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REVIEW ARTICLE

Sustainability in the global value chain—a scientometric analysis

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Abstract

For its promise in enhancing sustainability, the global value chain (GVC) has grown in relevance and sparked many studies. Due to different value activities in multiple countries and industry clusters, the competition and cooperation among value chains have attracted the considerable attention of business leaders and academicians worldwide. GVC-related sustainability research is a niche area despite its widespread presence in the literature. To bridge the gap, we use scientometric analysis in this paper, examining the corpus of 753 articles published in Web of Science journals from 2001 till 2021. This review illuminates the research performance constituents (e.g., most prolific authors, nations, institutions, and journals), the themes and issues that underpin the fields' intellectual structure, and transforming discoveries. GVC depends on nine basic clusters for sustainability research (i.e., global value chain participation, gendered global production network, repositioning organisational dynamics, labour stands, learning opportunities, Internet era). Future studies can be conducted to generate new knowledge across ten thematic (based on keywords) clusters (i.e., market liberalisation, trade pollution nexus, value chain dynamics, global value chain reconfiguration, non-governmental organisation, multipolar governance). A model that encompasses current knowledge of the global value chain for sustainability is developed, and avenues for future research are provided.

Keywords Global value chain · Global value chain participation · Gendered global production network · Sustainability · Scientometrics · Market liberalisation · Trade pollution nexus · Value chain dynamics

Introduction

Global value chains (GVCs), a collection of activities that enable the development, production, and distribution of goods and services, are essential for coordinating company investment and trade flows across borders (World Bank 2019). The foundation of economic globalisation, global value chains (GVCs), have undergone extensive, broad, and complicated transformations as a result of technology advancements and macroeconomic shocks. Particularly, the global financial crisis that was brought on by the US sub-prime crisis in 2008 dramatically altered the GVC landscape, had a significant impact on the global economic system, and resulted in reindustrialisation and value chain shrinkage in developed nations. Global value chain (GVC) has been a topic of importance and interest in the past few decades. GVC emerged incrementally from the subject of global commodity chains (GCCs), Bush et al. (2015). There are critiques of the GVC who argue that the difference is minuscule and that GVC only talks about vertical integration and does not consider horizontal integration between factors. Some

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authors, however, have found sustainability as a theme in the horizontal integration in the value chain (Bolwig et al. 2010; Mitchell and Coles 2011). The international trade flows have seen a transformation in the past three decades (Amador and Cabral 2015). This transformation was fuelled by a combination of the revolution in ICT, a huge reduction in artificial barriers via other preferential trade agreements, and political advancements that caused an increase in the share of the global population joining in the capitalist system (Antràs 2016). These changes resulted in the usage of foreign manufacturing parts and pushed global sales for intermediate products as opposed to local sales previously (Antras and Chor 2021). Juxtaposed with this is the global pandemic, during which the global supply chain has faced a shock. The lockdowns imposed to curb the COVID-19 disease have left many factories with piles of raw materials that take a long time to process and move along the value chain. Significant work needs to be done to measure the impact of this. However, the pandemic has shown how the impact of GVC on sustainability is multi-faceted and has gathered attention from researchers in multiple subjects. However, this is not restricted to the pandemic era but pre-COVID-19 years since we have been facing multiple sustainability issues over the past few decades. Thus, to add to the literature, a considerable amount of work in GVC has been drawing the attention of academicians from economics, geography, and even political geography (Liu and Mei 2016). Social and environmental concerns are the critical drivers in the decision-making of the GVC application by companies all around the globe (Gereffi and Fernandez-Stark (2011). The concept of linking physical input and output with production and consumption is gaining traction. However, it is uncertain how to achieve this change at the corporate and policy levels while ensuring that sustainability targets are met or exceeded, and the north/south divide is not widened (Hofstetter et al. 2021). Manufacturing units are trying to answer how have firms been coping with the entire value chain and supply chain mechanism with sustainability aspects in place. Rikap (2022) argues how the big data and machine learning algorithms are changing the way the value chain works and giving a monopolistic edge to larger firms. Rengarajan et al. (2022) further confirm this in their study using data for strong strategies.

With a simple search on key string global value chain on Google Scholar, which has a collection of all types of literature (papers, articles, news, reports), we get about 195,000 search items refined for the past two decades. The GVC studies have been receiving tremendous attention, and the current study tries to identify the relationship between the GVC and sustainability using scientometrics analysis based on citations. Liu and Mei (2016) have done a bibliometric analysis on the topic of GVC. However, sustainability research is not included in the same. González-Torres et al. (2020) attempted a bibliometric analysis but studied the industrial clusters and global value chain specifically. None of these studies have touched upon sustainability. Baz et al. (2022) have worked on GVC and sustainability but have limited their study to Africa only for a restricted period. This study provides an extensive overview on GVC and sustainability research over two decades worldwide. A brief comparison of existing literature with the current study is provided in Table 1.

A literature review synthesises the findings of prior studies systematically (Paul et al. 2021). Scientometric review is a useful tool for getting a current understanding of wide domains (for example, GVC for sustainability), helping researchers in their field to conduct much more advanced research and place their work in the context of what has already been done (Donthu et al. 2021a; Paul and Criado 2020). We investigated country-level, organisational-level, and individual-level involvements using bibliometric data, to shed light on the subject of GVC for sustainability by addressing four research questions (RQs):

RQ1. What are the sustainability research publishing trends in GVC?
RQ2. Who are the major research constituents in GVC for sustainability (e.g., authors, countries, institutions, and journals)?
RQ3. What are the most pertinent research topics in GVC for sustainability?
RQ4. What are some of the most potential topics for future study in GVC for long-term sustainability?

Through a complete bibliometric review, this article aims to bridge the gap in knowledge of GVC for sustainability as a topic of interest and make known the same's performance and intellectual structure. Second, by presenting a study agenda on interesting topics for new research on GVC for sustainability, this article seeks to bridge the gap between existing information and potential knowledge that may be developed or investigated. Researchers working in GVC for sustainability can utilise these articles to learn about the trends, patterns, and literature that has been published, to begin and, more significantly, to situate their work. Broadly, this study aims to understand the literature around the topic of global value chain and sustainability in the past few years. Liu and Mei (2016), González-Torres et al. (2020), and Baz et al. (2022) have examined GVC and sustainability relation; however, there is a lack of conclusive work, and hence, this research has been undertaken (Table 1).

This research is pertinent to understand the topic as it gains attention, especially since the adoption of the sustainable development goals (SDGs). In the academic domain, we look at scholars who are studying the various aspects

of GVC like multi-country value addition (Seung 2022), emerging markets and impact (Cuervo-Cazurra and Pananond 2023), and ecological asymmetry (Althouse et al. 2023) among others. In such a scenario, it is imperative to make a literature contribution that adds value and enhances subject structure for interested scholars. Furthermore, the results have been modelled with existing prominent theories of the subject area to achieve a theoretical framework. Firstly, we look at the resource-based view (RBV) theory. A managerial paradigm called the resource-based perspective (RBV) is used to identify the strategic resources that a company might use to gain a long-term competitive advantage. Following the publication of significant publications by Conner and Prahalad (1996), Barney (1991), and others, it came into being in the 1980s and 1990s. RBV proponents assert that taking advantage of external possibilities utilising already-existing resources in a novel way is considerably more practical than trying to learn new skills for every opportunity. The next theory we take into account is the stakeholder theory. A theory of organisational management and business ethics known as "stakeholder theory" takes into account the various constituencies that are influenced by business entities, including customers, suppliers, local communities, creditors, and others. It discusses ethics and values in managing an organisation, including those connected to a market economy, social contract theory, and corporate social responsibility. It has been greatly discussed by Freeman (1994) in his work. The third theory that we look at is the internationalisation theory. Although there is no universally accepted definition of internationalisation, it is generally understood to be the process of extending an enterprise's involvement in global markets. In order to address the sustainability of its development in various manufacturing and service sectors, particularly higher education, which is a very important context that needs internationalisation to bridge the gap between different cultures and countries, internationalisation is a crucial strategy not only for companies that seek horizontal integration globally. The prominent work was done by Whitelock (2002) and Buckley and Buckley (1989).

We discuss the methodology applied and the data tools and techniques used in the "Methodology" section. The performance and intellectual structure findings are in the "Findings" section. The "Towards a new theoretical model of GVC for sustainability" section is devoted for the discussion where we provide an in-depth analysis of the findings of the review. We discuss the metrics, authors, institutions, journals, and the collaboration network. In addition, we discuss the thematic analysis from keyword clusters and the co-citation analysis. We also propose a new theoretical model in this section. The directions for future research are given in the "Directions for future research" section. Finally, the paper concludes in the last section with the summary of findings.

Methodology

Data source and time frame

Around 90% of significant literature in a particular area is available only in a handful of journals as per Bradford's law (Garfield 1977). Considering this law, we have extracted the bibliographic data available at the Web of Science to measure the performance and unpack the research constituents

Table 1 Comparison of previous work on GVC bibliometric analysis and this work

Basis of comparison	Liu and Mei (2016)	González-Torres et al. (2020)	Baz et al. (2022)	Our study
Time	1995 to 2014	1900 to Jan 2020	2004 to 2018	2001 to 2021
Keywords	Global value chain	Global value chain, industrial cluster	Sustainability, supply chain, global value chains, Africa, bibliometric analysis, content analysis, visualisation	Extensive key strings represented in Table 2.
The focus of the Study	This study focuses on the temporal evolution of topics in GVC research.	This study focuses on understanding the conceptual and intellectual structure of the topic of industrial clusters and global value chains.	The focus of the study is to bring together and understand the literature on sustainability and value chains in Africa only.	The performance metrics and the intellectual structure of the GVC for a sustainability research area
Methodology	Bibliometric analysis using UCINET and Pajek software	Bibliometric analysis using SciMAT software	Bibliometric analysis using VoS Viewer and BibExcel software	Bibliometric analysis using CiteSpace.
Data Sourced	Web of Science (WoS)	Web of Science (WoS)	Web of Science (WoS)	Web of Science (WoS)

Source: authors' compilations

Table 2 Keywords used in bibliographic search

GVC-related keywords	Sustainability-related keywords
Global value chain	Climate footprint
Global manufacturing	Ecological footprint
Global industry	GHG
Global offshoring	Environment
	Social
	Governance
	Sustainability
	ESG

As per the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA[1]) guidelines illustrated in Fig. 1, we divided the procedure into four steps. Step 1 involved exploring the Web of Science data based on crucial strings developed to get a corpus of 771 records. Step 2 is screening the records to include only articles from 2001 till 2021 and refined for publication types as full articles. This reduced the record size to 753. Step 3 is the visualisation and analysis step. We used the software CiteSpace version 5.8.R3. This software was selected due to its ability to create visually appealing visualisations. Step 4 talks about future research directions based on the analysis and finding in the previous stage. An in-depth analysis is done in the

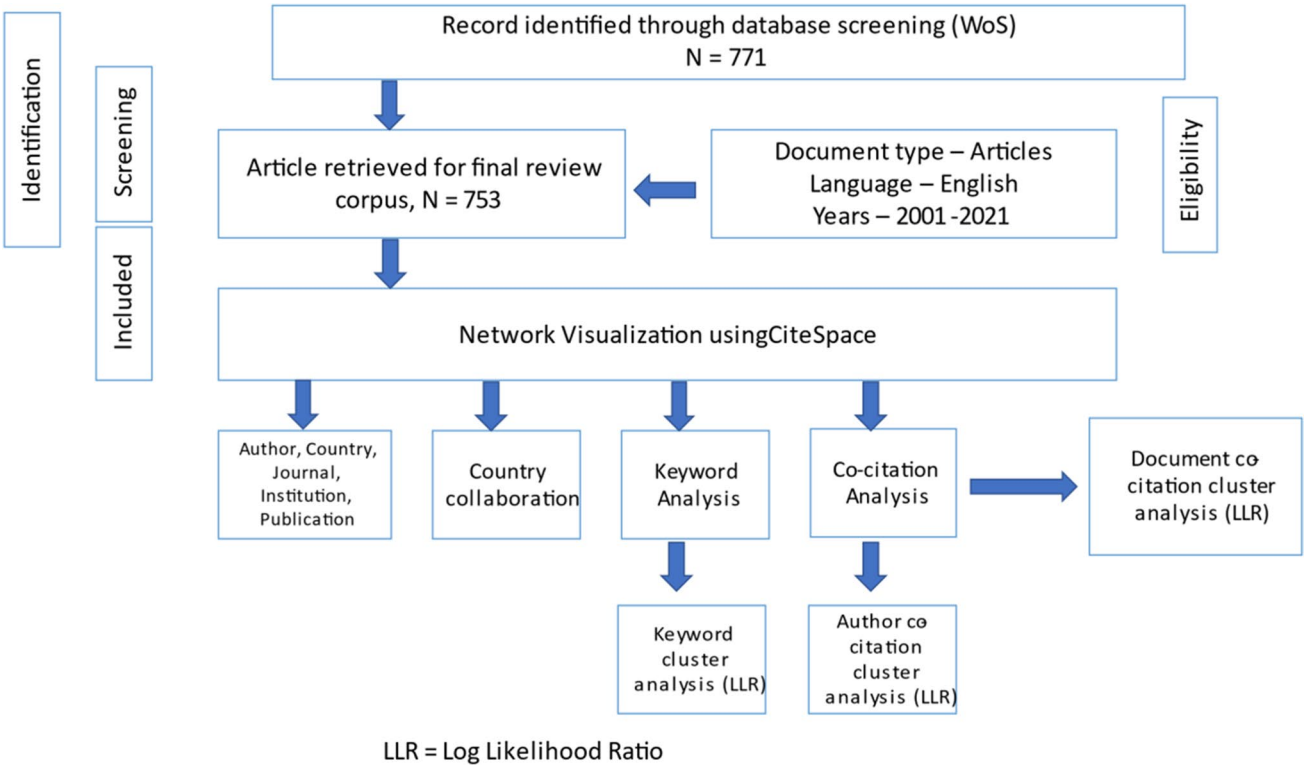

Fig. 1 PRISMA methodological procedure

and intellectual structure of the global value chain (GVC) for sustainability research. Web of Science is a scientific database that provides a vast collection of academic records of journal articles and other vital bibliometric information (Paul et al. 2021). It is one of the most reliable, comprehensive, and high-impact collections of academic papers (Zyoud et al. 2017). It also has extensive coverage across multiple disciplines compared to other databases (Paul and Criado 2020; Donthu et al. 2021a). In order to obtain suitable bibliometric data for analysis, a key string of words related to GVC and sustainability was used. The key string details are provided in Table 2 as the combination of GVC and sustainability.

"Towards a new theoretical model of GVC for sustainability" section of the paper, and future direction is based on the same suggested in the "Directions for future research" section.

To answer the question of how large and how statistically significant a sample should be in a scientometric analysis posed by Williams and Bornmann (2016), this review used Cochran's (1977) equation (Eq. (1)) for determining sample size adequacy.

[1] PRISMA is the minimum set of elements for systematic reviews and meta-analyses that is based on evidence.

Table 3 Parameter and criteria for analysis

Parameter	Description	Criteria
Time slice	Timespan for analysis	Year-by-year time slicing for the years 2001 through 2021
Term source	Bibliographic record for analysis	Title, abstract, author, keyword, and other information (citations)
Node type	Unit of analysis	Author, institution, country, journal, keyword, and reference
Pruning	Technique for systematically removing superfluous (low impact) linkages. The approach improves the network's visualisation.	The Pathfinder approach is used for network analysis.
Selection criteria	For network analysis, the Pathfinder method is utilised.	g-index/source selection top 20/k-value based on network size

$$n = \frac{Nz^2(p(1-p))}{(N-1)\mathrm{e}^2 + z^2p(1-p)} \quad (1)$$

To select the appropriate sample size, Cochran's formula is very useful. Equation (1) suggests that a sample size of 257 documents is deemed to be adequate for analysing a population of 771 documents (n) at 95% confidence ($Z = 1.96$), 10% significance ($p = 0.10$), and 5% error ($e = 0.05$) levels.

Data analysis technique and tool

Algorithm-based scientometric mapping had emerged as a result of technological advancements, allowing for a comprehensive picture of a particular study topic (Petticrew and Roberts 2008). Unlike previous reviews, which allowed subjective data presentation and interpretation, this technique relied on complicated algorithms to offer an objective picture of the study topic (Klarin and Suseno 2021). In addition, a scientometric review supported the search of all academic articles on a particular topic, allowing for a thorough comprehension of the study field. As a result, the complete academic literature was able to overcome key gaps between diverse disciplinary boundaries (Hu and Zhang 2017). Furthermore, visual representations aided in recognising significant academic subject developments across time. Finally, using this technique, researchers were able to objectively assess how studies may be structured systematically and give a content analysis of the topic, including the most important topics and trend publications. We used the clustering program CiteSpace to systematically scan and categorise the literature to discover phrases with high similarity and their placement on a map. Clustering was enabled by the software, which allocated nodes in a network based on associations between phrases, and articles belonging to the same clusters were more likely to have a shared theme. These give us an insight into the publication's trends in the world, among authors and researchers, and the underlying themes. Table 3 shows the parameters and criteria that guide the building and comprehension of networks and visualisations. The authors employed several selection criteria to deal with a large amount of data and provide meaningful and appropriate results. It lists the top 20 elements to choose from (e.g., authors, countries, institutions, journals). We have lowered the "k" value to include the most popular or significant clusters (Chen et al. 2010). Pathfinder algorithm (Chen et al. 2014) was used to manage and reduce the number of crossing links for each network, to enhance the visibility of prominent nodes and links (Chen 2006). The number of articles published was represented by the size of the node, and the thickness of the connections between the nodes indicates the density of their connections (collaborations) (Zhao 2017; Donthu et al. 2021b). To identify patterns of co-citations and co-authorships in the literature, we use one type of bibliometric analysis—citation network analysis—in the current study (Van Eck and Waltman 2010). We created the maps using two connectivity metrics: co-authorship, the degree of collaboration between writers is determined by how many papers they have co-authored together, and co-citation, the number of times two writers or publications are cited by one another indicates how closely related they are. The co-citation relationship between two writers is stronger if the more publications are jointly cited (Nielsen et al. 2023).

Findings

Performance analysis of global value chain for sustainability research

The performance analysis includes the publication trend, country analysis, journal analysis, and author and cited author analysis. Performance analysis gives us a glimpse of the subject area and node details like the most prolific authors and countries with the most research done in the area, among other details. The detailed analysis is given in the following sections.

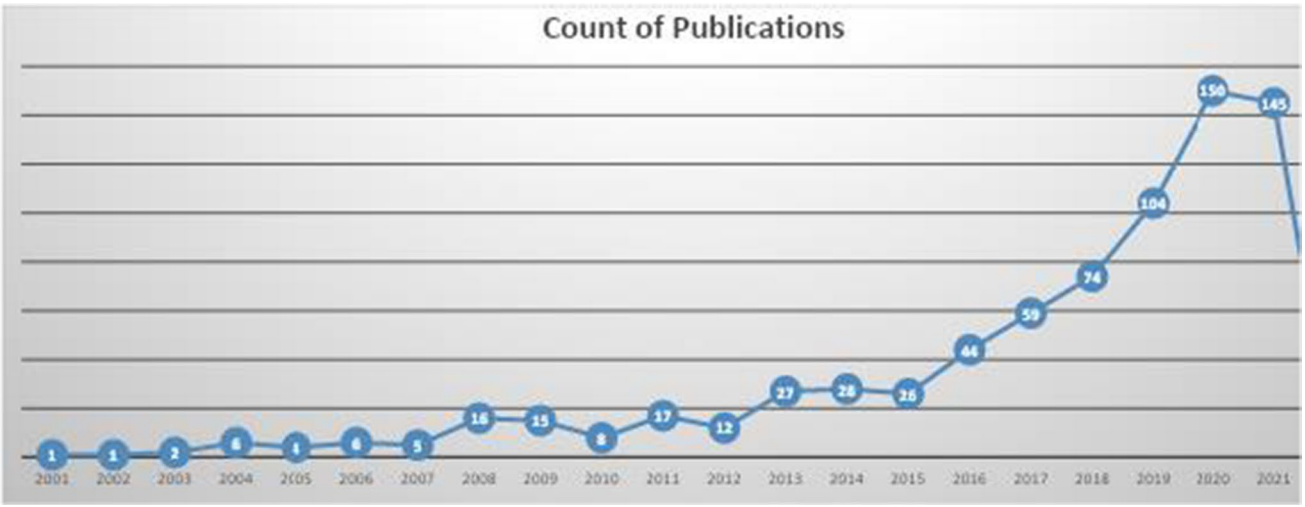

Fig. 2 Annual publication trends for global value chain for sustainability research

Publication trend of global value chain for sustainability research

To answer the first research question (RQ1), the publication trend of articles in GVC for sustainability research can be seen in Fig 2. The article count is relatively lower at the start of the research study years. However, since 2013, and particularly after 2015, when the United Nations General Assembly adopted the sustainable development goals, we can see that publications have increased.

The research articles have since then seen an upward trend. Even though the previously signed millennium development goals were set up in 2000, the impact on research is not entirely visible here. It can be noted that research has gained momentum since the adoption of SDGs. The Paris agreement for climate change, effective in 2016, can also be considered a game-changer, pushing up the interests of academicians to work on this topic.

Top authors of global value chain for sustainability research

Figure 3 depicts the network of writers in the GVC for sustainability research. With 180 nodes and 325 links, the network has a modularity score of 0.73 and a density of 0.02, indicating loosely organised groups. This indicates that the field in question has been contributed to by many authors rather than just a few.

We answer the second research question in this section (RQ2). Table 4 lists the top ten most prolific authors. Gereffi G is the leading author with 360 publications and has a betweenness centrality score of 0.4, indicating a highly influential node, or author in this case. The other top researchers are Humphrey J, with $N = 195$ and centrality of 0.17, and Kaplinsky R with 136 papers and a sigma value of 1.56. The burstiness score is 4.47 for Kaplinsky, the average year being 2001.

Other prominent authors are Koopman R (136), Bair J and Ponte S (122), Gibbon P (109), and many more. Bair J, again, has the highest burst score of 8.33, indicating that a sudden increase in the citation of his articles' average year is 2003. The bursts can be observed in the visualisation as the bright pink trim in the nodes.

Figure 4 depicts the author's KM collaborative network for sustainability research. A total of 56 relationships exist between the 139 authors. The modularity is strong with a Q value = 0.73, while the density is low (0.0058), indicating that the network is loosely clustered, meaning authors are interested in collaborating within the same groups and then exploring new opportunities. This observation is further strengthened by the high silhouette value of 0.9056, indicating high clustering quality.

The top 10 authors for collaboration are presented in Table 5. The leading author is Lizhi Zing, with 12 papers, followed by Jun Guan (8) and Yuegang Son (8). We can notice that the average author's years of publication are recent, which suggests that more research is on the way and paves the way for academicians and researchers interested in the area to undertake work in the subject area.

Top countries in global value chain for sustainability research

China and USA are the new drivers of the GVC (Gereffi and Fernandez-Stark 2011). The largest cluster can be observed as the People's Republic of China, contributing 231 articles. Other prominent clusters are England (103) and Germany (42). The country's network shows that there are 279 links between the countries. The modularity Q value is 0.4008

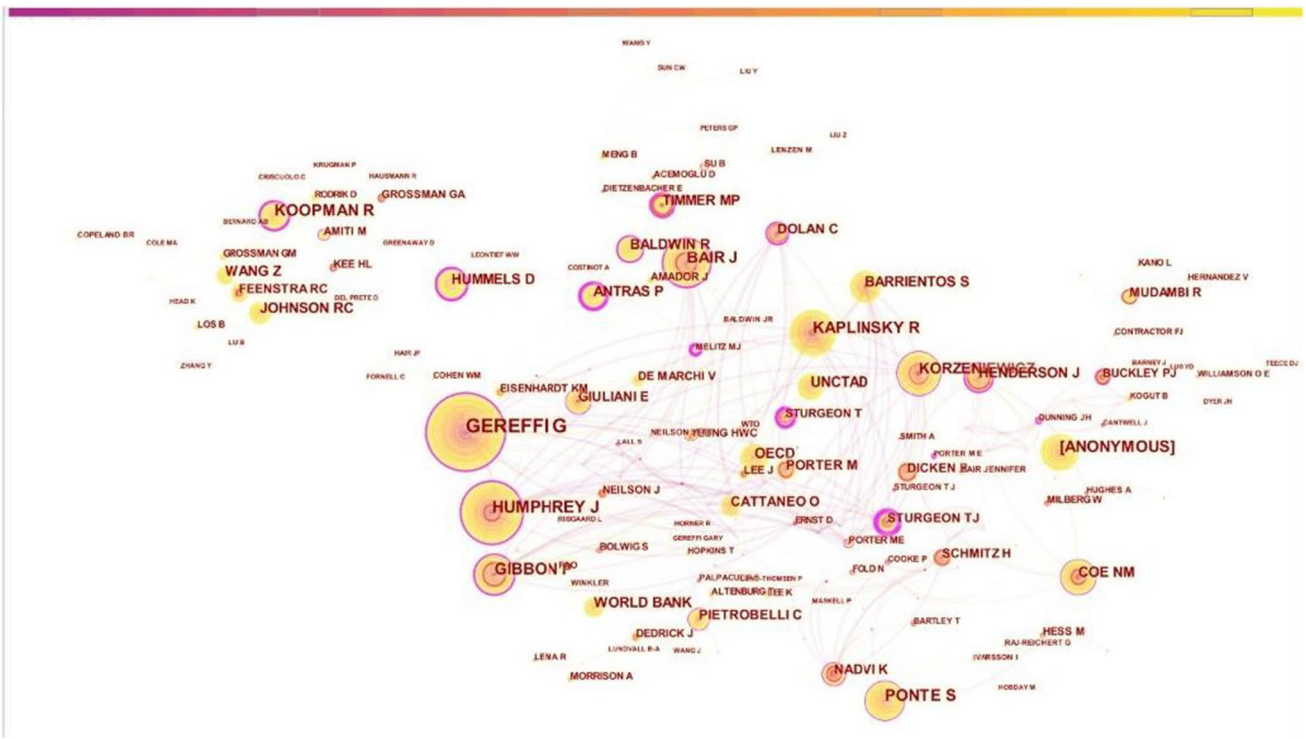

Fig. 3 Author network in global value chain for sustainability research

Table 4 Top 10 most prolific authors in the global value chain for sustainability research

Rank	Author	Frequency	Sigma	Burstiness	APY	Betweenness centrality
1	Gereffi G	360	1	–	2001	0.4
2	Humphrey J	195	1	–	2001	0.17
3	Kaplinsky R	136	1.56	4.47	2001	0.1
4	Koopman R	129	1	–	2014	0.03
5	Bair J	122	1.73	8.33	2003	0.07
6	Ponte S	116	1	–	2008	0.03
7	Gibbon P	109	1.27	7.17	2003	0.03
8	Korzeniewicz RP	101	1.42	4.69	2001	0.08
9	Coe NM	95	1.11	3.65	2008	0.03
10	Hummels D	91	1	–	2013	0.02

(density = 0.0625) and is a moderate or average value indicating that our field has authors contributing across countries that make up the chunk of articles. The bursts in the node, which can be seen as a pink trim, indicate the outbreak of shooting up of the citation of a document in a particular year frame. England has the highest burstiness which starts in 2003 and ends in 2009, followed by Denmark, from 2001 till 2009 (Fig. 5).

Other countries with a burst of over 2 are France (2.01), the USA (3.09), Germany (2.8), Spain (2.4), Austria (2.7), and Australia (2.7). Another point to consider, however, is that the highest bursts are found in countries that are smaller nodes, meaning lesser articles contributed as compared to contributions from China (232 pieces), South Korea (34), and Japan (23). Japan also has a burst score of 2.15, indicating a promise in the surge of citation of Japanese literature of GVC. This should be encouraged as it can very well represent the oriental nations. We can understand from the distribution here that the prominent and most cited literature comes from developed countries, which translates that the policy suggestions and decisions are also centred around first-world problems. This, in turn, implies that more

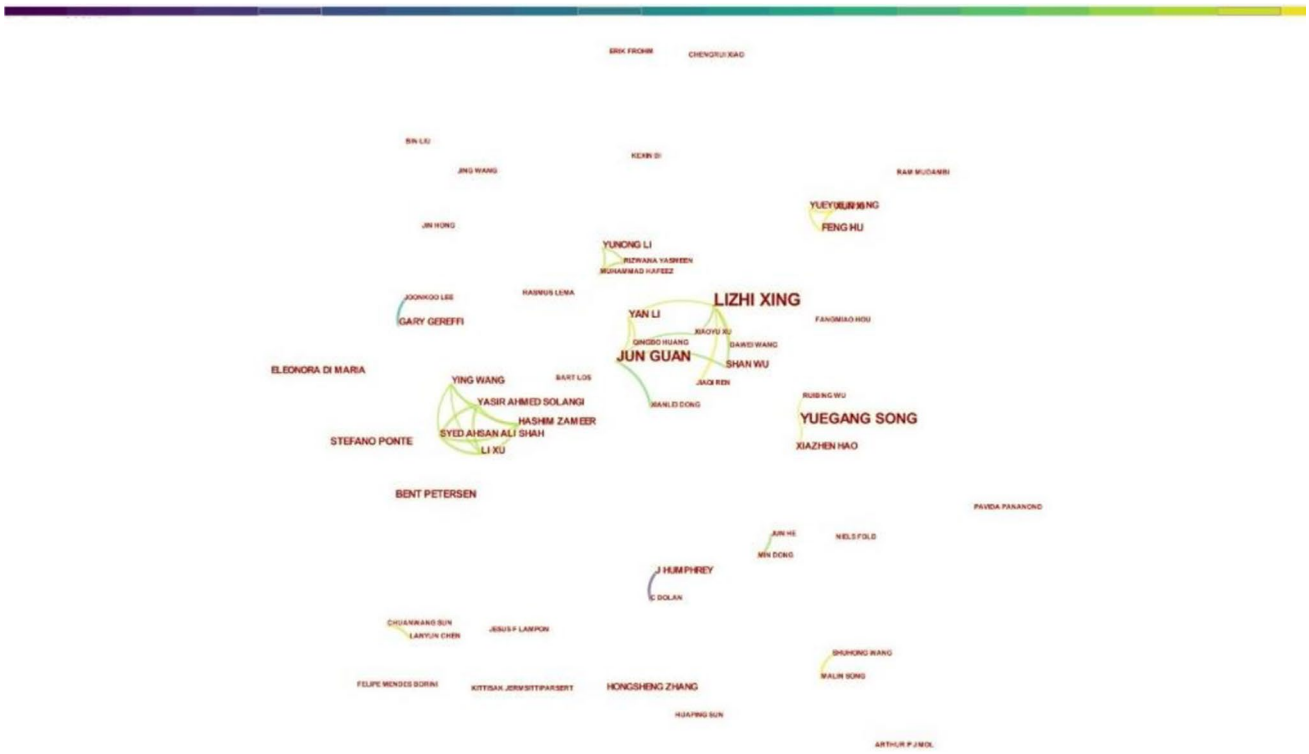

Fig. 4 Author collaboration network in the global value chain for sustainability research

Table 5 Top 10 authors for collaboration in the global value chain for sustainability

Rank	Author	Frequency	Sigma	Burstiness	APY	Betweenness centrality
1	Lizhi Xing	12	1	3.22	2017	0
2	Jun Guan	8	1	3.07	2017	0
3	Yuegang Song	8	1	–	2021	0
4	Stefano Ponte	5	1	2.1	2009	0
5	Niels Fold	4	1	–	2008	0
6	Eleonora Di Maria	4	1	–	2010	0
7	Bent Petersen	4	1	–	2007	0
8	Isidoro Romero	4	1	–	2011	0
9	Yan Li	4	1	2.41	2020	0
10	Feng Hu	4	1	–	2021	0

research is encouraged and expected from scholars and academicians from the developing and third-world nations who should highlight cases and scenarios present there, and jointly international trade policies can be rectified (Fig. 6).

Top institutions in global value chain for sustainability research

The figure depicts the relationship between the institutions in the GVC and sustainability domain. There are a total of 360 institutions with 234 links between them. The modularity Q value of 0.73 and density of 0.0038 indicates that the clusters are loosely related, meaning there were weak links between them. This suggests that institutions tend to work on topics within the same group than collaborate. The high silhouette value of 0.906 indicates robust clustering, further proving the point. The same is also supported if we carefully observe the thick lines between the institutions in the graph (Fig. 7).

This gives us directions that institutions may want to work outside their circles to expand their research output. The largest node is the Copenhagen Business School. Other noticeable institutions are the University of International Business and

Fig. 5 Country network in the global value chain for sustainability

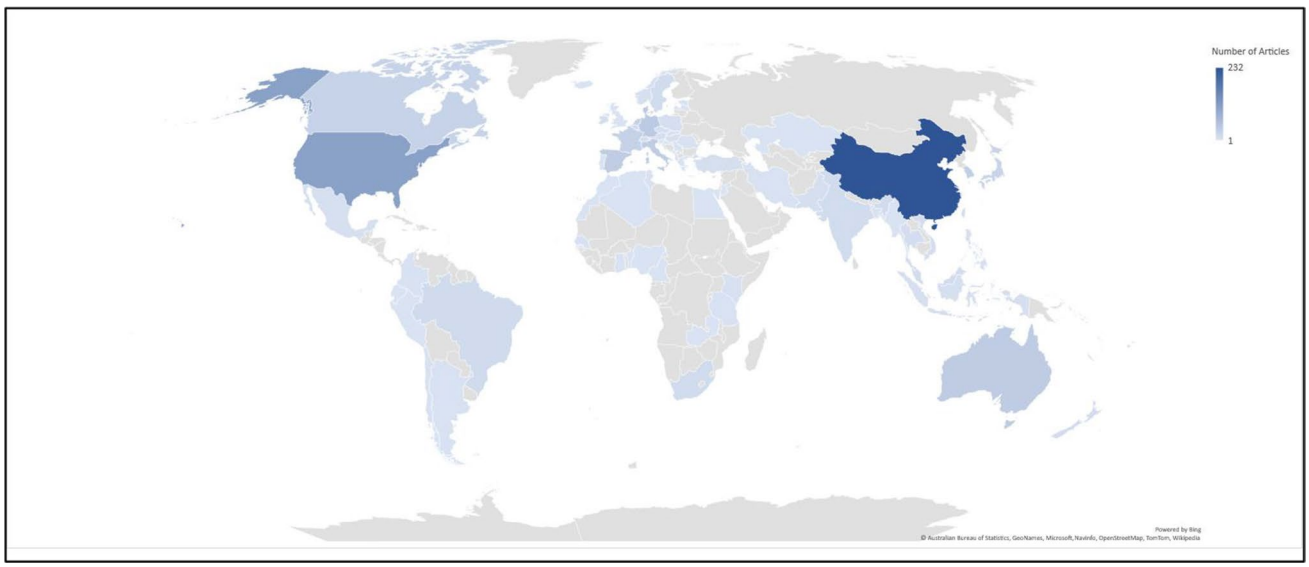

Fig. 6 Country-wise spread of global value chain for sustainability research

Economics (UIBE, Beijing), Beijing University of Technology, the University of Sussex, and the University of Manchester. Furthermore, we also notice that the institutions mentioned are all in developed nations, except China, siding similar results as the country analysis. This indicates that more research needs to occur in developing nations (Fig. 8).

Top journals in global value chain for sustainability research

The network of journals contains 690 journals and a total of 2236 links between them. This network's strong modularity ($Q = 0.808$) and moderate density (0.0094) indicate loose clustering. This means that journals have formed their niche in topics, and there is a lack of multidisciplinary or interdisciplinary collaboration. The high clustering quality value (silhouette = 0.9068) further strengthens this point because high clustering quality translates to homogeneity in clustering. The noticeably large nodes visible are the significant contributors, as also can be seen in Table 6. The *Journal of International Economics* is the major contributor, with 283 papers in the data range under study in this paper. Other prominent journals are *Review of International Political Economy*, *World Development*, *American Economic Review*, *Regional Studies*, and *Journal of Economic Geography*. It is interesting to see journals covering political geography and economic geography on the list as it suggests the inclusion of new study areas in the topic.

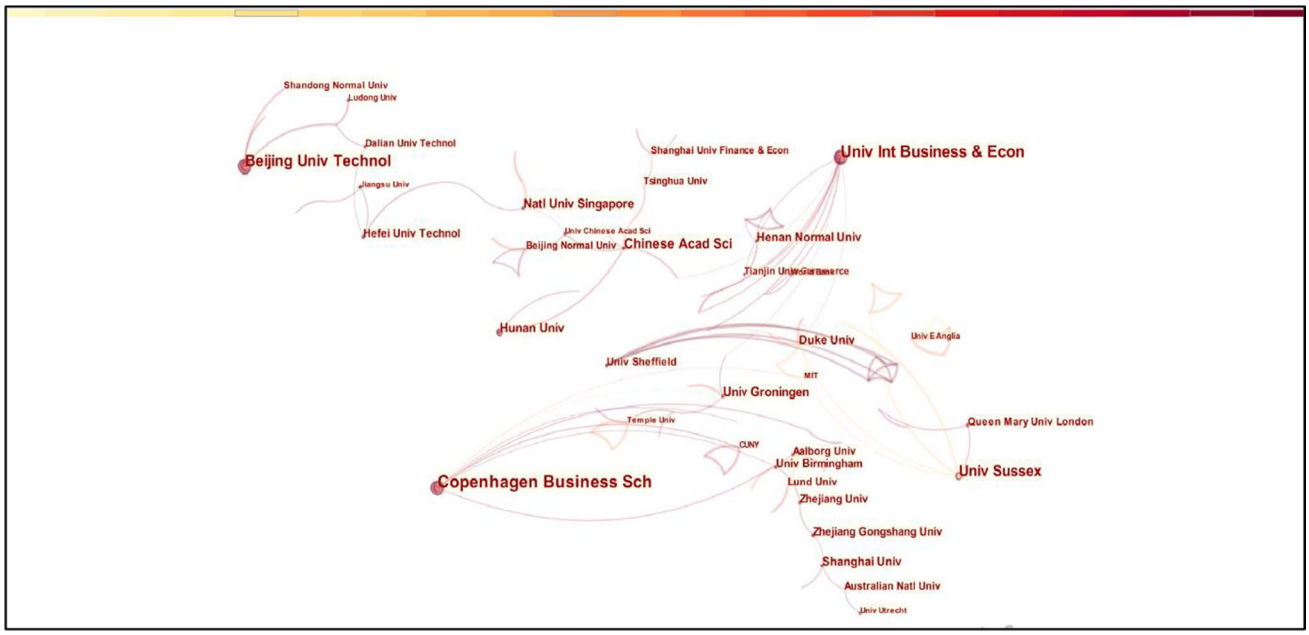

Fig. 7 Institution network in the global value chain for sustainability research

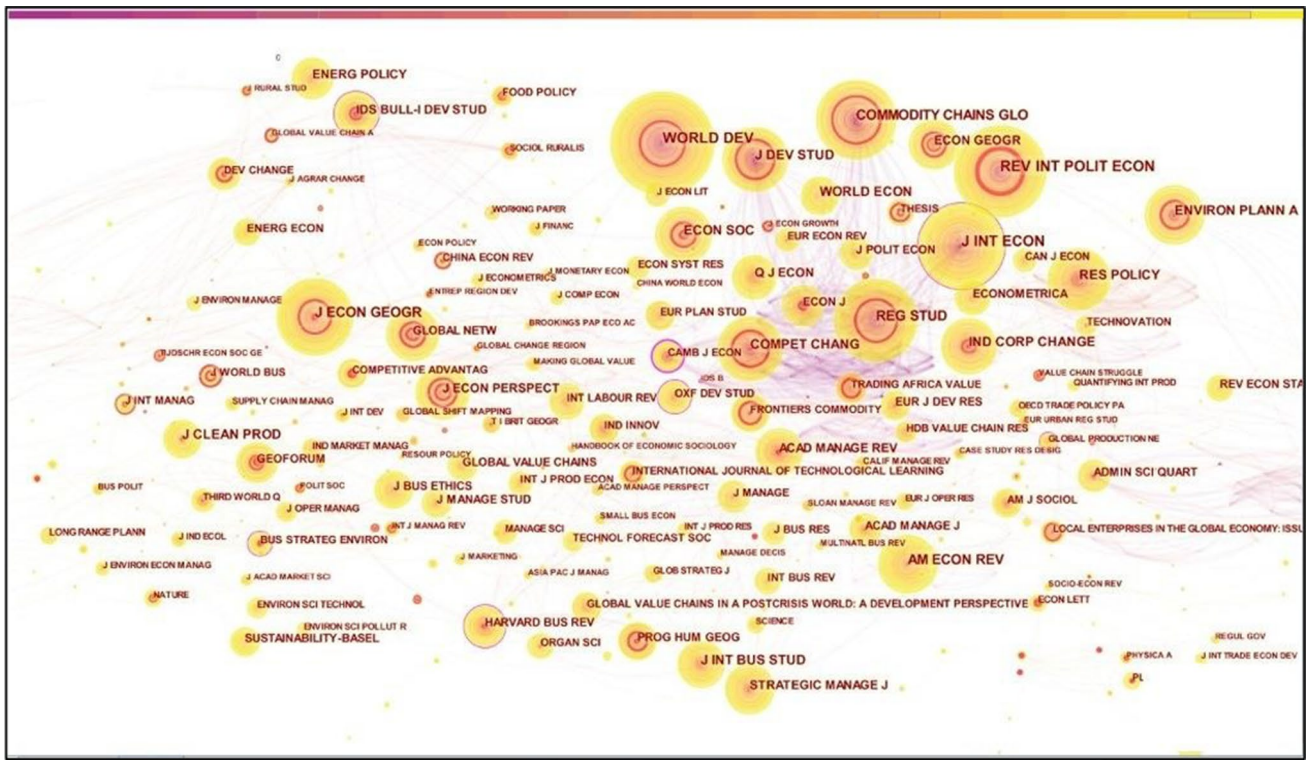

Fig. 8 Journal network in the global value chain for sustainability research

Table 6 Top 20 journals in the global value chain for sustainability research

Rank	Source	Frequency	Sigma	Burstiness	Betweenness centrality	Impact factor
1	*Journal of International Economics*	283	1	–	0.2	3.373
2	*Review of International Political Economy*	280	1.19	8.36	0.02	4.659
3	*World Development*	277	1.46	13.41	0.03	5.278
4	*American Economic Review*	225	1	–	0.04	9.09
5	*Regional Studies*	191	1.33	7.66	0.04	4.27
6	*Journal of Economic Geography*	185	1.05	6.34	0.01	4.862
7	*Research Policy*	145	1	–	0.05	8.11
8	*The Journal of Development Studies*	132	2.71	12.36	0.08	2.21
9	*Environment and Planning A: Economy and Space*	122	1.46	7.1	0.05	4.056
10	*Industrial and Corporate Change*	118	1.55	7.25	0.06	3.085
11	*Journal of Cleaner Production*	117	1	–	0.04	9.297
12	*Competition and Change*	115	1.44	12.63	0.03	3.043
13	*Economy and Society*	112	1.86	11.87	0.05	2.849
14	*The World Economy*	111	1	–	0.04	1.45
15	*Journal of International Business Studies*	110	1	–	0.02	9.26
16	*Quarterly Journal of Economics*	108	1	–	0.03	15.563
17	*Strategic Management Journal*	108	1	–	0.03	8.641
18	*Journal of Economic Perspectives*	108	1.13	6.01	0.02	8.1
19	*Academy of Management Review*	104	1.19	2.83	0.06	12.638
20	*Energy Policy*	97	1	–	0.02	6.142

Intellectual structure of global value chain for sustainability research

The intellectual structure of the paper tells us about the intellectual structure and trajectory of the topic. The co-citation analysis and keyword analysis help bring out the themes in the subject. The detailed analysis is given in the following sections.

Co-citation analysis of global value chain for sustainability research

Co-citation analysis is the technique of identifying the documents that are widely or commonly cited by authors in review to develop knowledge groups (Donthu et al. 2021b). We look at the third research question here (RQ3). To simplify, we may say that authors depend on co-citation analysis to figure out new research themes or sub-themes in a broader area. Chen et al. (2010) recommend that researchers of the scientometric study rely on the silhouette score value to find or identify prominent clusters that can be the new subject themes or sub-theme. The ideal value ranges between 0.7 and 1.0. CiteSpace detects co-citations and classifies them into clusters based on silhouette scores. Standard connections between the cited documents in each cluster and the citations of records in that cluster are used to test the cluster labelling process's strength. Table 7 and Fig. 9 summarise the findings.

Cluster #0 (n = 102, silhouette = 0.906), labelled as global value chain participation, is the largest cluster formed. It is a relatively large cluster with 102 members and concentrates on the theme of participation. The authors here talk about the global value chain and its effect on the participation of members in the value chain process in the wake of policy impact financial constraints. Notable contributions have been from Qu et al. (2020), Pleticha (2021), Yang et al. (2020), Agostino et al. (2015), Xiao et al. (2020), and Ndubuisi and Owusu (2021).

Cluster #1 (n = 92, silhouette = 0.881) is the second-largest group that has a silhouette score of 0.881. The larger the silhouette score, the more accurate the clustering process. The cluster is labelled as a gendered global production network. As we know from the literature, global commodity chains evolved into value chains and further into production networks; as per systems theory explained by Lee (2017), this cluster talks about gender and governance in these production networks. Authors have given cases of countries like Indonesia and sub-Saharan Africa for the same. Major contributions to this cluster are from McWilliam et al. (2020), Kano et al. (2020), Liu and Mei (2016), Bush et al. (2015), Ponte and Sturgeon (2014), Fold (2014), and Neilson (2014).

Cluster #2 (n = 90, silhouette = 0.897) is labelled as repositioning organisational knowledge dynamics. At the same time, governance has been a sub-theme in the previous cluster. This cluster talks about the organisational dynamics

Table 7 Co-citation clusters in global value chain for sustainability research

Cluster	Size	Silhouette	APY	Cluster label (LLR)	Description	Major papers
#0	102	0.906	2007	Global value chain participation	The cluster here talks about the production network in the value chain process. The influential papers build and contribute to the literature on the same. Also, how embedding greening into the value chain process. Some articles talk about the specific examples of their home countries regarding the same.	Qu et al. (2020), Pleticha (2021), Yang et al. (2020), Agostino et al. (2015), Xiao et al. (2020), and Ndubuisi and Owusu (2021)
#1	92	0.881	2007	Gendered global production network	The theme of this cluster can be identified as governance and production network. Various papers here talk about the governance models and the different kinds of "chains".	McWilliam et al. (2020), Kano et al. (2020), Liu and Mei (2016), Bush et al. (2015), Ponte and Sturgeon (2014), Fold (2014), and Neilson (2014)
#2	90	0.879	2009	Repositioning organisational knowledge dynamics	While governance has been a sub-theme in the previous cluster, this cluster talks about the organisational dynamics and how and where the global value chain intersects with the business part and the multidisciplinary approach considered while looking at GVC	Jurowetzki et al. (2018), Murakami and Otsuka (2020), Buckley et al. (2019), Su et al. (2020), Horner (2016), and Ma et al. (2022)
#3	54	0.815	2002	Labour standard	The cluster presents the theme of labour standards, and the literature talks about the various labour standards in multiple industries, varying from flowers to sporting goods.	Challies and Murray (2011), Neilson (2014), Özatağan (2011), Morris and Staritz (2014), and Ramirez and Rainbird (2010)
#4	50	0.849	2001	Local cluster	Studies here draw attention to the local market clusters and their entry or linkages to the international or global market through the value chain. Some studies also focus on how geographically dispersed groups can be brought together through the GVC	Gereffi and Fernandez-Stark (2016) Ponte and Ewert (2009), Nadvi and Halder (2005), Parrilli and Sacchetti (2008), Hall et al. (2012), Özatağan (2011), Bair and Gereffi (2001) and Hervas-Oliver et al. (2011)
#5	41	0.888	2000	Learning opportunities	The cluster's theme is the learning opportunities for developing nations from their value chains. The various studies here focus on whether new information can be used for policy and decision-making.	Pietrobelli and Rabellotti (2011), Fernandez (2015), Techakanont and Charoenporn (2011), Rainbird and Ramirez (2012)
#6	39	0.986	2001	Internet era	This cluster talks about the Internet era and the impact of trade in the global chains, especially for third-world countries.	Moodley (2002), Humphrey, and Schmitz*, H. (2001), Ponte (2009), Dolan (2004), Quentin and Campling (2018), and Werner et al. (2014)
#7	36	0.954	1998	Global enterprise network	The cluster discusses the global enterprise network that arises due to the global value chain. Various studies look at the possibility of employment at multiple levels due to the globalised fashion of production networks	Palpacuer and Parisotto (2003), Dolan (2004), Kritzinger et al. (2004), Dolan and Humphrey (2004), and Smith and Barrientos (2005)
#8	33	0.921	2000	Inclusive growth	The literature of this cluster discusses inclusive growth in the GVC model. While inclusion is a core part of sustainability, authors have contributed to literature that uncovers the ground-level facts.	Humphrey, and Schmitz*, H. (2001), Ponte (2009), Strange and Humphrey (2019), Challies and Murray (2011), Hall et al. (2012), Neilson (2014), and Lee et al. (2016)

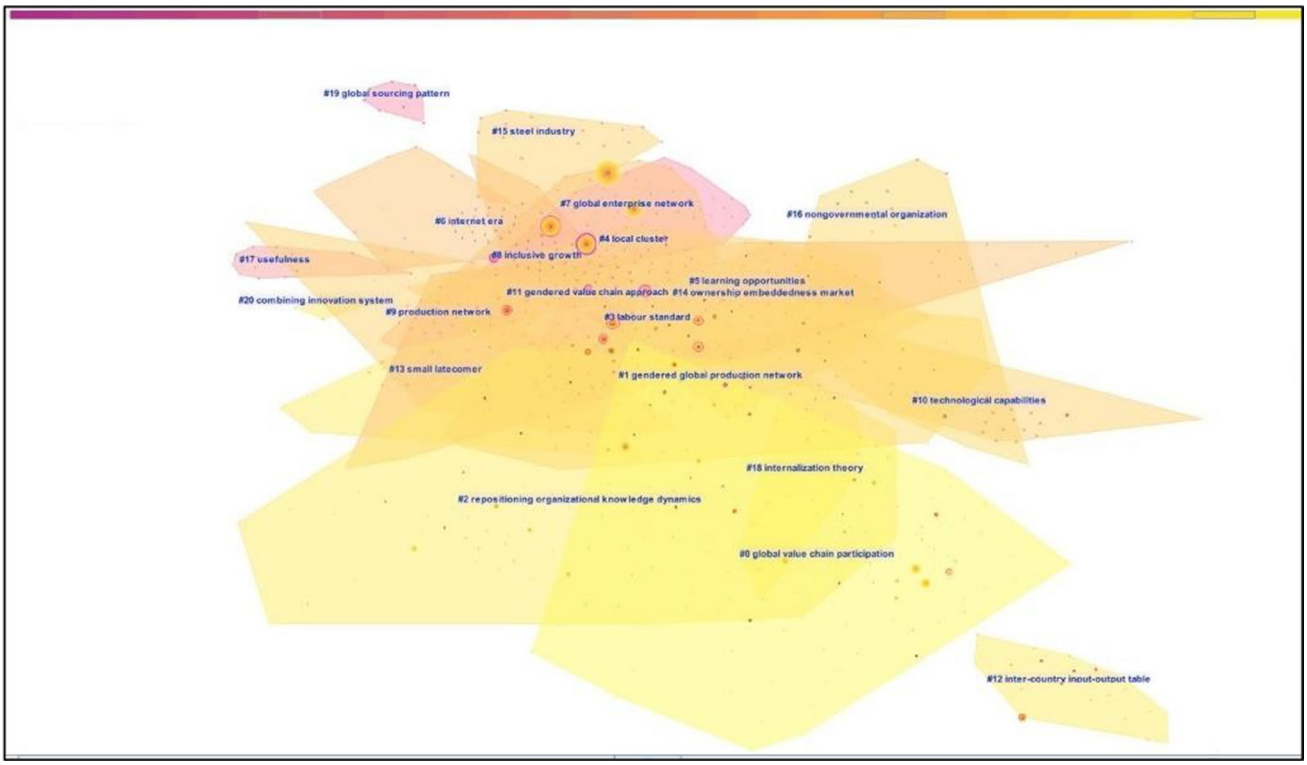

Fig. 9 Co-citation clusters in the global value chain for sustainability research

and how and where the global value chain intersects with the business and the multidisciplinary approach considered while looking at GVC. Significant works include Jurowetzki et al. (2018), Murakami and Otsuka (2020), Buckley et al. (2019), Su et al. (2020), Horner (2016), and Ma et al. (2021).

Cluster #3 (n = 54, silhouette = 0.815) talks about the labour conditions in the global value chain process and, as such, is a crucial topic under the purview of sustainability. Most often, the purpose of having a global chain would be to reach more masses and collect resources from where the cost would be the lowest to optimise profits. However, resources like labour are often overworked or underpaid, which is the central theme here. Significant contributions have been from Challies and Murray (2011), Neilson (2014), Özatağan (2011), Morris and Staritz (2014), and Ramirez and Rainbird (2010).

Cluster #4 (n = 50, silhouette = 0.849) is labelled as local clusters—the local markets and hubs of trade and how they should be integrated into the global chain. The key here is the inclusion and upgrading of these local clusters to the international scale in the global value chain process. Also, authors have contributed to the literature suggesting how geographically dispersed clusters can be brought together through the value chain. Major contributors to the cluster are Giuliani et al. (2015), Ponte and Ewert (2009), Nadvi and Halder (2005), Parrilli and Sacchetti (2008), Hall et al. (2012), Özatağan (2011), and Hervas-Oliver et al. (2011).

Cluster #5 (n = 41, silhouette = 0.888) enables the scope for learning, which is the cluster's theme here. This cluster has contributions from authors who challenge if the information assimilated in the global value chain and production networks can improve the process, removing hiccups and being used for policy creation and implementations. The focus is also on developing nations where there is much scope for work, primarily in policymaking. Major contributions come from Pietrobelli and Rabellotti (2011), Fernandez (2015), Techakanont and Charoenporn (2011), and Rainbird and Ramirez (2012).

Cluster #6 (n = 39, silhouette = 0.986) is with excellent silhouette value describing the close-knitted relation between the member papers indicating a strong cluster. Rightly so, it talks about the Internet era, which has been around for a while and has also made its way into the arena of global value chains and sustainability. A small cluster of 39 papers talks about the Internet era and its impact on the members of the global value chain. The authors turn the light to third-world countries where, unlike first-world counterparts, the range and effect of the Internet are still underway. The major contributors are Moodley (2002), Humphrey, and Schmitz*, H. (2001), Ponte (2009), Dolan (2004), Quentin and Campling (2018), and Werner et al. (2014).

Cluster #7 (n = 36, silhouette = 0.954) is based on the global enterprise network theme of the cluster and talks about

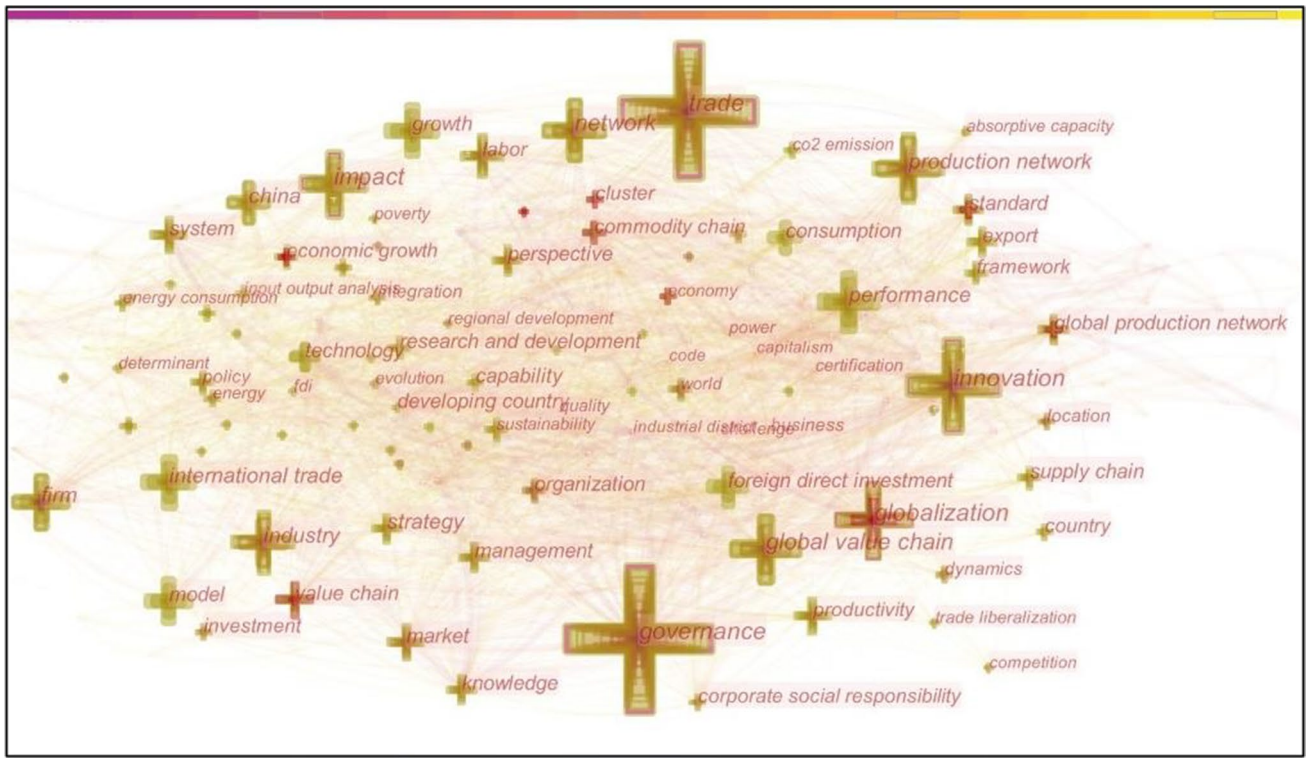

Fig. 10 Keyword network in the global value chain for sustainability research

the employment opportunities that arise at the various levels of the worldwide value chain process, right from production to transportation. There is ample employment opportunity available at multiple levels, which points out the sustainability aspects of the GVC, generating long and lasting jobs and raising livelihoods. Significant contributions are from Palpacuer and Parisotto (2003), Dolan (2004), Kritzinger et al. (2004), Dolan and Humphrey (2004), and Smith and Barrientos (2005).

Cluster #8 ($n = 33$, silhouette = 0.921) is relatively small in size but, with a high silhouette value, is an excellent example of how sustainability is embedded in the global value chains. Authors here have discussed the possibility of inclusion in the supply chain process but however have also raised concerns if that is indeed what happens at the ground level. This gives scholars scope to probe into the ground-level reality to expose the truth and suggest means to improve the situation if not up to the mark. Contributions are majorly from Humphrey, and Schmitz*, H. (2001), Ponte (2009), Strange and Humphrey (2019), Challies and Murray (2011), Hall et al. (2012), Neilson (2014), and Lee et al. (2016).

Keyword analysis of global value chain for sustainability research

The keyword analysis finds the trend of themes, sub-themes that arise based on the keyword's authors list in their articles. The keywords are a mini representation of the contents of the papers; they provide a peek into the major themes the author would be touching on in their work (Zhao 2017). It also helps us understand the hot topics that are new in the academic world and where the focus is needed or is already gathered. The burst indicator is a good measure for the same helping us pinpoint on author, journals, keywords, or other nodes (Chen 2016).

Kleinberg's (2002) technique was utilised to create theme clusters based on author keywords to describe the field's intellectual cluster (Fig. 10).

The total number of articles we considered for analysis is 753 and from those stood out multiple keywords. However, Table 8 shows the top 10 keywords. Additionally, on clustering the data for keywords, 7 clusters were formed. The largest is cluster ID 0, with $n = 101$. The silhouette score of 0.664 shows an above-average but not high precision in clustering. However, the silhouette score increases as we go further to clusters with smaller inclusions; as discussed earlier that as the cluster size is bigger, the score will be lesser and vice versa (Chen et al. 2010). The most relevant citation of this cluster talks about human rights and labour protections in the wake of the globalisation of business (Parella 2014.0). As we look at the other clusters and observe the cluster labels that are system generated, we see it mostly talks about market liberalisation (cluster #0), trade-pollution

Table 8 Top 10 keywords in the global value chain for sustainability research

Rank	Keyword	Frequency	Sigma	Burstiness	Betweenness centrality
1	Governance	128	1	–	0.14
2	Trade	119	1	–	0.11
3	Innovation	69	1.24	1.86	0.12
4	Global value chain	69	1.22	3.46	0.06
5	Impact	62	1	–	0.13
6	Globalisation	58	1.7	8.48	0.06
7	Network	53	1	–	0.17
8	Industry	50	1.56	2.72	0.18
9	Production network	49	1	2.62	0
10	Performance	49	1	–	0.05

nexus (cluster #1), value chain dynamic settlement (cluster #2), global value chain reconfiguration (cluster #3), non-governmental organisation (cluster #4), South African wine (cluster #5), multipolar governance (cluster #6), local cluster (cluster #7), global value chain engagement (cluster #8), Senegalese export horticulture (cluster #9), and globalised world (cluster #10). One of the major citers of the second cluster is Duan et al. 2021 who talk about the pollution haven effect and the impact on countries due to the global value chain.

We do a keyword analysis along with citation, country, and other studies to understand how the topics and keywords have been moving along over the years in GVC for sustainability. The overall silhouette value of the keyword analysis is 0.6801 and, as such, shows an average score indicating not very strong clustering, meaning the topics that converge to form a relationship are more heterogeneous. When we look at the top 10 keywords from the analysis, we can still see that most words still revolve around trade and production or network, and the emphasis, though present, is relatively low when it comes to sustainability and governance. Governance, no doubt, is the top keyword with $n = 128$ but is single-handedly representing the entirety of sustainability in the top 10. This indirectly tells us that there is more scope for work in this subject matter of global value chains.

If we look at the burstiness of these keywords, globalisation (8.48), cluster (5.16), commodity chain (4.89), value chain (4.79), organisation (4.70), and global production network (4.62) are at the top. Burst is the detection of a sudden increase in citations of a paper or author contribution (Chen et al. 2010). It is, however, not necessary that the burst of source occurs exactly near the time of publication. It may also happen later based on the trending topic and relevance of the literature. The clusters formed by the keywords are discussed below. These clusters give us a theme and future directions for research (Fig. 11).

Cluster #0: The first cluster is labelled as market liberalisation. Kumaraswamy et al. (2012) talks about how domestic supplier businesses might adapt and perform as market liberalisation develops through catch-up methods targeted at integrating with the industry in this research. The prominent other papers from this cluster are Nadvi and Halder (2005), Liu et al. (2018), Lu et al. (2015), Patchell and Hayter (2013), Tallontire et al. (2014), and Abd Rahman et al. (2021).

Cluster #1: The international economy has undergone substantial changes due to the development of global commerce. As a result, global trade expansion raises the question of whether trade benefits are beneficial or harmful to the environment. As a result, many scholars and policymakers are concerned about the effects of globalisation on the environment (Yasmeen et al. 2019). This cluster talks about the trade pollution nexus or interconnections. The other prominent papers are Agostino et al. (2015), Baiardi et al. (2015), Strange and Humphrey (2019), Surmeier (2020), and Vicol et al. (2018) (Table 9).

Cluster #2: This cluster talks about the value chain dynamics settlement. Fold (2014) talks about the GVC study to be complemented with a look at livelihoods at the settlement level. Livelihood diversification's presence—or absence—suggests specific settlement trajectories that define regional development patterns. It is also recommended that incorporating features from the global production network (GPN) theory into the combined technique will increase knowledge of how value chain dynamics shape areas. Other papers of the cluster include Duan et al. (2021), Ha et al. (2013), Funk et al. (2010), and Tsakiridis et al. (2020).

Cluster #3: The reconfiguration discussed in this cluster is how the clusters and linkages are changing or shifting in the GVC, meaning how industry linkages are affected in the face of MNCs and in different areas or territories. This would be a shift from the local internal clusters or groups of networks. Prominent works include Oliver et al. (2008), Chaminade and Vang (2008), Mintz-Habib (2013), and Harbi et al. (2009).

Cluster #4: This cluster talks about non-governmental organisations (NGOs). The rise of organised civil society and NGOs as organisational expressions of broader social movements has drastically transformed the global political–economic landscape. The growing worldwide reach of NGOs poses a challenge to established international business research and emphasises prospects for widening and altering existing paradigms in the sector. Teegen et al. (2004), Jindra et al. (2019), Helfen et al. (2018), Belton and Little (2011), and Alvstam et al. (2019) are the prominent papers in this cluster.

Cluster #5: The processes of economic globalisation and international commerce are examined using a global value

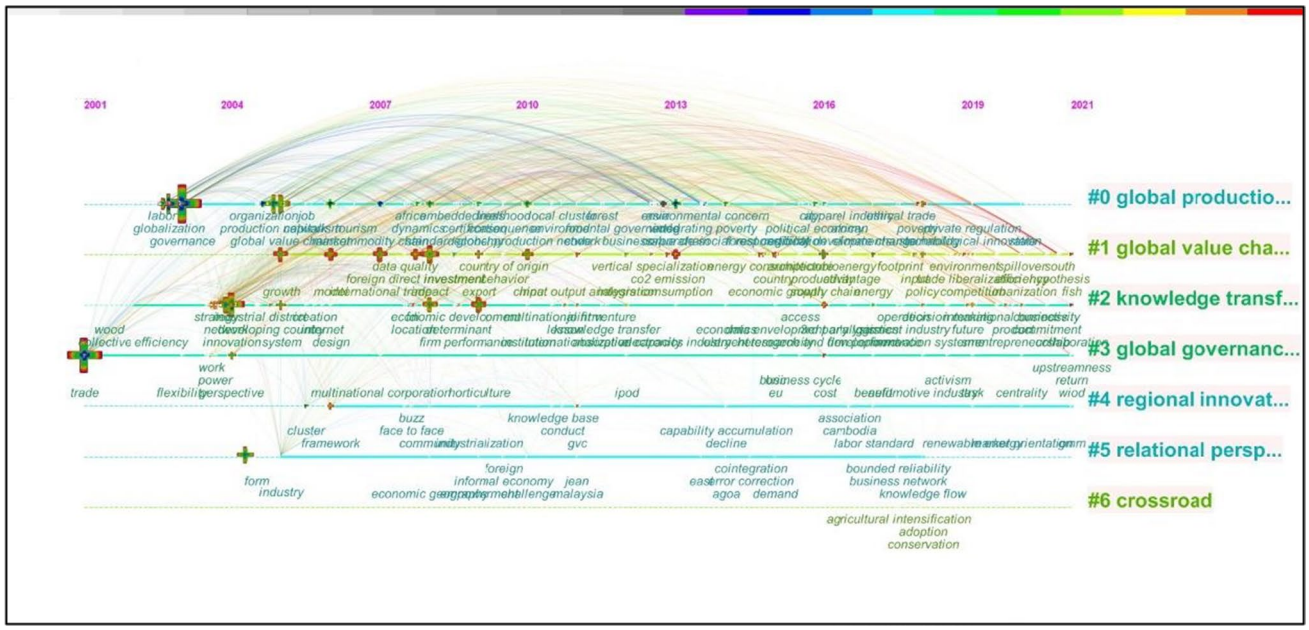

Fig. 11 Keyword clusters in the global value chain for sustainability research

Table 9 Keyword clusters in the global value chain for sustainability research

Cluster no.	Size	Silhouette	Cluster label or theme (LLR)	Explanatory labels or topics
#0	36	0.893	Market liberalisation	Economic benefit, global inequality chain, Taiwanese manufacturing, export manufacturer, functional upgrading
#1	35	0.937	Trade-pollution nexus	Global inequality chain, Taiwanese manufacturing, export manufacturer, functional upgrading, environmental harm
#2	35	0.918	Value chain dynamics settlement	Analysing sustainability performance, material resource, new method, global inequality chain, Taiwanese manufacturing
#3	30	0.923	Global value chain reconfiguration	Export manufacturer, functional upgrading, new venture, emerging market, Chinese technology
#4	29	0.936	Non-governmental organisation	Global inequality chain, Taiwanese manufacturing, export manufacturer, functional upgrading, environmental harm
#5	28	0.886	South African wine	Technological upgrading, Indonesian electronics, garment sector, global inequality chain, Taiwanese manufacturing
#6	28	0.905	Multipolar governance	Environmental harm, unsustainable business models-recognising, global inequality chain, Taiwanese manufacturing, export manufacturer
#7	27	0.832	Local cluster	Panel data, global inequality chain, Taiwanese manufacturing, export manufacturer, functional upgrading
#8	27	0.871	Global value chain engagement	Innovation efficiency, global value chain embeddedness, global inequality chain, Taiwanese manufacturing, export manufacturer
#9	25	0.871	Senegalese export horticulture	Global inequality chain, integrating mechanism, Taiwanese manufacturing, export manufacturer, functional upgrading
#10	20	0.975	Globalised world	Global value chain, Taiwanese manufacturing, cross-disciplinary innovation, global inequality chain, export manufacturer

chain (GVC) methodology. GVC governance depicts how 'lead businesses' accomplish precise functional divisions of labour along a value chain, resulting in specified resource allocations and gain distributions. Ponte (2009) discusses that buyer power, market share, and economies of size or scope are not the only factors that agri-food lead corporations use to manage supply chains; normative work is also used. The author uses convention theory to investigate governance in the South African wine value chain to accomplish this. This is the central theme of the cluster. Other

works, though not focused on the African wine industry specifically, but contributing to similar theory are Parker et al. (2018), Opazo-Basáez et al. (2021), Lauridsen (2018), Vagneron and Roquigny (2011), and Bolwig et al. (2010).

Cluster #6: This cluster labelled as multipolar governance wishes to focus on a multipolar model that researchers may undertake to study the GVC relation. Ponte (2014), in his paper, suggests through the idea of 'polarity,' seeks to push the boundaries of global value chain (GVC) governance analysis. Much of the previous GVC work has concentrated on 'unipolar' value chains, in which one set of 'lead businesses' occupying a single function in the chain has a dominating role in managing it. Some researchers have looked at the governance dynamics of 'bipolar' GVCs, where two sets of players in distinct functional roles both drive the chain. The author would want to take this further and propose that governance be thought of as a continuum between unipolarity and multipolarity. Significant papers of the cluster include Brønd (2018), Gudbrandsdottir et al. (2021), Jindra et al. (2019), Xue and Chan (2013), and Zhang et al. (2021).

Cluster #7: Local cluster as a theme emerged in the co-citation analysis as well, drawing focus to the fact that it is in fact an emerging and trending topic. Studies here draw attention to the local market clusters and their entry or linkages to the international or global market through the value chain. Some studies also focus on how geographically dispersed clusters can be brought together through the GVC. Prominent papers are Giuliani et al. (2015), Ponte and Ewert (2009), Nadvi and Halder (2005), Parrilli and Sacchetti (2008), Hall et al. (2012), Özatağan (2011), and Hervas-Oliver et al. (2011).

Cluster #8: Lu et al. (2019) studied the effect of GVC engagement on wages and found a positive relationship. This is the theme of the cluster as well—the global value chain engagement. A better knowledge of the global value chain (GVC) impact on wages is critical for calculating the benefits of international integration. In capital-intensive and foreign-invested businesses, the improving impact is more pronounced. Furthermore, earnings and the degree of embedment in the GVC have a U-shaped connection (the marginal improvement changes from decreasing to increasing). Other significant works include Yao and Deng (2016), Romero et al. (2020), Murakami and Otsuka (2020), Colovic and Mayrhofer (2011) and Cumming et al. (2020).

Cluster #9: Baglioni (2018) discusses labour control in global production networks in their paper. This work is set in the backdrop of the Senegalese export horticulture. The other labels of this cluster, if we closely examine, point towards the global inequality chain, integrating mechanism, Taiwanese manufacturing, export manufacturer, and functional upgrading. The prominent papers of this cluster are Kano (2018), Cooper et al. (2021), Stringer et al. (2014), Morris et al. (2016), and Lee et al. (2016).

Cluster #10: This cluster is labelled as the globalised world and is a term we have often heard. With the opening of international trade, the setting up of MNEs, and the advent of the Internet, the world has in fact become a global village. The papers in this cluster talk about the setting, challenges, and avenues of growth in the face of this globalised world. The major contributing papers are Rueda et al. (2018), Bair (2017), Parella (2014), He et al. (2018), and Lee et al. (2020).

Towards a new theoretical model of GVC for sustainability

A few noteworthy points that we came across through this review were, first, we found the theme of local clusters while performing the keyword analysis and, upon scrutinising the literature, found the importance and relevance of local clusters in the global value chains. More focus needs to be paid to the local sourcing and integration than complete dependence on imports. At the time of the global pandemic, because of supply shocks and stringent lockdown measures in producer countries, the entire global value chain system came to a halt, and as per the IMF blog article, the authors suggested domestic production of goods and supply diversification. This boosts economies that want to enter the global production network. Secondly, labour standards are a theme that emerged, suggesting evaluation for the second- and third-tier suppliers and the governance of labour rights. This theme is particularly an essential point of discussion as scholars debate the benefits vis-a-vis the demerits of global value chains. A popular debate point is exploiting resources, particularly the workforce, when outsourcing work. This stands true here, too, and in the age and day of human rights, what is the cost to the business for poor working standards in the long run? This is a significant point of consideration. Countries and companies often have laws and rules to ensure that workers' rights are protected, but the efficacy still needs to be measured. We also look at the greenwashing vs. greening of the supply chain. What often comes across as greening may be greenwashing. More studies are needed to learn the impact of many processes in the value chain and their impact on overall sustainability. The overall focus of this review and its implication is for developing nations rather than developed nations since the developing nations have shown more promise for change and quick adaptability. Though majorly contributed from developed nations, the literature works on developing nations and the local clusters. China has been a significant contributor to both the value chains and the literature to it. Both academia and governments need to encourage more research to streamline the topic.

World Bank and the World Trade Organisation (WTO) have expressed high hopes for GVCs' development potential.

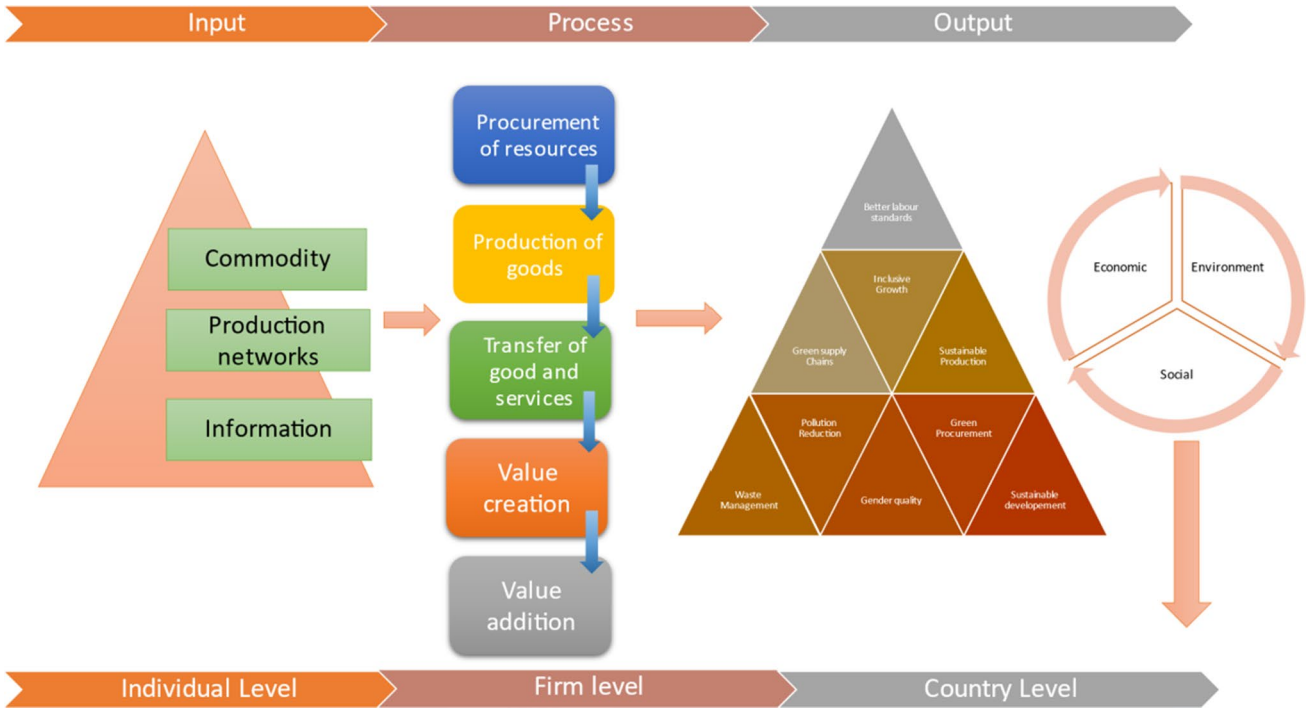

Fig. 12 Theoretical framework of the global value chain for sustainability research

This positive perspective of globalisation is based on the assumption that developing nations may specialise in a small number of uncomplicated jobs rather than building up national businesses from the ground up. Through the literature that has been explored in this paper, we have proposed a theoretical model of global value chains (GVCs) for sustainability, as depicted in Fig. 12. The input for the model would be the commodity, the resource that has to be traded, essentially, and along with it is the information that passes through the various channels. The output will be more meaningful and sustainable when this process is complete. There will be better labour standards, equitable wages, equality in work, and gender-sensitive chains. There will be more inclusive growth. There will be greener supply chains and net-zero goals on the environment front. Pollution and waste will be better managed and reduced as much as possible. The commodity chain, turned value chains, will add more value to sustainability. The result would provide a framework that contributes to the sustainable development goals.

Global value chain operates on a few theories like the stakeholder theory, resource-based view theory, and internationalisation theory. GVC and stakeholder theory go hand in hand. Companies in a GVC must manage the demands and expectations of many different stakeholders, both inside and outside of their own organisations. Although it can be difficult and complex, this work is crucial for long-term success. The GVC and the RBV theory are intertwined. According to the RBV principle, businesses can achieve a competitive edge by creating special assets and skills that are beneficial to clients. These resources can be applied to increase the efficacy or efficiency of the business' operations or to set the company's goods and/or services apart from those of its rivals. GVC (global value chain) and internationalisation theory are two distinct but related theories for comprehending the globalisation of business. The macro-level theory of internationalisation focuses on the elements that affect a company's choice to become global. Typically, it takes into account things like the company's size, sector, and domestic environment. GVC is a micro-level theory that focuses on the particular actions that businesses take to engage in international markets. Typically, it takes into account elements like the place of production, the structure of the value chain, and the connections between the chain's participants. To comprehend the globalisation of business, one can apply GVC and internationalisation theory together. They provide various viewpoints and ideas, nevertheless. While GVC offers a more in-depth understanding of the specific activities that corporations engage in, internationalisation theory offers a broader grasp of the factors that impact internationalisation.

The organisations going forward should integrate cluster-level themes in their strategy. Keeping sustainability at the heart of value chains, apart from profit, firms should understand the strategy. One of the prominent clusters, that points to the local cluster as the theme, points to the relative importance of localisation of work and process. Good research

arises from groundwork and addresses the issues faced by the firms and people who work in the field. Upon examining the clusters and keywords, the most common terms are 'reconfiguration', 'governance', 'laboour standard', etc. This shows a shift from traditional roles and order. This is the future of global trade and value chains. Governance is one of the most common themes, and in fact, a lot of study in the recent and distant past has been undertaken in this area (Wu et al. (2023), Gamarra et al. (2022), Saini et al. (2022) and Fok (2021)). The downfall to not following this path would be not just being left out of the game but loss of goodwill, leading to lower satisfaction levels of both suppliers and customers (forward and backward linkages).

Directions for future research

We develop this section to answer the fourth research question (RQ4). A scientometric review on global value chains in the sustainability research area has been undertaken through this review. Suppose scientometric methods are used to their full potential. In that case, a soundly based statement about the degree of internationalisation in research, the researchers' ability to publish in prestigious journals, and the publication type, visibility, and subsequent impact of the publications in the scientific community can be made (Wallin 2005). The paper certainly hopes to cover for interested authors the extent of research that has been conducted in this area and the future scope as well. While the scientometric review has covered the performance (publication trend, author, country, institution, and journal) and the intellectual structure (co-citation analysis and keyword analysis) of the subject, it may undoubtedly lack in certain places and is not a replacement for a systematic literature review.

Firstly, though covered till 2021, the literature has little coverage on COVID-19 and its impact on GVC and sustainability research. While authors have suggested risk mitigation measures, we do not know how it will pan out in the pandemic scenario. More research is underway and is not part of the corpus the authors have taken in this paper.

Secondly, the articles for this review have been taken from the Web of Sciences database as it is one of the best databases in terms of journal coverage and quality. However, readers may also depend on other databases to procure articles or resources on the topic. However, care must be taken when reading such articles for various reasons. For example, an author's work in a conference proceeding might still be underway, and profound conclusions cannot be drawn, or even worrisome would-be findings based on incomplete data. Furthermore, the rise in predatory journals poses severe threats to the entire research community. The data and facts are not scrutinised with the same rigour level as for journals indexed in prestigious databases like the Web of Science (Chopra et al. 2021).

Another drawback would be skewed co-citation analysis, caused by long publication periods, self-citations, and anomalous citations. These cannot be separated from the scientometrics method that we have employed. The author's study shows us that the subject of global value chains for sustainability research has evolved across subject areas. It no longer is an economic or operations topic but has travelled wide and far to geography, geo-political science, and sociology. The country-wise analysis shows us that notable work is done in developed nations, although the cluster analysis identified clusters of work focussed on more developing and underdeveloped nations. This is a signal for more work to be undertaken by researchers locally. The keyword clusters and the co-citation clusters both point towards this (cluster #4 co-citation analysis and cluster #5, cluster#9 keyword cluster).

Similarly, the top institutions in this research field belong to developed nations, although research topics and themes belong to developing and underdeveloped nations. Developing nations like India and China have many educational institutions and researchers, though they fail to reach the list. Development research coming from developing countries and institutions will be more impactful because they have options to include real-time cases and ground-level reality. This is especially useful if authors would like to take up qualitative research for this topic.

The global value chain for sustainability research can be further explored, especially with technology in the mix. Our study has not focussed much on the technological impact and has been more on the sociological aspects. The impact of COVID-19 is again not explored well in this research, and academicians may explore that as an option. Also, more recent topics like blockchain technology, artificial intelligence, and others may be analysed to see the impact and possible drivers for GVC in sustainability research.

Conclusion

The review of 753 documents in this work focuses on (1) research constituent performance and (2) the intellectual structure that underpins the area of GVC for sustainability. The scientometric study has again demonstrated its ability to handle a vast data collection and provide researchers with helpful information (Donthu et al. 2021a). The paper offers the same, with a few significant reflections covered in greater depth.

The performance study of the corpus of literature has brought out the underlying trends and topics and the top countries, institutions, journals, and authors in the field—this guide other researchers interested in the field to pursue their research in the subject area. The publication trend shows a spike in the publication count since 2019. However, the gradual increase saw a boost since 2016 when the Paris agreement for climate

change was also affected. This alone cannot be attributed as the reason for the increase in publications; the adoption of SDGs also plays an important role. In the country-wise analysis, we observed how China stood out as a hub among other nations, most of which were developed nations. This tells us how developing countries need to contribute more towards the literature. Also, among the authors, we found a few prominent ones, Gereffi G, Humphrey J, Kaplinsky R, Koopman R, Bair J, and Ponte S, among others. The authors of the GVC for sustainability research show close links in how they work. While Gereffi is the top author, they often work with Bair, a prominent author. Similarly, works of Bair can also be seen alongside Ponte. Their notable work talks about upgrading, which should be enlarged to include both its economic and social components to more effectively relate the GVC and cluster literature to upgrading and the function of CSR (Gereffi and Lee 2016).

Furthermore, the failure of private norms to accomplish social advancement has prompted proposals for synergistic governance, including the global and local collaboration of commercial, governmental, and social actors (Lee and Gereffi 2015). Another interesting point to note is the evolvement of the topic of global value chains. Traditionally, this was a topic of supply chains and operation that over time gained interest and importance in economics, and now, it is interesting to note how the top authors are from the field of sociology, i.e. Gereffi G, Bair J, and Korzeniewicz RP.

The institutions' network gave us a clear picture of the top institutions in the GVC for sustainability research. Besides the Beijing University of Technology, other top institutions from developed nations sided with the country-wise analysis. This also implies that not enough attention has been given to the topic despite its pervasiveness across institutions. The chain affects the globe, but studies are limited to prominent institutions.

The co-citation analysis and keyword analysis brought significant research themes in the corpus of literature studied in this review. We can see clearly from the intellectual structure studies that the topic of GVC for sustainability research has evolved from just commodity chains and production networks to more gender-neutral, inclusive networks. More issues like labour regulations, workforce development, and greening have been focussed on in the recent past. A recent article in the financial express suggested the growth of Micro, Small & Medium Enterprises (MSME) in India if they are a part of the global value chain, essentially adding value to the business at each stage. Epede and Wang (2022) also suggest that guaranteeing the effective integration and expansion (upgrading) of these SMEs inside GVCs, the required preconditions, resources, and strategies must be put in place. Cluster #4 in the co-citation analysis suggested the same, while labelled as local clusters. This gives a new direction to researchers and policy makers to focus future work. With the globalisation of workers, it is more critical than ever to look at the influence of global value chain involvement on inherent carbon emission concentration. Cluster #1 from the keyword analysis talks about this trade pollution nexus. The influence of global value chain involvement on carbon emission intensity reflected in international export demand is more significant than that inherent in domestic demand, according to different forms of demand (Liu and Zhao 2021).

The country-wise spread of the research topic shows that considerable research is being done in most developed nations. Also, with COVID-19 still lingering and holding its own set of uncertainties, it brings risks and possible mitigation strategies. Global value chain involvement reduces risk exposure because idiosyncratic shocks are minimised by increasing market differentiation (Borin et al. 2022). Similarity, it is worth seeing that the *Journal of International Economics* published a maximum number of papers in this area covering topics ranging from trade, international economics, and international finance.

Author contributions The research is a culmination of the combined efforts of all the authors. Material preparation, data collection, and analysis were performed by Nimmy Rose Jacob, Shalini Aggarwal, and Neha Saini. The first draft of the manuscript was written by Nimmy Rose Jacob and Suleman Sarwar, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript, and Rida Waheed helped in the final proof reading and grammatical corrections.

Declarations

Ethical approval The authors consent that the work carried out in this research is of high ethical standard. Moreover, this study does not include any human or animal subjects.

Consent to participate This study does not have any participants, and hence, consent is not needed. The study is based on secondary research data only, and there were no participants.

Consent for publication The authors gave consent to publish this work of research to the journal and publisher.

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