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Review Article

Environmental degradation and poverty: A bibliometric review

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ABSTRACT

Understanding the mutual logic between environment and poverty mitigation is vital for achieving the United Nations Sustainable Development Goals (SDGs). This study conducts a bibliometric review of the available literature on environmental degradation and poverty and summarizes the existing researches. By applying suitable keywords, we retrieved 175 peer-reviewed articles from the Web of Science published between 1993 and 2020. We utilized the visualization of similarity viewer (VOSviewer) for this bibliometric study and classified the leading publications, prominent journals, and institutions. Furthermore, our bibliometric review found a phenomenon in investigation that people are indifference about the impact of environmental degradation on rising poverty levels in poor and developing countries. In terms of contributions, this study classifies 4 leading thematic clusters that identify how environmental degradation increases poverty. By employing text mining analysis, this research connects specific environmental terms accountable for the recent rise in global poverty. We finally recommend that including other databases to strengthen the findings of environmental degradation and poverty is one of the future research directions.

1. Introduction

The world has endorsed the Kyoto Protocol and the Paris Agreement to counter and reverse the negative impacts of environmental degeneration, which is referred to as the continuous deterioration of diverse ecosystems and human life habitats due to the over-consumption of natural and manufactured resources (Johnson et al., 1997). The World Bank (1992) defined it as deforestation, air pollution, land degradation, water scarcity and contamination, and biodiversity loss. Nevertheless, environmental degeneration is defined in various manners because multiple factors are responsible for its advent. For instance, rapid industrialization and economic growth consume many finite natural resources, leading to environmental degradation (Chakravarty and Mandal, 2020). Increasing energy consumption is another factor (Al-Mulali and Binti Che Sab, 2012) resulting in environmental degradation. Many studies (e.g., Jian et al., 2019; Pandey et al., 2020) use CO_2 emissions to proxy environmental degradation. Hence, this study employs environmental degradation as a term to select relevant literature for bibliometric review.

Out of the 17 United Nations Sustainable Development Goals (SDGs), 8 goals are directly and 3 goals are indirectly related to environment (United Nations, 2021). Poverty eradication is the first and chief SDG. Researchers (Asongu et al., 2017; Akinlo and Dada, 2021) have reported that environmental degradation may lead to high poverty levels when essential resources are needed to improve

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people's wellbeing and applied to meet ecological challenges. Poverty refers to all forms of human deprivation, such as food malnutrition, lack of healthcare services, lack of or low quality of education and income, exposure to various types of pollution, and gender disparity (Akinlo and Dada, 2021).

Because of relatively cheaper labour, the world's manufacturing bases have been shifted from developed countries to developing countries (Agten, 2021). Although this manufacturing and production expansion increased economic activity in developing countries, it also generated high global CO_2 emissions (Akinlo and Dada, 2021; Kousar and Shabbir, 2021). This negative externality is responsible for the rapid environmental degradation within developing countries. Researches have indicated that rising CO_2 emissions have further worsened environmental degradation and poverty levels (Ahluwalia et al., 1979; Akinlo and Dada, 2021; Kousar and Shabbir, 2021). Hence, environmental degradation and poverty are interconnected; therefore, eliminating them is vital for economic studies in developing countries (Barbier, 2010; Kousar and Shabbir, 2021).

Considerable researches (Scherr, 2000; Nyssen et al., 2004; Pattanayak et al., 2010; McElwee, 2012) are available on the relationship between environmental degradation and poverty, yet literature fails to provide a conclusive overview about this relationship. Researchers (Reardon and Vosti, 1995; Duraiappah, 1998; Barbier, 2010) have argued that the negative impact of environmental degradation on poverty is more severe in developing countries than in developed countries. However, literature (Ravnborg, 2003) provides an unbalanced viewpoint regarding this fundamental relationship. Some researchers (e.g., World Bank, 1992; Shaista, 2010; Masron and Subramaniam, 2019; Malerba, 2020) argued that poverty will cause environmental degradation. Kumar and Hotchkiss (1988) and Duraiappah (1998) have pointed out that environmental degradation causes poverty as the poor overexploit natural resources and damages the environment. The Intergovernmental Panel on Climate Change (IPCC, 2018) reported that ecological degradation is currently responsible for escalating global poverty levels.

Review studies (Duraiappah, 1998; Masron and Subramaniam, 2019) examining the relationship between environmental degradation and poverty underscore that it is too simplistic to assert a direct link between them. Current review studies on environmental degradation are also limited in their scope. For instance, a recent bibliometric study by Sarkodie and Strezov (2019) recognized that researchers typically examine the environmental Kuznets curve (EKC) hypothesis by measuring greenhouse emissions such as CO_2 emissions. However, this study emphasized this limitation and measured the EKC hypothesis and the environmental quality by using land, sea, biodiversity, and freshwater accessibility indicators. These related studies provide valuable insights, yet fail to explicitly focus on the link between environmental degradation and poverty. To the best of our knowledge, we do not find a single bibliometric review study that has investigated the relationship between environmental degradation and poverty.

This study will fulfill this gap and aim to provide a comprehensive literature summary covering environmental degradation and poverty. For this purpose, we conduct a bibliometric review of available literature on environmental degradation and poverty within the Web of Science database (https://clarivate.com/webofsciencegroup/solutions/web-of-science/). Bibliometric methodology maps the structures and development of a scientific field (Zupic and Čater, 2015). This approach provides broader insights into the examined research field and a structured understanding of the research patterns, thematic clusters, and frameworks within the research field. The following research questions guide our bibliometric analysis.

(1) What is the publication trend in this research field?
(2) Which influential journals, researchers, and research organizations dominate this research field?
(3) What are the top-cited research publications and their impact in this research field?
(4) What thematic research clusters and research terms dominate this research field?

Our study makes valuable contributions to literature on relationship research between environmental degradation and poverty. First, it conducts citation analysis and provides a structured classification of leading journals, publications, research organizations, and countries. This scientific mapping technique provides intellectual dynamics about this research field and how researchers contribute to this research field. Recognizing the ongoing research efforts on environmental degradation and poverty will provide avenues to improve interdisciplinary research. Further, it will give a better intellectual understanding of the mutual interconnectivity between environmental degradation and poverty. Second, analysis in this study provides four thematic clusters; these clusters have overlapping research fields such as sustainability, climate change, developing countries, deforestation, conservation, biodiversity, poverty, and sustainable development, demonstrating interdisciplinary research. Third, our text mining analysis identifies the leading terms that dominate environmental degradation and poverty research. These terms will provide the critical relevance and connectivity that researchers should employ to study ecological issues and poverty in poor regions of the world. Broadly, these contributions would help researchers to explore severe environmental problems in a superior manner.

2. Research methodology, data sources, and analysis software

Bibliometric review is a statistical technique to quantitatively analyze academic literature on a selected topic (Zhong et al., 2016). This technique provides an overview of the existing literature and recognizes the leading contributions made by authors, countries, and research institutions. In addition, the keyword analysis summarizes central research themes and future research directions.

2.1. Visualization software

We applied the visualization of similarity viewer (VOSviewer) software to generate, visualize, and analyze bibliometric networks for this study (van Eck and Waltman, 2010a). We chose VOSviewer over other visualization software (such as Bibexcel, Biblioshiny, and

SciMAT) due to its helpful features. Its user-friendly techniques allow users to create co-authorship, co-citation, and co-occurrence networks, density and overlay visualization, as well as clustering and text mining analyses (Moral-Muñoz et al., 2020). VOSviewer provides networks of leading authors, journals, institutions, and publications. It also provides visualization at scales that are not infeasible when using manual methods or legacy software tools (Perianes-Rodriguez et al., 2016). With the help of VOSviewer, text mining analysis technique constructs network maps of co-occurrence keywords sourced from the abstracts and bodies of selected research articles. Compared to other computer software programs, VOSviewer pays a special attention to the graphical representation of bibliometric maps (van Eck et al., 2010). Furthermore, large bibliometric maps are easy to display and decipher within VOSviewer.

2.2. Search terms

We applied three keywords in a stepwise process to retrieve the relevant literature from the Web of Science database. This approach preserves the validity and relevance of the research results for bibliometric review. First, we applied the keyword 'environmental degradation' in the topic field. Successively, we added stepwise 'poverty' and 'developing countries' to extract the relevant research articles. The search process provided us with 181 publications. We further selected "All Years" for the timespan. Our search databases included Science Citation Index-Expanded (SCI-EXPANDED), Social Science Citation Index (SSCI), Arts & Humanities Citation Index (A&HCI), Conference Proceedings Citation Index (CPCI-S), Conference Proceedings Citation Index-Social Science & Humanities (CPCI-SSH), and Emerging Source Citation Index (ESCI). In the next step, we kept only the research publications written in English and excluded materials such as editorial material and book chapters. After applying these inclusion and exclusion criteria, we ended up with 175 published papers from the Web of Science database during 1993–2020.

3. Results

3.1. Publication trend

Fig. 1 shows the publication exponential trend line, which can be divided into three periods, i.e., the pre-Kyoto Protocol period (1993–1996), the post-Kyoto Protocol period (1997–2015), and the post-Paris Agreement period (2016–2020). In the first period, the world lacks comprehensive international agreements to protect environment, and accordingly, we see limited researches in the Web of Science database. In the second period, the world reached an agreement to offset climate change under the Kyoto Protocol. As a result, we notice an upward trend in the yearly research publications. This trend reveals the effects of research funding received by different organizations, research centers, academic institutions, and researchers investigating environmental-related themes. Finally, the last (and ongoing) period shows an increasing trend in research publications on the environmental degradation-poverty nexus. This expanding interest of the international research community may be the outcome of the Paris Agreement, a more transparent global agreement to achieve SDGs and mitigate environmental degeneration and poverty.

3.2. Leading journals

We classified the leading top journals and their total citations by applying the bibliographic coupling algorithm. We set 2 articles per journal as the threshold criteria. Twenty-eight journals meet the threshold criteria out of the 133 journals. Table 1 shows the top 12

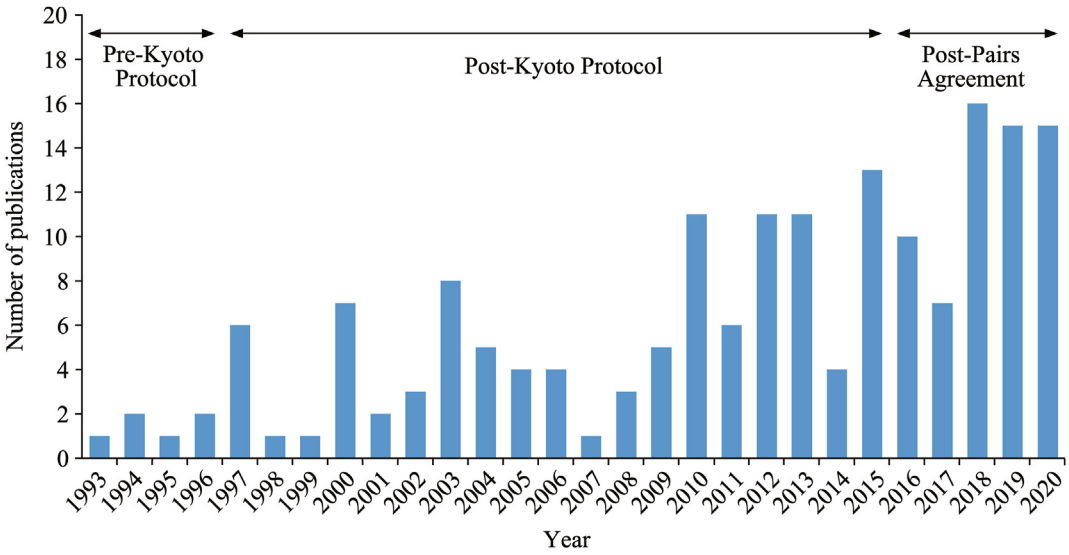

Fig. 1. Publication trend of studies on relationship of environmental degradation and poverty.

journals with their respective total citations, average citations, average normalized citations, and total link strength (TLS). Average citations are the average number of citations received by a publication published by a source (i.e., the selected journals). Average normalized citations normalize the citations received by older and recent articles because older articles are likely to receive more citations. TLS is an attribute that indicates the total strength of the co-authorship links of a given researcher with other researchers (van Eck and Waltman, 2020). With 134 citations, World Development published 6 articles, the highest number on the environmental degradation-poverty nexus research field. Forests is the next journal, which published 4 papers with 74 citations. Next, International Journal of Sustainable Development and World Ecology published 4 articles with 31 citations, followed by Geographical Journal, with 3 published articles and 160 citations.

3.3. Journal co-citation analysis

We chose journal sources as the unit of analysis in co-citation analysis. By choosing 10 citations per source (journal), we shortlisted 105 journals from our analysis. In addition, a co-citation network map was provided. The co-citation network is formed by nodes showing the relative number of co-citations for a specific journal. Different colors classify the nodes of the co-citation network. The arrangement of items (journals) into the different nodes indicates a series of similarities in the content of those documents (Dorin et al., 2020). Furthermore, the lines and distance between journals represent the links of the co-citations between articles published in other journals. Thus, the closer the journals are to the co-citation network map, the stronger the relatedness between them (van Eck et al., 2010).

Six clusters were observed by applying this co-citation criterion (Fig. 2). The most dominating and largest cluster (red color) has 32 journals. Ecological Economics is the leading journal with 175 citations and a TLS of 5285. Science is another important journal with 130 direct citations and a TLS of 3476. Proceedings of the National Academy of Sciences of the United States of America has 72 citations and a TLS of 2631.

In the second cluster (green color), there are 25 journals. World Development is the leading journal in the network map, having 247 citations and a TLS of 7184. The journal Environment and Development Economics has 66 citations and a TLS of 2719.

The third cluster (blue color) has 14 journals. Agriculture Ecosystems & Environment is the leading journal with 61 citations and a TLS of 2714. The journal Land Degradation & Development has 30 citations and a TLS of 1039.

The fourth, fifth, and sixth clusters bring together journals with minimum citations. The fourth cluster (yellow color) has 12 journals, including Energy Policy, a reputable journal with 55 citations and a TLS of 1269. The fifth cluster (purple color) has 12 journals. AMBIO-A Journal of Environment and Society is among them, which has 38 citations and a TLS of 850. The last cluster (light blue color) has 10 journals. Journal of Cleaner Production is the most prominent journal with 55 citations and a TLS of 1307.

3.4. Leading organizations

By applying the bibliographic coupling method, we identified the most influential organizations in this research field. Two publications per organization were set as the threshold criteria. Out of 299 organizations, 28 organizations met the threshold criteria; out of these 28 organizations, 24 organizations have only 2 research articles, indicating that most organizations are equal in research publications. Using total citations as a benchmark, we selected the top 16 contributing organizations. Table 2 illustrates total citations, average citations, average normalized citations, and TLS for each organization. The top 4 leading organizations are Charles Sturt University, Santa Clara University, International Livestock Research Institute, and University of Gothenburg.

3.5. Geographical placement

To examine the geographical placement of the research publications, we applied a bibliographic coupling algorithm. We set 3

Table 1
Top 12 journals with the most articles in the environmental degradation-poverty nexus research field.

Journal	Number of articles	Total citations	Average citations	Average normalized citations	TLS
World Development	6	134	22.33	0.95	80
Forests	4	74	18.50	0.61	41
International Journal of Sustainable Development and World Ecology	4	31	7.75	0.79	5
Geographical Journal	3	160	53.33	1.46	45
Land Use Policy	3	127	42.33	1.52	20
Land Degradation & Development	3	69	23.00	1.18	8
Environmental Science & Policy	3	45	15.00	1.72	6
Environmental Science and Pollution Research	3	6	2.00	0.19	27
International Journal of Hygiene and Environmental Health	2	308	154.00	2.76	3
Energy Policy	2	159	79.50	2.41	3
Journal of Environmental Management	2	135	67.50	1.30	10
Environment and Development Economics	2	107	53.50	0.72	42

Note: TLS, total link strength.

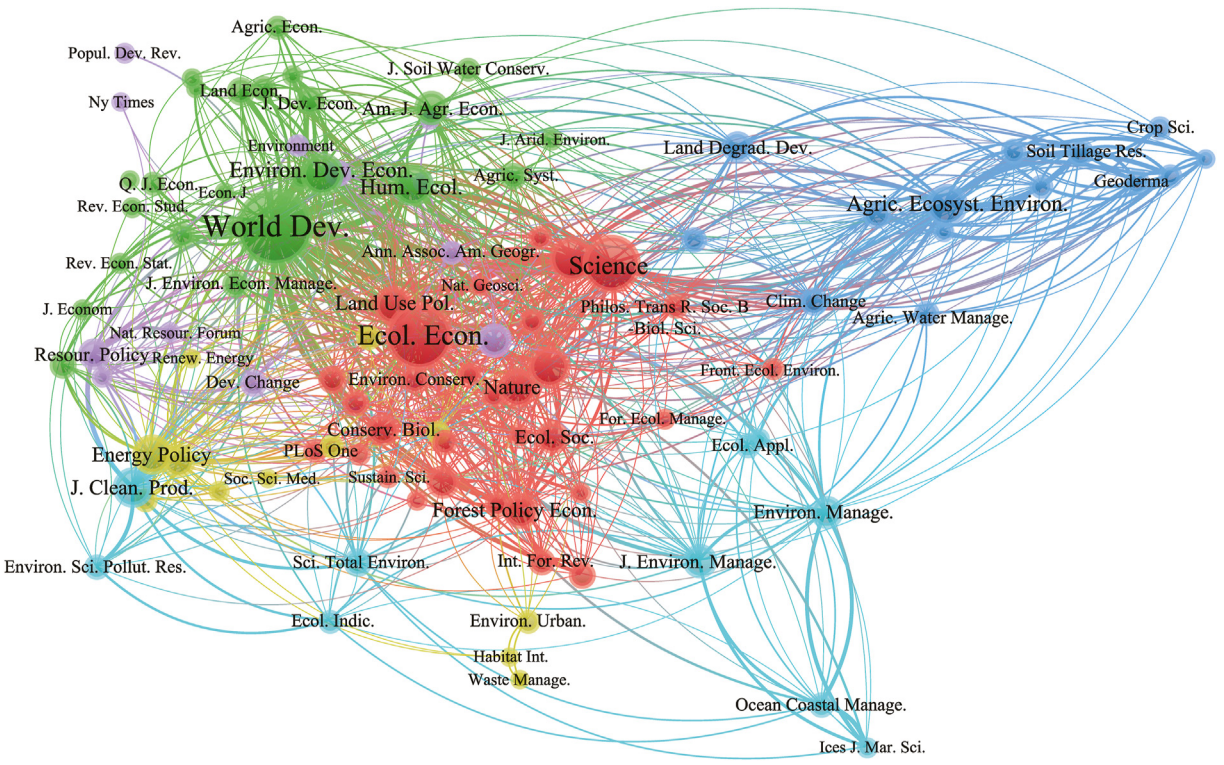

Fig. 2. Co-citation network of 105 journals in the environmental degradation-poverty nexus research field. Nodes show the relative number of co-citations for specific journal. Different colors classify the nodes of the co-citation network. The arrangement of journals into different nodes indicates a series of similarities. The closer the journals are to the co-citation network map, the stronger the relatedness between them. Popul. Dev. Rev., Population and Development Review; Ny Times, New York Times; Q. J. Econ., Quarterly Journal of Economics; Rev. Econ. Stud., Review of Economic Studies; Rev. Econ. Stat., Review of Economics and Statistics; J. Econom., Journal of Econometrics; Nat. Resour. Froum, Natural Resources Forum; Resour. Policy, Resources Policy; Renew. Energy, Renewable Energy; J. Clean. Prod., Journal of Cleaner Production; Environ. Sci. Pollut. Res., Environmental Science and Pollution Research; Agric. Econ., Agricultural Economics; Land Econ., Land Economics; J. Dev. Econ., Journal of Development Economics; Environ. Dev. Econ., Environment and Development Economics; Econ. J., Economic Journal; World Dev., World Development; J. Environ. Econ. Manage., Journal of Environmental Economics and Management; Dev. Change, Development and Change; Soc. Sci. Med., Social Science & Medicine; J. Soil Water Conserv., Journal of Soil and Water Conservation; Am. J. Agr. Econ., American Journal of Agricultural Economics; J. Arid. Environ., Journal of Arid Environments; Agric. Syst., Agricultural Systems; Hum. Ecol., Human Ecology; Ann. Assoc. Am. Geogr., Annals of the Association of American Geographers; Nat. Geosci., Nature Geoscience; Land Use Pol., Land Use Policy; Ecol. Econ., Ecological Economics; Environ. Conserv., Environmental Conservation; Conserv. Biol., Conservation Biology; Sustain. Sci., Sustainability Science; Sci. Total Environ., Science of the Total Environment; Ecol. Indic., Ecological Indicators; Ecol. Soc., Ecology and Society; Forest Policy Econ., Forest Policy and Economics; Int. For. Rev., International Forestry Review; Environ. Urban., Environment and Urbanization; Habitat Int., Habitat International; Waste Manage., Waste Management; Land Degrad. Dev., Land Degradation & Development; Agrofor. Syst., Agroforestry Systems; Philos. Trans. R. Soc. B-Biol. Sci., Philosophical Transactions of the Royal Society B-Biological Sciences; For. Ecol. Manage., Forest Ecology and Management; J. Environ. Manage., Journal of Environmental Management; Crop Sci., Crop Science; Soil Tillage Res., Soil & Tillage Research; Agric. Ecosyst. Environ., Agriculture Ecosystems & Environment; Clim. Change, Climatic Change; Agric. Water Manage., Agricultural Water Management; Front. Ecol. Environ., Frontiers in Ecology and the Environment; Ecol. Appl., Ecological Applications; Environ. Manage., Environmental Management; Ocean Coastal Manage., Ocean & Coastal Management; Ices J. Mar. Sci., Ices Journal of Marine Science. The order of the full name is from left to right and top to bottom in the map.

publications per country as the minimum benchmark. Out of the 63 countries, 31 met this threshold criterion. Table 3 shows the top 18 countries in the environmental degradation-poverty nexus research field. The USA tops this ranking with 47 articles, exhibiting total citations of 2077 and a TLS of 2232. India is the second country with 16 articles, having 158 total citations and a TLS of 775. With 14 articles, China is in the third position, having 370 total citations and a TLS of 1679.

With the help of VOSviewer, Fig. 3 shows the network visualization of the top countries. The label (such as the USA and China) size shows a considerable variation, which indicates the differences in respective weights. The USA, India, and China stand out with their large labels, and the weights represent the number of published articles in each country. Fig. 4 illustrates the overlay visualization, i.e., the timeline of publications. The color ranges from purple (earliest or initial research) to yellow (latest research). The USA, India, Ethiopia, Kenya, and the Netherlands are among the initial countries (illustrated by their purple color) to conduct research, while Germany, Malaysia, and Zimbabwe, represented by yellow color, are the most recent (2018 and onwards) ones. In our time horizon, the threshold benchmark is 3 publications per country, and therefore we only illustrated the overlay visualization between 2012 and 2018.

Table 2
Top 16 contributing organizations in the environmental degradation-poverty nexus research field.

Institutions	Number of articles	Total citations	Average citations	Average normalized citations	TLS
Charles Sturt University	2	192	96.00	2.17	3
Santa Clara University	2	134	67.00	1.97	39
International Livestock Research Institute	3	89	29.67	1.46	39
University of Gothenburg	2	76	38.00	1.72	38
London School of Economics and Political Science, University of London	2	74	37.00	1.92	25
University of North Carolina	2	70	35.00	1.27	26
Colorado State University	4	60	15.00	1.69	63
World Agroforestry Centre	2	60	30.00	1.11	56
Boston University	2	56	28.00	0.50	268
University of Namur	2	56	28.00	0.50	268
Wageningen University & Research	2	54	27.00	2.55	156
National Institute of Agricultural Research	2	45	22.50	1.89	186
Center for International Forestry Research	2	32	16.00	1.67	142
United Nations Development Programme	2	31	15.50	1.63	140
Auburn University	2	27	13.50	0.30	136
Fujian Normal University	2	27	13.50	0.30	136

Table 3
Top 18 countries in the environmental degradation-poverty nexus research field.

Countries	Number of articles	Total citations	Average normalized citations	TLS
USA	47	2077	1.17	2232
India	16	158	0.43	775
China	14	370	1.05	1679
Australia	11	358	0.97	618
England	11	130	0.72	835
Germany	9	89	0.96	1306
Kenya	8	329	1.66	818
South Africa	8	52	0.46	241
France	6	130	0.94	504
Netherlands	6	140	1.65	828
Brazil	5	164	1.23	639
Belgium	4	407	2.23	869
Canada	4	55	1.38	158
Ethiopia	4	404	2.20	402
Mexico	4	61	1.00	160
Saudi Arabia	4	11	1.11	84
South Korea	4	23	0.35	412
Turkey	4	52	1.99	44

3.6. Co-authorship network

We chose country as the unit of analysis in co-authorship analysis, and shortlisted 31 countries by putting a ceiling of 3 publications per country. Fig. 5 shows the 6 clusters. The first cluster (red color) includes Brazil, Canada, India, Indonesia, Kenya, and the Netherlands. The second cluster (green color) comprises South Korea, Germany, Denmark, Japan, Malaysia, and Thailand. Belgium, Ethiopia, Mexico, Sweden, the USA, and Vietnam are in the third cluster (blue color). The fourth cluster (yellow color) includes England, France, Italy, South Africa, Zimbabwe, and Spain. Finally, the last 2 clusters (purple and light-blue colors) include Australia, Switzerland, China, and Saudi Arabia.

3.7. Top cited publications

We selected document as the unit of analysis and applied the bibliometric coupling method to identify the top-cited journal publications that examine environmental degradation and poverty. Out of the 175 publications, 24 publications met the minimum threshold criteria of having 50 citations. Table 4 lists the selected publications in descending order. The leading article by Pattanayak et al. (2010) with 341 citations is published in the journal Review of Environmental Economics and Policy. This paper focuses on obtaining an optimal supply of environmental services in developing countries through payments for environmental services (PESs), a policy tool applied to investigate environmental and poverty outcomes. The study concludes a positive relationship between environmental degradation and poverty, suggesting that several factors determine the efficiency of PESs. Furthermore, it underscores the presence of strong and transparent governmental institutions as the leading factor in determining PES efficiency. The second leading article is "Human impact on the environment in the Ethiopian and Eritrean highlands—a state of the art" (Nyssen et al., 2004), with 315 citations.

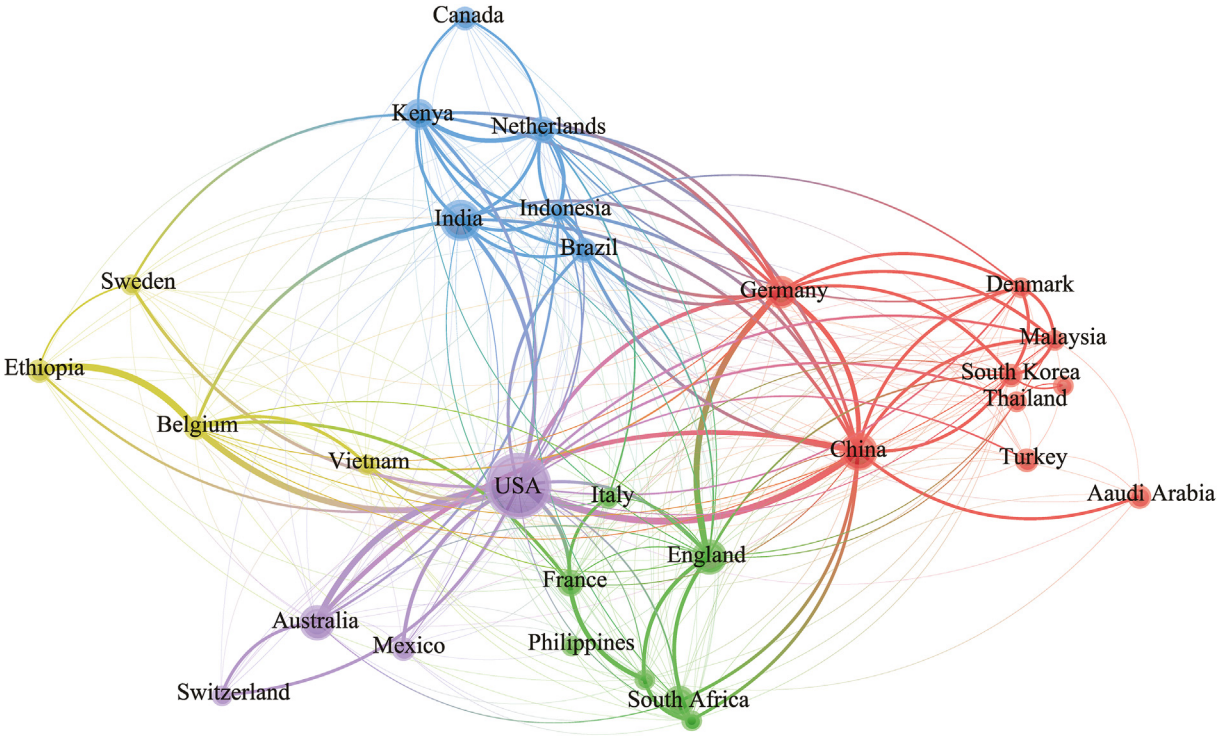

Fig. 3. Network visualization of the dominant countries in the environmental degradation-poverty nexus research field. Nodes show the relative number of co-citations for a specific country. Different colors classify the nodes of the co-citation network. The arrangement of countries into different nodes indicates a series of similarities. The closer the items are to the co-citation network map, the stronger the relatedness between them.

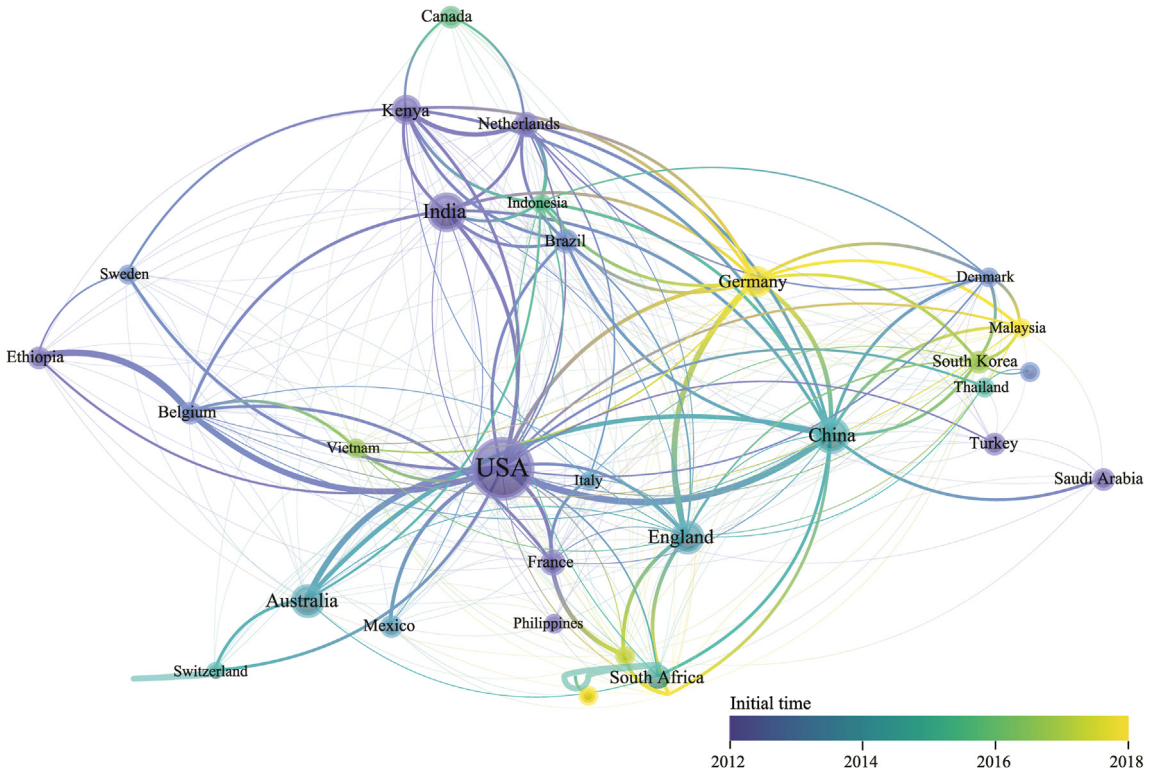

Fig. 4. Overlay visualization map of initial time of each country starting the environmental degradation-poverty relationship research.

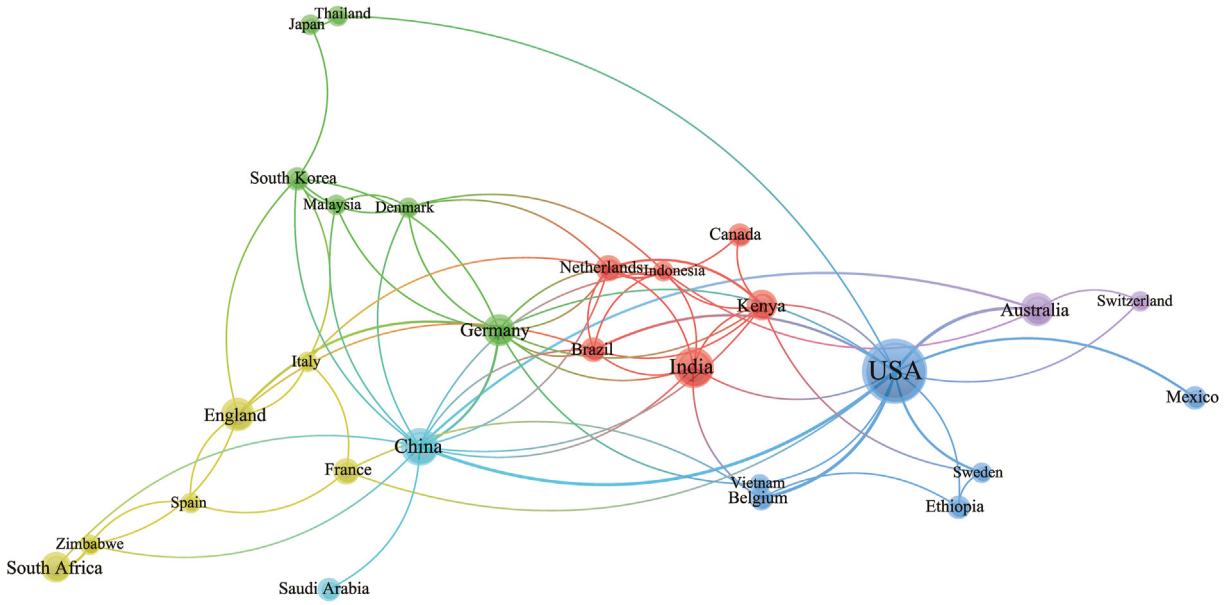

Fig. 5. Co-authorship networks analysis. Nodes show the relative amount of co-authorship of various countries. Different colors classify the nodes of the co-citation network. The arrangement of items in different nodes indicates a series of similarities. The closer the countries are in the co-authorship network map, the stronger the relatedness between them. The larger the circle size, the higher the number of authors representing a country.

Table 4
Top 24 highly cited articles in the environmental degradation-poverty nexus research field.

Title	Author(s)	Total citations	Rank
Show me the money: Do payments supply environmental services in developing countries?	Pattanayak et al. (2010)	341	1
Human impact on the environment in the Ethiopian and Eritrean highlands—a state of the art	Nyssen et al. (2004)	315	2
Global urbanization and impact on health	Moore et al. (2003)	196	3
The political economy of energy poverty: A review of key challenges	Sovacool (2012)	172	4
A downward spiral? Research evidence on the relationship between poverty and natural resource degradation	Scherr (2000)	164	5
Cautionary Tales: Adaptation and the global poor	Kates (2000)	147	6
Determinants of household energy consumption in India	Ekholm et al. (2010)	125	7
Payments for environmental services as neoliberal market-based forest conservation in Vietnam: Panacea or problem?	McElwee (2012)	119	8
Soil erosion in developing countries: a socio-economic appraisal	Ananda and Herath (2003)	115	9
Wastewater irrigation and environmental health: Implications for water governance and public policy	Hanjra et al. (2012)	112	10
Poverty, development, and environment	Barbier (2010)	102	11
Agriculture in Brazil: impacts, costs, and opportunities for a sustainable future	Martinelli et al. (2010)	96	12
A geographical perspective on poverty-environment interactions	Gray and Moseley (2005)	92	13
Linking climate change research with food security and poverty reduction in the tropics	Sanchez (2000)	91	14
Innovative grassland management systems for environmental and livelihood benefits	Kemp et al. (2013)	80	15
Harnessing innovation for change: Sustainability and poverty in developing countries	Khavul and Bruton (2013)	74	16
The economic determinants of land degradation in developing countries	Barbier (1997)	72	17
Estimating returns to soil conservation adoption in the northern Ethiopian highlands	Kassie et al. (2008)	64	18
The trends, promises and challenges of urbanization in the world	Zhang (2016)	63	19
Community participation and benefits in REDD+: A review of initial outcomes and lessons	Lawlor et al. (2013)	60	20
Design challenges for achieving reduced emissions from deforestation and forest degradation through conservation: Leveraging multiple paradigms at the tropical forest margins	Minang and van Noordwijk (2013)	57	21
The nature, causes and consequences of desertification in the drylands of Africa	Darkoh (1998)	55	22
The environmental impact of poverty: Evidence from firewood collection in rural Nepal	Baland et al. (2010)	53	23
Poverty, urbanization, and environmental degradation: Urban streams in the developing world	Capps et al. (2016)	50	24

3.8. Keyword co-occurrence analysis and thematic clusters

The keyword co-occurrence analysis is an insightful evaluation method and provides an overview of which topics investigated by researchers frequently. It also demonstrates the strength of the relationship among keywords, future research trends (Dorin et al., 2020), and information about emerging topics (Bhattacharya and Basu, 1998). We set the minimum benchmark to 5 keywords. Out of the 976

keywords from the 175 Web of Science publications, 40 keywords met the criterion. Each cluster of keywords is unique and separated by a particular color.

Furthermore, the lines between keywords represent links, and the thickness of a line represents the connection quality and strength (van Eck and Waltman, 2020). Poverty, developing country, and sustainable development are the three top keywords (Fig. 6). Environmental degradation is a broad keyword as it contains similar and interchangeable terms such as land degradation and degradation. However, it maintains the same position as the other top three keywords.

Fig. 6 shows strong relationships between poverty and other significant keywords such as developing country, environmental degradation, degradation, land degradation, deforestation, environment, climate change, poverty alleviation, and sustainable development. Poverty is the most dominating keyword and closely connected with developing country and sustainable development, which are the main research themes during 2008–2016. The overlay visualization format (i.e., from 2016 onwards) shows keywords such as livelihood, land-use, food security, environmental services, consumption, EKC, and land degradation. Keyword poverty has a strong connection with these macro concepts, and fundamentally, these keywords reflect the worsening environmental decay at the macro level. This figure also reveals emerging and future research directions.

Four thematic clusters are presented in Table 5. Individual occurrence of keywords is given in bracket (Table 5). Cluster 1 indicates research fields associated with general sustainability. This cluster identifies how environmental degradation affects climate change and food security, which influence poverty levels. Cluster 2 includes conservation aspects that adversely affect economic growth and EKC. A reduction in natural capital (resources) augments environmental and economic poverty in developing economies. This factor is more evident in Cluster 3, which is composed of ecological conservation topics such as improving biodiversity and ecological services. These aspects are essential in reducing poverty. Finally, Cluster 4 consists of universal topics that are concurrently necessary for mitigating environmental decay and poverty. All the clusters are closely interconnected, and from the closely interconnected clusters we can acknowledge that emerging topics such as food security, population, biodiversity, ecosystems services, and livelihoods are necessary for environmental protection and mitigating poverty. All of them provide research directions significantly at individual, social, economic, and political levels.

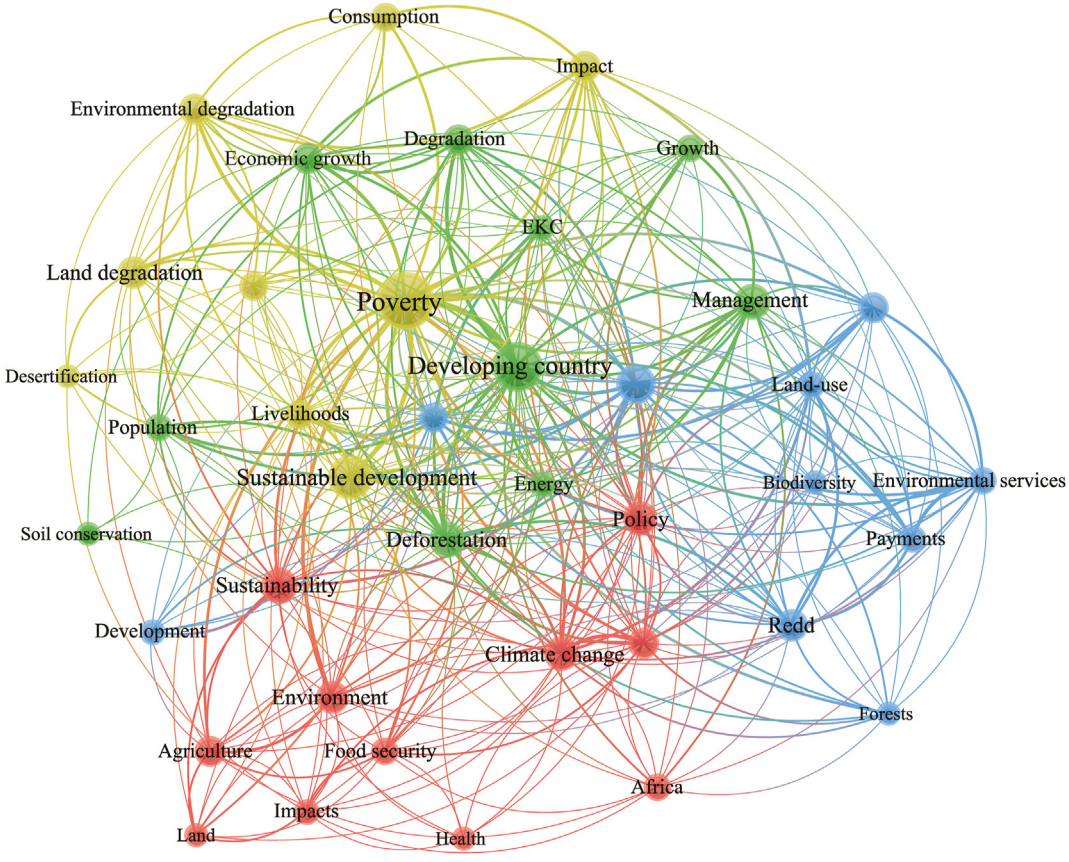

Fig. 6. Keyword co-occurrence network visualization. Nodes show the relative number of co-occurrences for a specific keyword. Different colors classify the nodes of the co-occurrence network. The arrangement of keywords in different nodes indicates a series of similarities. The closer the keywords are to the co-occurrence network map, the stronger the relatedness between them. EKC, environmental Kuznets curve.

Table 5
Thematic clusters of various keywords in the environmental degradation-poverty nexus research field.

Cluster 1	Cluster 2	Cluster 3	Cluster 4
Africa (8)	Deforestation (14)	Biodiversity (5)	Consumption (9)
Agriculture (10)	Degradation (10)	Conservation (17)	Desertification (5)
Climate change (12)	Developing country (28)	Development (6)	Environmental degradation (10)
Environment (11)	Economic growth (10)	Ecosystem services (10)	Impact (6)
Food security (7)	EKC (6)	Forests (5)	Land degradation (11)
Health (5)	Growth (7)	Land-use (8)	Livelihoods (9)
Impact (10)	Management (14)	Payments (7)	Poverty (41)
Land (5)	Population (7)	Poverty alleviation (9)	Sustainable development (22)
Policy (12)	Soil conservation (5)		
Sustainability (14)			

Note: The clusters are constructed based on the association between keywords. The occurrence of each keyword is calculated using a binary counting procedure via Vosviewer text mining technique, and is given in bracket. EKC, environment Kuznets curve.

3.9. Text mining analysis

We used the co-occurrence map to identify research areas and understand how researchers combine environmental degradation with poverty. By using title, abstract, and keywords as term sources from the selected 175 publications, we obtained 5850 unique terms. Next, we applied text mining analysis functionality of VOSviewer to identify the noun phrases in the text and converted all plural noun phrases into singular ones. A minimum threshold of 20 occurrences provided us with 68 terms. Finally, VOSviewer calculated a relevance score, and the top 60% phrases were selected.

However, we excluded terms not germane to our analysis goals, such as specific names, places, and general statistical terms. This reduction reveals 36 terms that we used to construct a bibliometric visualization map (Fig. 7). Each term is represented by a blurred circle, where the size of the label represents the term's frequency. The color describes the conceptual foundation, and the proximity to other phrases indicates the degree of relatedness between phrases. Table 6 illustrates the terms, their occurrence, and their relevance scores. The top 8 terms have a relevance score of >1.0, which underscores their weight for researchers investigating the environmental degradation-poverty nexus.

4. Discussion and contributions

4.1. Discussion

Policymakers and environmental researchers understand the vital connection between environmental degradation and poverty. Recognizing a better scholarly understanding between environmental degradation and the dimensions of poverty plays a critical role in achieving the United Nations SDGs under the 2030 Agenda for Sustainable Development. This study aimed to identify the vital connectivity between poverty, the first SDG, and the environment-focused global development goals. Poverty is the first antecedent, which is essential to fulfill the next 5 SDGs (goals 2–6, i.e., zero hunger, good health and well-being, quality education, gender equity, and clean water and sanitation, respectively). Unless the world accomplishes the first 6 SDGs, it would be insignificant for the majority of the world's population to show sustainability concerns. Hence, this underscores why having comprehensive research knowledge on poverty and environmental degradation is vital for determining future research avenues and countering climate change.

This bibliometric review provides a broad synopsis and outlines the critical elements related to environmental degradation and poverty that researchers can utilize. It also shows the impact of global environmental treaties and climate change issues on the research publication trend over the last 28 a. We listed the top-cited publications, leading journals, countries (geographical placement), and research organizations (institutions) using bibliographic coupling method (Table 4). Paper of Pattanayak et al. (2010) is the top-cited article that reviews the empirical literature on PES. The second leading article is by Nyssen et al. (2004), with 315 citations. These 2 articles suggest policies that could help to mitigate environmental degradation and poverty simultaneously in developing countries. Other top-cited publications by influential authors also identify the most pertinent research topics in this research area.

With 134 citations, World Development is the leading journal that examines the environmental degradation-poverty nexus (Table 1). Six articles are published in this journal, the highest number in the top 12 journals. A modest number of publications in a leading journal during the last 28 a suggests that no single journal has a high degree of influence in this research field. Hence, most of the top journals enjoy equal research standing. Charles Sturt University, Santa Clara University, and International Livestock Research Institute are the top 3 research organizations in the research field of environmental degradation-poverty nexus (Table 3). International intergovernmental organizations and western (European and American) universities are the most influential research organizations. Although western research institutions produce a low number of publications, they dominate the research quality. The USA leads in research publications, total citations, and TLS. India and China are the second and third leading countries in this research field, respectively (Fig. 3).

The journal co-citation analysis provides 6 clusters and shows the multidisciplinary nature of the top-cited publications (Fig. 5). World Development focuses on interdisciplinary development subjects such as poverty, economics, environment, geography, politics, and sociology. This feature is central to the journal and provides the journal a prominent position in the co-citation network map (Fig. 2).

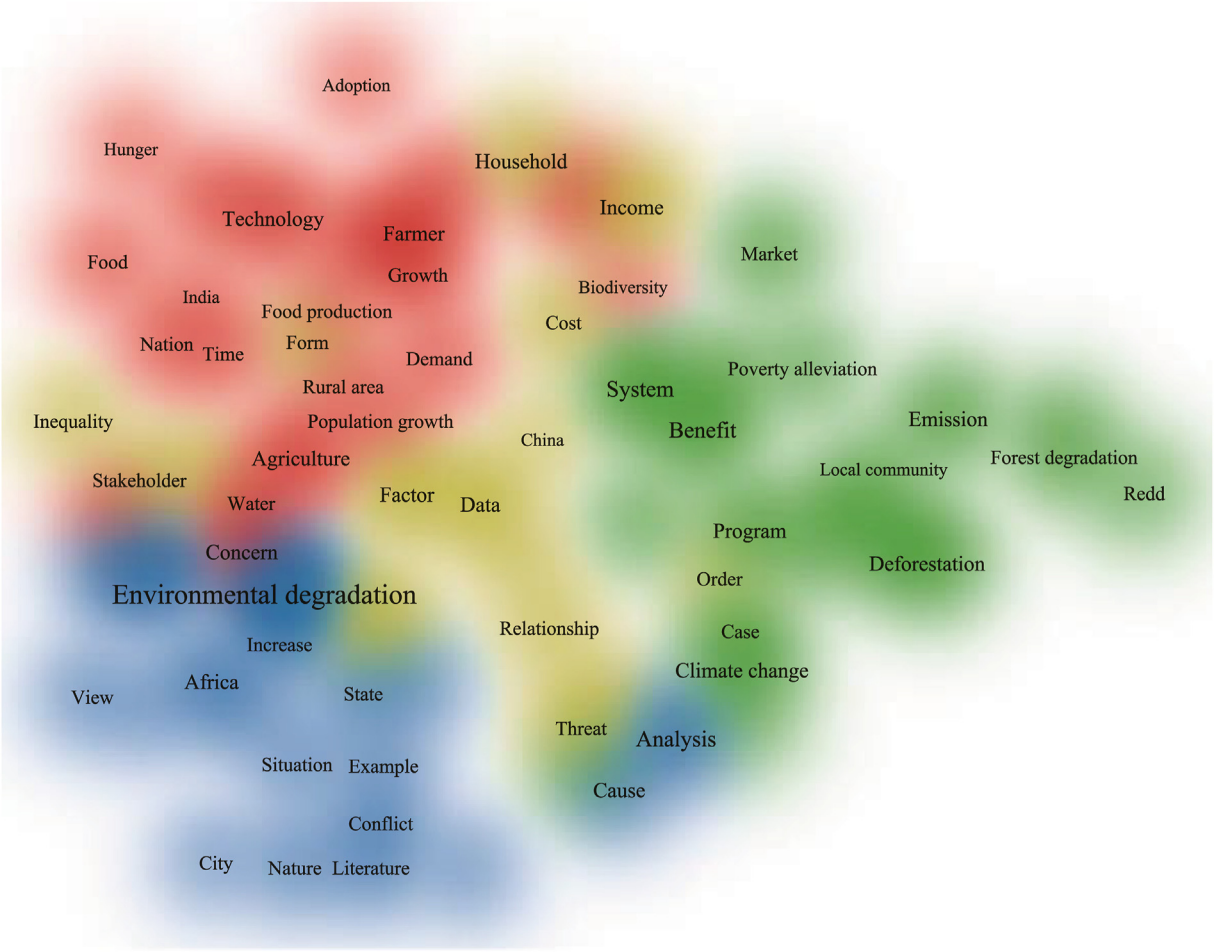

Fig. 7. Bibliometric density visualization of terms in the environmental degradation-poverty nexus research field. Different colors represent different clusters, and the color depth and size of all terms in each cluster represent the density of each cluster.

The closer the journals are to each other in a co-citation network map, the stronger the relatedness between each other. The co-citation visualization helps researchers in selecting potential journals to publish their work. The keyword co-occurrence analysis results in 4 thematic research clusters (Table 5). Collectively, these clusters identify the logical interrelatedness between current and future research directions. Text mining analysis provides the leading conceptual terms and their interconnective applicability in this research field.

Our study shows that researchers are increasingly aware to examine the mutuality between environmental degradation and poverty issues over the years. In 1972, Stockholm Conference recognized the need to protect environment, while the 1992 Rio Conference established an official, formal, and legal link between environment and socio-economic variables (eliminating poverty was one of the main variables). The Paris Agreement of 2015 and the launching of 17 SDGs for sustainable development by the United Nations are more pragmatic behavior in examining the environmental degradation-poverty relationship. Therefore, public authorities and private corporations must apply consolidative and multidisciplinary approaches at all levels to strengthen environmental awareness and alleviate poverty. Such prudent governmental policies and research approaches would help individual countries and international ecological agencies fight the combined menace of environmental degradation and poverty.

4.2. Research contributions

This review contributes to the literature on environmental degradation and poverty in many ways. First, the keyword analysis shows the critical interconnectivity among environmental degradation, poverty, and sustainable development. Although environmental degradation and poverty are examined actively as a combined theme (Clayton, 1983; Jain, 1988). Our keyword analysis shows that new emerging topics connected with environmental degradation and poverty are gaining attention. For instance, this interconnection is becoming significant in examining forest degradation, deforestation, land degradation, family unit livelihood, and ecosystems. In this manner, our study clearly shows that other current aspects also play vital roles in the environmental degradation-poverty nexus. These aspects are also critical in achieving SDGs. Second, the 4 thematic clusters offer necessary insights to practitioners, senior poverty

Table 6
Occurrence and relevance score of top 23 terms in the environmental degradation-poverty nexus research field.

Term	Occurrence	Relevance score
Forest degradation	15	6.6741
Deforestation	28	3.2978
Emission	25	2.9394
Forest	24	2.5119
Land degradation	15	1.2734
Household	22	1.2035
Sustainable development	21	1.1491
Water	20	1.0811
Economic growth	18	0.9478
Nature	17	0.9304
Environmental degradation	88	0.9199
Poverty alleviation	17	0.9119
Food security	20	0.7493
Country	151	0.7379
Agriculture	31	0.7305
Climate change	30	0.6644
Technology	29	0.5978
Economic development	16	0.5833
Income	32	0.5512
Opportunity	28	0.3557
Community	40	0.3391
Population	32	0.3323
Strategy	47	0.2925

mitigation managers, and researchers in order to understand the emerging role of food security, climate change, agriculture and soil conservation, and ecosystems vitality in neutralizing increasing ecological decay and ever-increasing global poverty. Finally, text mining analysis further strengthens the mandatory multifaceted approach to examining the environmental degradation-poverty nexus. Our study identifies a set of significant specific terms that provide researchers with practical future research directions.

5. Conclusions

This study aims to identify the connection between environmental degradation and poverty, one of the humanity's most significant challenges. This nexus between environmental degradation and poverty is vital to neutralize the visible harsh consequences of climate change. Unless this strong correlation is not seriously recognized and examined by sincere researchers (primarily located in countries which are most susceptible to climate change challenges), it is challenging to accomplish the United Nations SDGs.

Like all other review studies, this study has a few limitations. First, our bibliometric review relies solely on a single database, the Web of Science; however, consideration of more databases, such as Scopus, would improve the results of our bibliometric review. Second, this study does not summarize research contexts and applied research methodologies. We recommend that these could be included in the future bibliometric review studies.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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