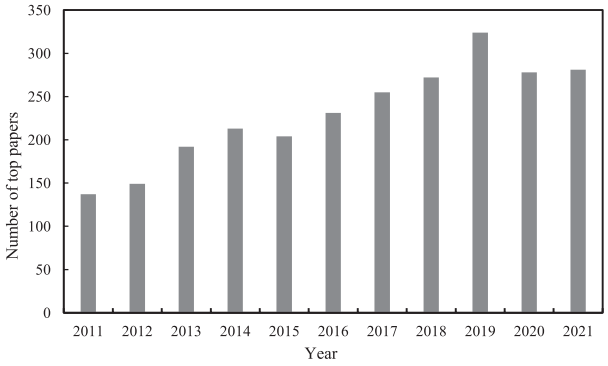

Fig. 1. Number of top papers for Environmental Studies category per year from 2011 to 2021.

and the highly cited papers. All the top papers were published in English language.

Publication Output

Fig. 1 showed the top paper of Environmental Studies category for eleven years from 2011 to 2021. The mean publication number was 230.55 each year, and the highest value was 324 in 2019. For the total 2,536 top papers, the *h*-index is 315, the sum of the times cited is 431,194 and the average citation per item is 170.03 till to March 29, 2022.

Web of Science Categories and Research Areas

Based on the WoS categories, the total 2,536 top papers belong to all 45 WoS subject categories and total 35 research areas. Table 1 list the top 15 WoS categories and research areas for Environmental Studies category during 2011-2021. The top five categories included Environmental Studies (2,515 papers, 99.172% of 2,536 papers), Environmental Sciences (1,063, 41.916 %), Economics (498, 19.637 %), Geography (415, 16.364 %), Energy Fuels (349, 13.762 %). The top five research areas included Environmental Sciences Ecology (2,515, 99.172 %), Business Economics (789, 31.112 %), Geography (415, 16.364 %), Energy Fuels (349, 13.762 %) and Meteorology Atmospheric Sciences (320, 12.618 %). Journals or papers may be classified into two or more categories in the WoS, showed the multidisciplinary character of this research field.

Core Journals

All the 2,536 top papers were published in 112 journals and two book series. The two book series titles were Annual Review of Environment and Resources (12, 0.473 %), Annual Review of Resource Economics (4, 0.158 %). The top 21 core journals were displayed in the Table 2 with total articles each more than

Table 1. The top 15 WoS categories and research areas for Environmental Studies category during 2011-2021.

Rank	WoS categories			Research areas		
	Categories	No. papers	% Total papers	Areas	No. papers	% Total papers
1	Environmental Studies	2,515	99.172	Environmental Sciences Ecology	2,515	99.172
2	Environmental Sciences	1,063	41.916	Business Economics	789	31.112
3	Economics	498	19.637	Geography	415	16.364
4	Geography	415	16.364	Energy Fuels	349	13.762
5	Energy Fuels	349	13.762	Meteorology Atmospheric Sciences	320	12.618
6	Meteorology Atmospheric Sciences	320	12.618	Public Administration	276	10.883
7	Management	291	11.475	Urban Studies	232	9.148
8	Ecology	256	10.095	Social Sciences Other Topics	221	8.715
9	Regional Urban Planning	253	9.976	Science Technology Other Topics	213	8.399
10	Urban Studies	232	9.148	Physical Geography	134	5.284
11	Hospitality Leisure Sport Tourism	216	8.517	Transportation	73	2.879
12	Green Sustainable Science Technology	213	8.399	Psychology	71	2.8
13	Geography Physical	134	5.284	International Relations	47	1.853
14	Transportation	73	2.879	Development Studies	39	1.538
15	Psychology Multidisciplinary	71	2.8	Engineering	25	0.986

Table 2 The top 21 core Journals on Environmental Studies category research indexed in the WoS.

Rank	Journal	TP	Ratio (%)	IF2021	IF 5year	QC	QR
1	Energy Policy	343	13.525	7.576	7.88	Q1	16
2	Nature Climate Change	260	10.252	28.66	32.35	Q1	1
3	Tourism Management	216	8.517	12.879	13.761	Q1	5
4	Global Environmental Change Human and Policy Dimensions	188	7.413	11.16	14.927	Q1	6
5	Landscape and Urban Planning	134	5.284	8.119	9.408	Q1	14
6	Land Use Policy	127	5.008	6.189	6.158	Q1	24
7	Energy Research Social Science	88	3.47	8.514	8.756	Q1	11
8	Resources Policy	85	3.352	8.222	7.658	Q1	13
9	Sustainability	75	2.957	3.889	4.089	Q2	57
10	Sustainable Production and Consumption	71	2.8	8.921	8.424	Q1	10
11	Transportation Research Part D Transport and Environment	67	2.642	7.041	7.624	Q1	18
12	Ecological Economics	60	2.366	6.536	7.3	Q1	22
13	Nature Sustainability	54	2.129	27.157	28.224	Q1	2
14	Journal of Environmental Psychology	53	2.09	7.649	8.646	Q1	15
15	Wiley Interdisciplinary Reviews Climate Change	52	2.05	10.072	10.452	Q1	8
16	Ecology and Society	47	1.853	4.653	6.486	Q2	37
17	Marine Policy	44	1.735	4.315	4.735	Q2	43
18	Business Strategy and the Environment	39	1.538	10.801	11.604	Q1	7
19	Urban Studies	31	1.222	4.418	4.869	Q2	41
20	Habitat International	25	0.986	5.205	6.256	Q2	32
21	Regional Studies	25	0.986	4.595	4.726	Q2	39

Note: TP: Total publications; Ratio: Ratio of 4,822 (%); IF 2021: journal impact factor in 2021; IF5 year: journal impact factor of 5 years; QC: Quartile in Category; QR: Quartile rank of 238 journals in Environmental Studies category from Journal Citation Reports ™ 2021.

25 top papers, and also showed the Journal impact factor as IF 2021 and IF 5 year, Quartile in Category (QC) and Quartile rank (QR) among the total 238 journals in Environmental Studies category from Journal Citation Reports ™ 2021 that was updated at the end of June each year.

The top 5 journals, top 10 journals, top 15 journals and top 21 journals published about 44.99%, 62.58 %, 73.86 % and 82.18 % of the total 2,536 top papers, respectively. The top five Journals are Energy Policy (343, 13.525%), Nature Climate Change (260, 10.252%), Tourism Management (216, 8.517%), Global Environmental Change Human and Policy Dimensions (188, 7.413%) and Landscape and Urban Planning (134, 5.284%), each published more than 134 papers. Based on results of Quartile Category in Table 2, fifteen journals were in Quartile 1 and six journals were in Quartile 2.

According to citation sources analysed by VOSviewer, for the publication data in the citation of 112 journals, there were 53 journals met the thresholds of 5 publications, and 52 journals were connected to each other. The network map of citation for 52 journals in the field of Environmental Studies category was shown seven clusters with different colors in Fig. 2, the size of circles reflected a total number of journal publication records. Journals in the same cluster usually suggested that they published the similar content papers and had close relations with each other. The first cluster (red) had thirteen journals and centred as Transportation Research Part D-Transport and Environment, the second cluster (green) had eleven journals and centred as Tourism Management, the third cluster (blue) had ten journals and centred as Nature Climate Change, the fourth cluster (yellow) had seven journals and centred as Energy Policy, the fifth cluster (violet) had six journals and centred as Landscape and Urban Planning, the sixth cluster (light blue) had three journals and centred as Resources Policy, the seventh cluster (orange) had two journals both Energy Research & Social Science and

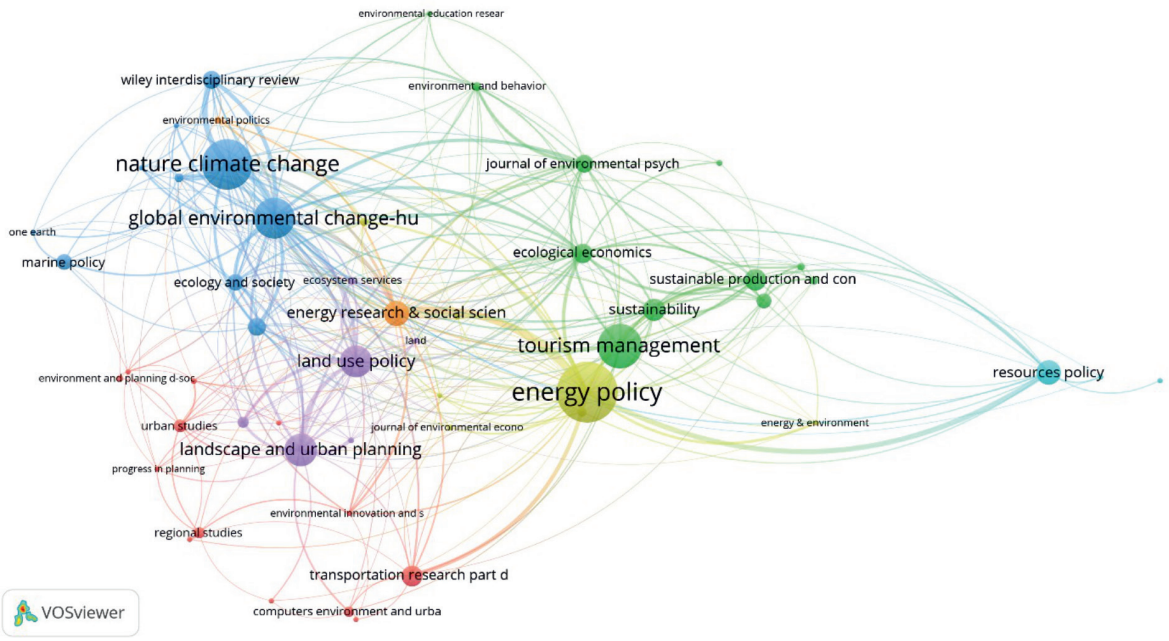

Fig. 2. Network visualization maps of citation journals in the field of Environmental Studies category based on WoS with 52 circles and seven clusters.

Environmental Politics. And the one journal with no relations was Journal of women health.

Authors Co-Authorship Analysis

A total of 10,495 authors have dedicated to all 2,356 top papers, and 132 authors met the thresholds of five publications, but 98 authors were connected with each other, and were separated into 25 clusters. The network of authors co-authorship analysis was represented in Figure 3. Authors in the same cluster usually suggested that they studied in a similar field or worked at same institute or had close cooperation with each other. The strong linkages between authors show that within cluster collaboration is strong.

The detail of author information published articles from 2011 to 2021 along with citation and average citations, were provided in Table 3. The top five authors were Shahbaz, Muhammad; Sovacool, Benjamin K.; Van Vuuren, Detlef P.; Liu, Yansui; Verburg, Peter H.; each published more than 17 papers. Based on the average citations, the top five mostly highly cited authors were Rogelj, Joeri; Kriegler, Elmar; Riahi, Keywan; Stehfest, Elke; Van Vuuren, Detlef P.; with cited more than 287.5 times per published paper.

Countries/Regions Co-Authorship Analysis

There were 119 countries or regions that contributed 2,536 top papers from 2011 to 2021 based on WoS and 68 countries or regions that met the requirement threshold as five. Table 4 represented the list of the top 20 countries or regions that published more than 69 papers. Among the 20 countries, top five countries were USA, Peoples R China, England, Germany and Australia with more than 307 papers. From the average citations, the top five countries were Scotland, Denmark, Australia, Japan, the Netherlands, which their citations are more than 234 times per paper.

The VOSviewer divided these 68 countries or regions into five clusters. In Fig. 4, the first cluster consisted of twenty-five countries or regions (red) including Germany, Sweden, Italy, Spain, Switzerland, Austria, Norway, Denmark, Scotland, Finland, Belgium, Portugal, Greece, Poland, Ireland, Czech Republic, Israel, Hungary, Romania, Lithuania, Estonia, Luxembourg, Slovenia, Slovakia, Cyprus. The second cluster consisted of twenty-one countries or regions (green) including USA, England, Australia, Canada, Japan, Brazil, Singapore, South Korea, Wales, New Zealand, Chile, Mexico, Vietnam, Indonesia, Thailand, Argentina, Peru, Ethiopia, Nigeria, Nepal, Philippines. The third cluster consisted of twenty countries or regions (blue) including Peoples R China, France, India, Pakistan, South Africa, Turkey, Malaysia, Taiwan, Saudi Arabia, Russia, Bangladesh, Iran, Kenya, Egypt, Tunisia, Ghana, North Ireland, Lebanon, Qatar, U Arab Emirates. The forth cluster consisted of only one country of Colombia (yellow). The fifth cluster consisted of only one country of Netherlands (violet). Taiwan, as a region of China, showed a stronger research ability in the field.

Organizations (Author Affiliation) Co-Authorship Analysis

They were updated according to the latest paper published by the author until March 29, 2022. A total

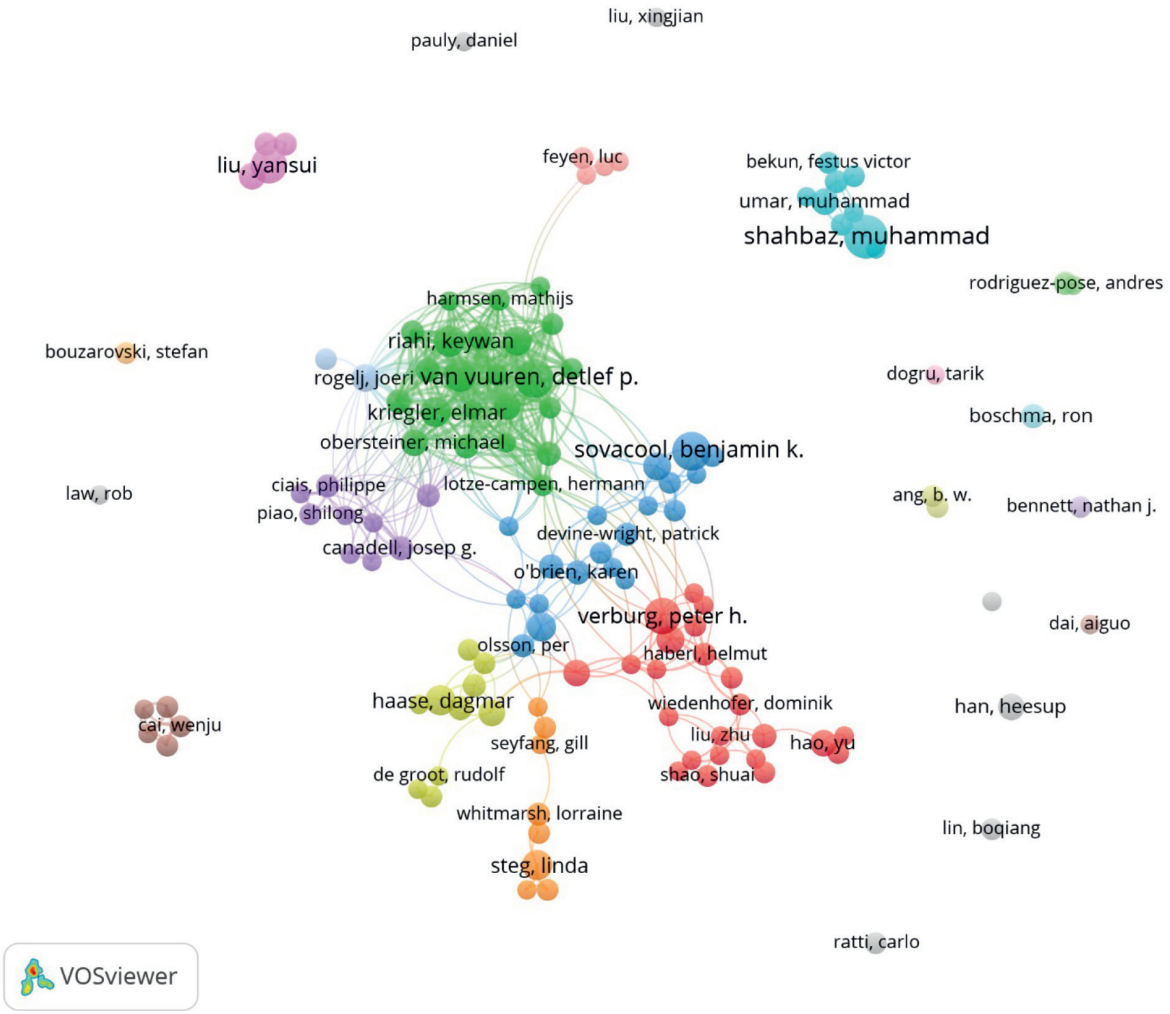

Fig. 3. Network visualization map of top authors in Environmental Studies category from 2011 to 2021.

Table 3. The top fifteen most prolific authors published papers in the field of Environmental Studies category from 2011 to 2021.

Rank	Author	Papers	Citations	Average citations
1	Shahbaz, Muhammad	25	3131	125.2
2	Sovacool, Benjamin K.	20	2161	108.1
3	Van Vuuren, Detlef P.	19	5463	287.5
4	Liu, Yansui	17	2578	151.6
5	Verburg, Peter H.	17	2821	165.9
6	Havlik, Petr	14	3878	277.0
7	Riahi, Keywan	13	4276	328.9
8	Haase, Dagmar	12	2282	190.2
9	Kriegler, Elmar	12	4428	369.0
10	Steg, Linda	12	2258	188.2
11	Folke, Carl	11	2466	224.2
12	Stehfest, Elke	11	3205	291.4
13	Geels, Frank W.	10	1792	179.2
14	Kuemmerle, Tobias	10	1659	165.9
15	Rogelj, Joeri	10	3959	395.9

Table 4. Top 2 countries/regions publishing top papers in the field of Environmental Studies category from 2011 to 2021.

Rank	Countries/Regions	Records Count	Cluster	Total link strength	Citations	Average citations
1	USA	844	2	1,803	176,868	209.6
2	Peoples R China	576	3	764	73,591	127.8
3	England	569	2	1,540	109,029	191.6
4	Germany	331	1	1,229	67,205	203.0
5	Australia	307	2	1,043	74,050	241.2
6	Netherlands	286	5	1,033	66,911	234.0
7	Canada	212	2	714	42,806	201.9
8	Sweden	196	1	757	37,805	192.9
9	Italy	184	1	646	33,463	181.9
10	France	177	3	818	39,239	221.7
11	Spain	168	1	695	28,895	172.0
12	Switzerland	130	1	612	27,911	214.7
13	Austria	119	1	563	25,583	215.0
14	Norway	117	1	562	21,306	182.1
15	Denmark	90	1	429	21,951	243.9
16	Scotland	75	1	382	18,993	253.2
17	Finland	72	1	417	14,642	203.4
18	Japan	71	2	383	16,839	237.2
19	Belgium	69	1	343	11,185	162.1
20	India	69	3	235	9,156	132.7

of 3,129 organizations had 2,536 top papers. Table 5 represented the top 21 organizations and institutions ranked by the number of total publications (more than 49 papers), ratio and country. These 21 organizations were mainly in England (5 organizations), USA (4 organizations), Netherlands (3 organizations), Germany (2 organizations), China (1 organization), Australia (1 organization), France (1 organization), Sweden (1 organization), Switzerland (1 organization), Austria (1 organization) and Canada (1 organization). Furthermore, the top five organizations were University of California System, Chinese Academy of Sciences, University of London, Commonwealth Scientific Industrial Research Organisation (CSIRO), Wageningen University Research, and contributed articles more than 74 papers each.

Keywords Co-Occurrence Analysis

For the author keywords by full counting method for co-occurrence analysis, there were total 6,471 author keywords, and 296 author keywords met the threshold of five level and were separated into thirteen clusters (Fig. 5a). The top twenty-two co-occurrence author keywords were climate change, China, sustainability, COVID-19, ecosystem services, sustainable development, economic growth, circular economy, renewable energy, adaptation, resilience, urbanization, CO_2 emissions, vulnerability, energy consumption, governance, carbon emissions, energy, land use, biodiversity, corporate social responsibility, urban planning, each author keywords occurred more than 23 times.

For the keywords plus by full counting method for co-occurrence analysis, there were total 5,656 keywords plus, and 696 keywords plus met the threshold of five level and were separated into eight clusters (Fig. 6a). The top twenty-two co-occurrence keywords plus were impact, management, climate-change, policy, model, impacts, CO_2 emissions, economic-growth, framework, conservation, energy, growth, sustainability, governance, innovation, consumption, performance, China, ecosystem services, determinants, systems, cities, each keywords plus occurred more than 76 times.

For the all keywords by full counting method for co-occurrence analysis, there were total 10,865 all keywords, and 980 all keywords met the threshold of five level and were separated into eight clusters that represented the different viewpoints on Environmental Studies category research (Fig. 7a). The top twenty-two co-occurrence all keywords were impact, management, climate-change, China, sustainability, policy, CO_2

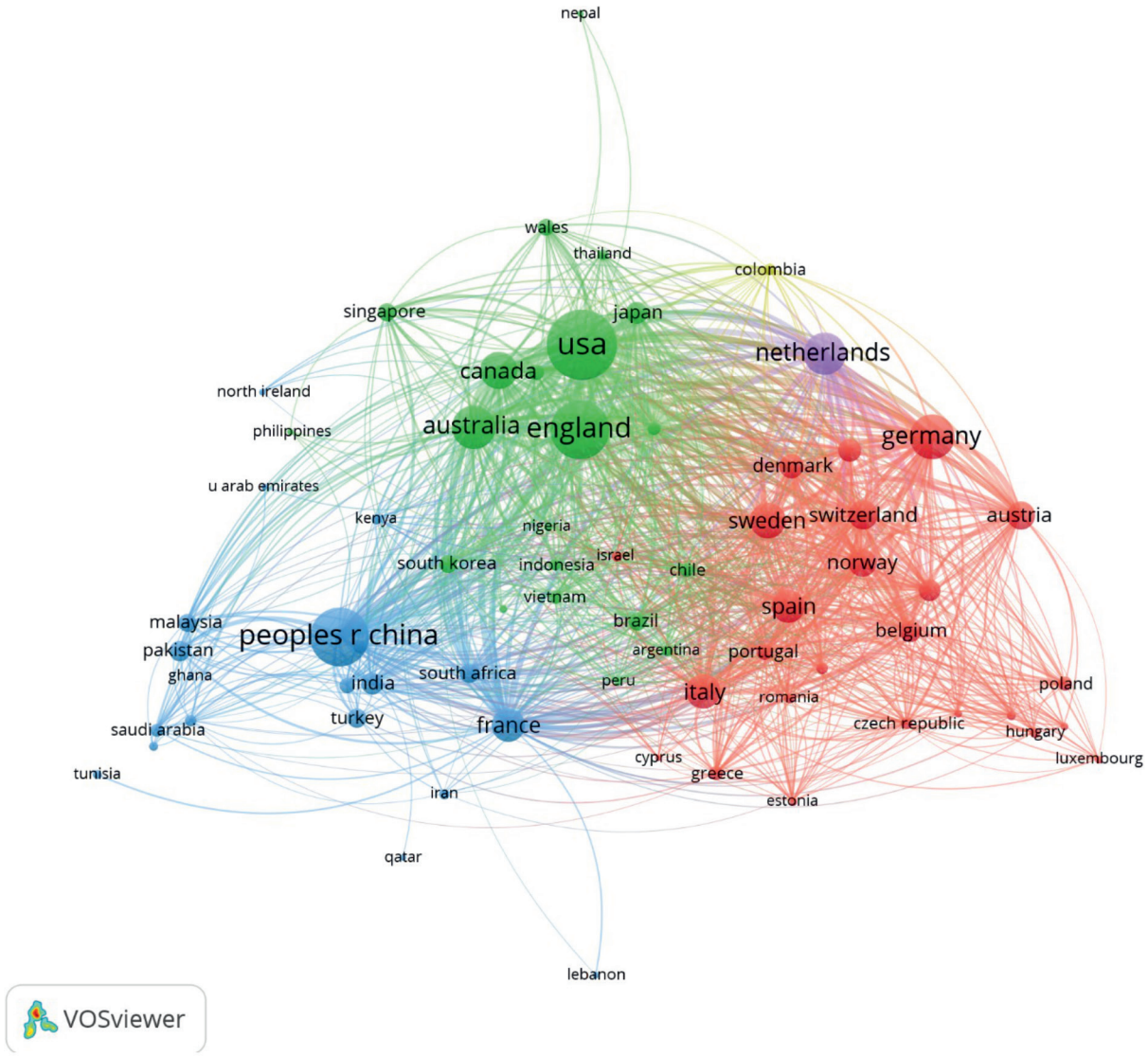

Fig. 4. The country co-authorship network of Environmental Studies category related top papers from 2011 to 2021. The country co-authorship network map with 68 nodes and five clusters.

emissions, model, impacts, ecosystem services, climate change, energy, governance, conservation, economic-growth, framework, innovation, growth, consumption, biodiversity, adaptation, vulnerability, each all keywords occurred more than 94 times.

The same data were then arranged by a period of Environmental Studies category research as overlay map for most frequent author keywords (Fig. 5b), plus keywords (Fig. 6b) and all keywords (Fig. 7b). Blue colors indicated earlier research topics, whereas, yellow and green colors indicated more recent topics of interest. Yellow and green circles present those research fronts. For example of all keywords in Fig. 7b), the upper part is the earlier research, and the lower part is the recent or front research.

Here, for all keywords, about twenty all keywords were list and ranked in each cluster based on Fig. 7a).

The first cluster (red) has 181 all keywords and focused on impact model, and 20 most frequently used all keywords as impact, model, determinants, attitudes, behaviour, risk, COVID-19, satisfaction, perceptions, tourism, technology, adoption, decision-making, information, quality, community, system, values, place attachment, planned behavior, each all keywords occurred more than 35 times.

The second cluster (green) has 150 all keywords and represents climate-change impacts, and 20 most frequently used all keywords as climate-change, impacts, climate change, emissions, agriculture, variability, temperature, trends, climate, water, food security, mitigation, carbon, pollution, scenarios, models, united-states, responses, uncertainty, land, each all keywords occurred more than 28 times.

The third cluster (blue) has 147 all keywords and is focused on carbon emissions and economic-growth, the 20 most frequently used keywords as CO_2 emissions, energy, economic-growth, growth, consumption, energy-consumption, financial development, carbon

Table 5. Top twenty-one organizations published papers in the field of Environmental Studies category based on WoS from 2011 to 2021.

Rank	Affiliations	Records	% of 2,536	Country
1	University of California System	116	4.574	USA
2	Chinese Academy of Sciences	106	4.18	China
3	University of London	92	3.628	England
4	Commonwealth Scientific Industrial Research Organisation (CSIRO)	75	2.957	Australia
5	Wageningen University Research	74	2.918	Netherlands
6	Helmholtz Association	71	2.8	Germany
7	Centre National De La Recherche Scientifique (CNRS)	63	2.484	France
8	Stanford University	63	2.484	USA
9	University of Exeter	62	2.445	England
10	Utrecht University	60	2.366	Netherlands
11	Potsdam Institut Fur Klimafolgenforschung	59	2.326	Germany
12	Stockholm University	57	2.248	Sweden
13	Vrije Universiteit Amsterdam	57	2.248	Netherlands
14	Eth Zurich	55	2.169	Switzerland
15	International Institute for Applied Systems Analysis (IIASA)	54	2.129	Austria
16	University of Oxford	53	2.09	England
17	University of Sussex	53	2.09	England
18	United States Department of Energy (DOE)	52	2.05	USA
19	University of East Anglia	52	2.05	England
20	State University System of Florida	49	1.932	USA
21	University of British Columbia	49	1.932	Canada

emissions, economic growth, environmental kuznets curve, cointegration, demand, efficiency, empirical-evidence, energy efficiency, greenhouse-gas emissions, trade, panel-data, carbon-dioxide emissions, countries, each all keywords occurred more than 36 times. This topic is a front research in Fig. 7b).

The fourth cluster (yellow) has 119 all keywords and represents policy, and 20 most frequently used all keywords as policy, renewable energy, systems, politics, knowledge, industry, perspective, power, economy, transition, globalization, lessons, sustainability transitions, institutions, electricity, justice, geography, energy transitions, transitions, climate policy, each all keywords occurred more than 19 times.

The fifth cluster (violet) has 111 all keywords and is focused on management of sustainable development and innovation, and 21 most frequently used keywords as management, sustainability, innovation, performance, sustainable development, challenges, future, circular economy, design, barriers, green, strategies, environmental performance, drivers, corporate social responsibility, corporate social-responsibility, environmental impacts, implementation, technologies, financial performance, life-cycle assessment, each all keywords occurred more than 21 times. This topic is a front research Fig. 7b).

The sixth cluster (light blue) has 98 all keywords and is focused on urbanization and land-use, and 22 most frequently used keywords as China, urbanization, land-use, dynamics, city, patterns, indicators, land-use change, driving forces, Europe, deforestation, vegetation, landscape, policies, security, areas, consequences, expansion, transformation, land use, urban planning, ecology, each all keywords occurred more than 20 times.

The seventh cluster (orange) has 95 all keywords and is focused on ecosystem services and biodiversity, and 20 most frequently used all keywords as ecosystem services, biodiversity, cities, health, environment, benefits, scale, urban, environmental justice, green space, exposure, diversity, physical-activity, gender, space, green infrastructure, stress, built environment, preferences, recovery, each all keywords occurred more than 18 times. The eighth cluster (brown) has 79 all keywords and focused on governance and conservation, and 21 all keyword as governance, conservation, framework, adaptation, vulnerability, resilience, science, trade-offs, social-ecological systems,

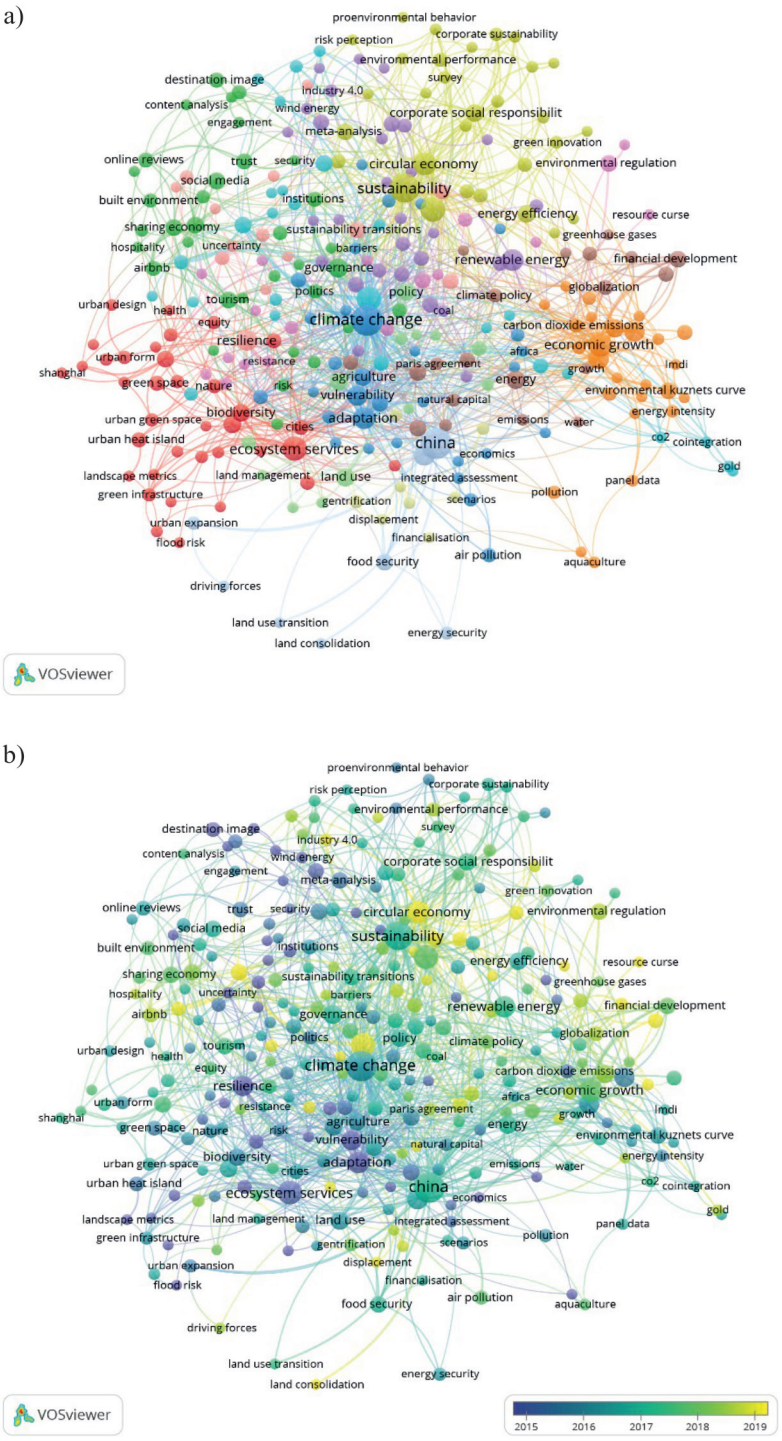

Fig. 5. VOSviewer co-occurrence network visualization (Figure 5a) and overlay visualization (Figure 5b) of most frequent author keywords in Environmental Studies from 2011 to 2021.

economics, valuation, adaptive capacity, poverty, infrastructure, protected areas, environmental-change, perspectives, services, fisheries, global change, level, each all keywords occurred more than 14 times.

The Most Frequently Cited Articles

The annual citations of the nine papers showed an increasing trend after year of publication (Fig. 8). Here, the total citations for the most frequently cited articles were more than 1,150 times. The nine papers were authored by Costanza et al. (2014) in Global Environmental Change-Human and Policy Dimensions [30], Dai (2013) in Nature Climate Change [31], Dai (2011) in Wiley Interdisciplinary Reviews-Climate Change [32], Wolch et al. (2014) in Landscape and Urban Planning [33], Trenberth et al. (2014) in Nature Climate Change [34], Yao et al. (2012) in Nature

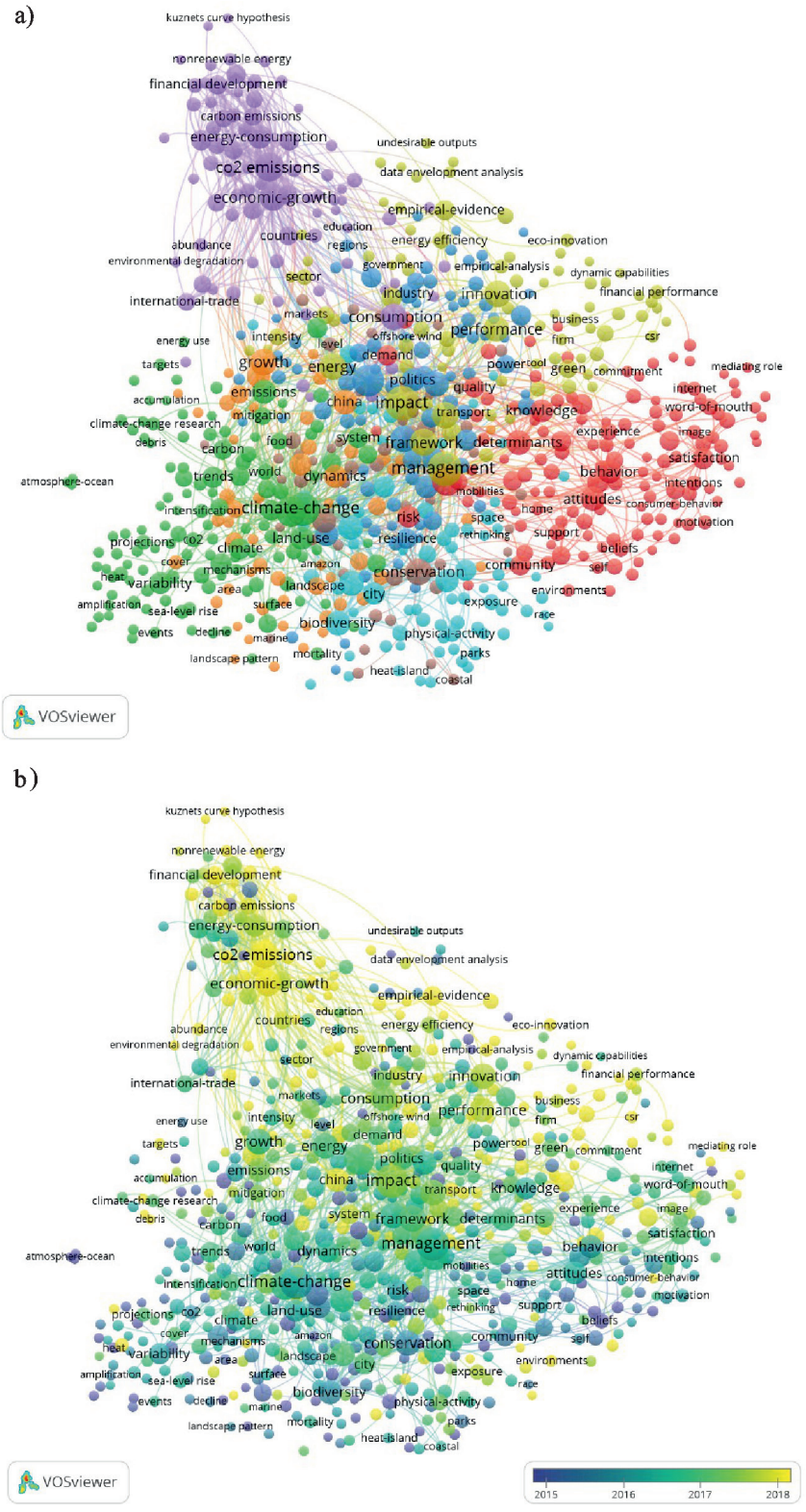

Fig. 6. VOSviewer co-occurrence network visualization (Figure 6a) and overlay visualization (Figure 6b) of most frequent keywords plus in Environmental Studies from 2011 to 2021.

Climate Change [35], Jacob et al. (2014) in Regional Environmental Change [36], Coumou and Rahmstorf (2012) in Nature Climate Change [37], Cai et al. (2014) in Nature Climate Change [38]. Total Citations of nine most cited papers were 2352, 2245, 1533, 1434, 1417, 1324, 1243, 1192 and 1150 times. From the publication year to 2022, the average citation per year of the most citation nine papers were 261.33, 224.5, 127.75, 159.33, 157.44, 120.36, 138.11, 108.36 and 127.78 times. Among the nine articles, the highest average citation per year

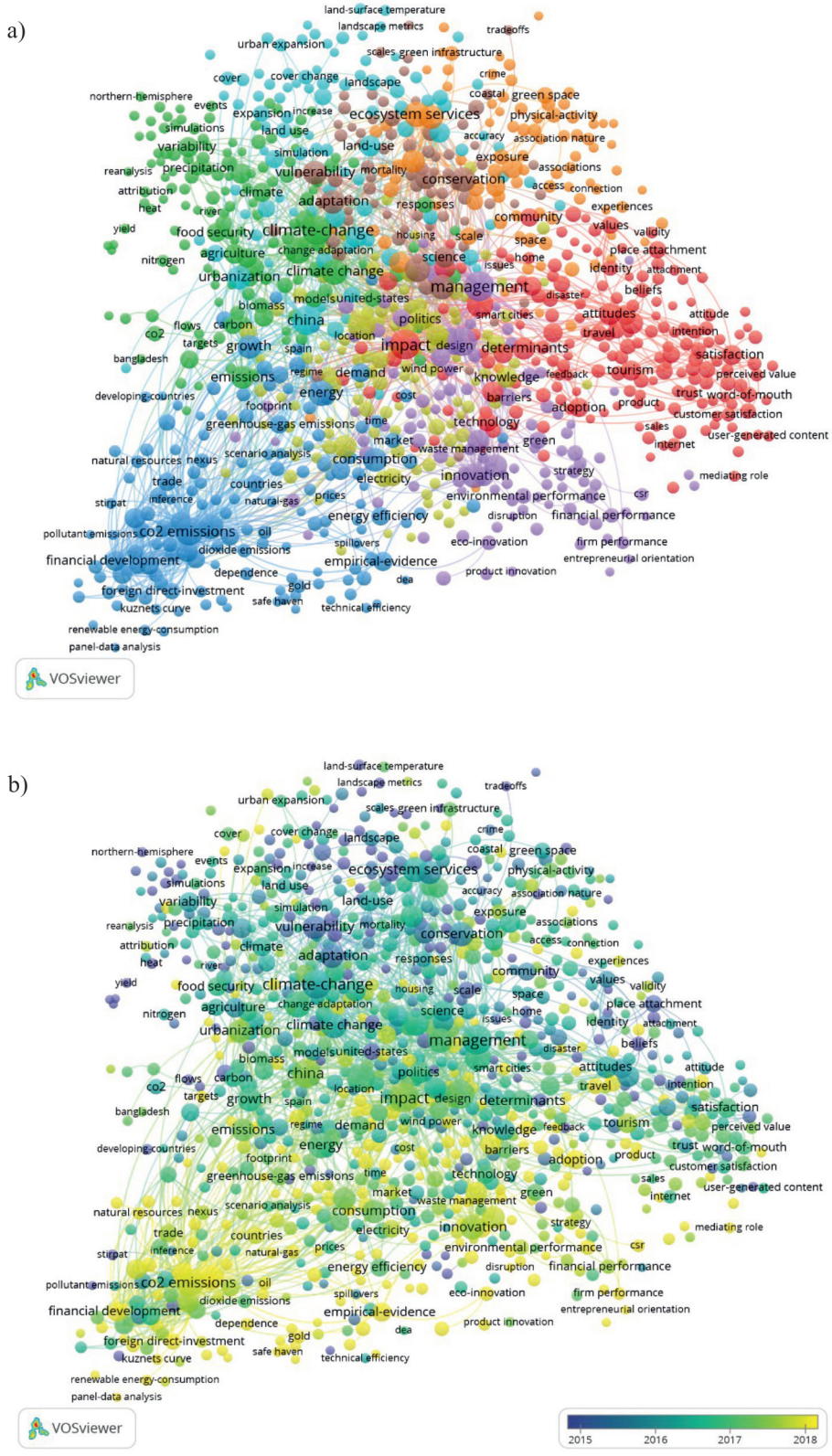

Fig. 7. VOSviewer co-occurrence network visualization (Figure 7a) and overlay visualization (Figure 7b) of most frequent all keywords in Environmental Studies from 2011 to 2021.

(261.33) was observed for article of Costanza et al. (2014) published in Global Environmental Change-Human and Policy Dimensions (Fig. 8).

Conclusions

This study analyzed 2,536 top papers in the subject category of Environmental Studies about

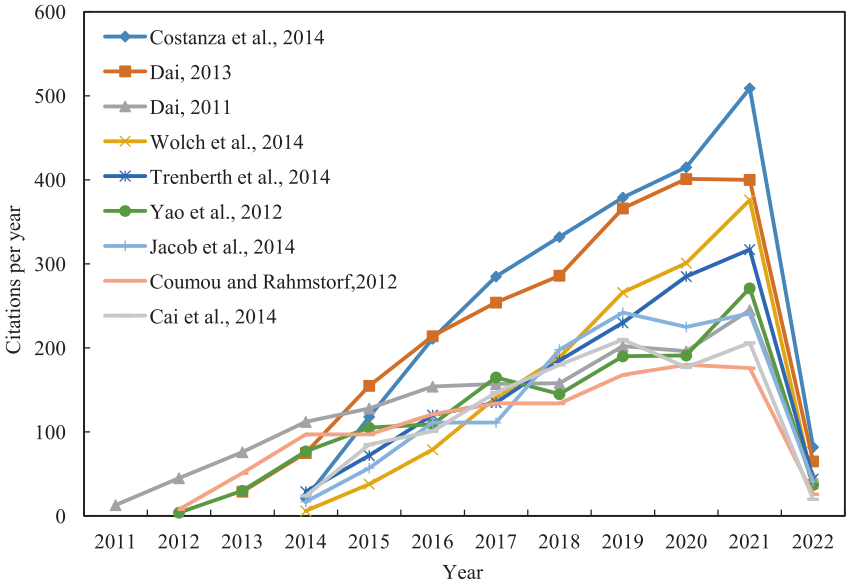

Fig. 8. Comparison of the citations per year of the most nine papers from their initial publications to March 29, 2022.

eleven years from 2011 to 2021, which included 2,524 highly cited papers and 66 hot papers and belonged to 45 WoS categories and 35 research areas. All top papers written in English, were from 10,495 authors, 3,129 organizations and 119 countries or regions, and published in 112 journals and two book series. The top five Journals are Energy Policy, Nature Climate Change, Tourism Management, Global Environmental Change - Human and Policy Dimensions and Landscape and Urban Planning. Top five countries were USA, Peoples R China, England, Germany and Australia. The top five organizations were University of California System, Chinese Academy of Sciences, University of London, Commonwealth Scientific Industrial Research Organisation (CSIRO), Wageningen University Research. The top five authors were Shahbaz, Muhammad; Sovacool, Benjamin K.; Van Vuuren, Detlef P.; Liu, Yansui; Verburg, Peter H. All keywords were separated into eight clusters for different research topic on impact model, climate-change impacts, carbon emissions and economic-growth, policy, management of sustainable development and innovation, urbanization and land-use, ecosystem services and biodiversity, governance and conservation. The research fronts were mainly focused on the cluster of carbon emissions and economic-growth, and the cluster of management of sustainable development and innovation. This work is also useful for student identifying graduate schools and researchers selecting journals.

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Conflict of Interest

The authors declare no conflict of interest.

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