

GREEN ENTREPRENEURSHIP: A BIBLIOMETRIC INVESTIGATION

P. Mathushan
Postgraduate student
University of Sri Jayewardenepura
mathush92@gmail.com

Abstract

The nations with transition economics are under pressure to boost entrepreneurial activity, allowing for rapid growth while minimising their effect on the environment. Green entrepreneurship is a salient phenomenon from the economic development perspective and is recognised as a vital enabler of the sustainable economic-environmental-social system. However, the past literature shows that the topic has not been thoroughly examined, and there is no systematised body of knowledge about green entrepreneurship. Notably, little is known about the evolution of this new field of research. Ultimately, this calls for an in-depth investigation of the antecedents and consequences of green entrepreneurship to patronise green organisations and the economic resilience and natural ecosystems. In a similar vein, exploring intriguing questions like current trends, what has been explored to date, and the lacunas in the green entrepreneurship domain could be pivotal. Thereby, the overriding purpose of this paper is to analyse and synthesise the documents published to date in the Scopus database on green entrepreneurship. Bibliometric and citation analysis was performed to identify the most influential authors, articles, and research keywords and topics in the domain of green entrepreneurship. Concerning the findings, the paper identified new trends in green entrepreneurship. Notably, ten compelling research clusters were identified in the green entrepreneurship domain. Further, it is found that several factors foster or dampen the quest of green entrepreneurship *viz*, green innovation, entrepreneurial drives, social innovation, and corporate social entrepreneurship.

Keywords- green entrepreneurship, environmental mindfulness, sustainable economy, economic development.

1. Introduction

Today, countries are conscious of natural resources and environmental sustainability (O'Neill and Gibbs, 2016). Growingly, the world is confronting severe environmental challenges *viz*, climate change, water pollution, soil degradation, deforestation, energy consumption, climate change, and so forth owing to the population growth and increasing consumption (Silajdžić et al., 2015). Eventually, this calls for entrepreneurial interventions in the economy that can evoke exponential growth with less natural resources, contributing to sustainability. In the entrepreneurship domain, scholars have growing attention to the interconnectedness between business and environment, particularly to the role of the entrepreneurs in developing a sustainable commercial and economic system (O'Neill and Gibbs, 2016). Thus, green entrepreneurship has absorbed the thrust globally as it aims to facilitate several businesses to consider their social and environmental impact. Green businesses are growingly successful and demonstrating that sustainability is not just a cost yet, an opportunity to reap profits and customer trustworthiness while preserving the natural environment (Silajdžić et al., 2015; O'Neill and Gibbs, 2016). Jolink and Niesten (2013) state that green entrepreneurship is the creation of new products, services or firms to meet market opportunities and propose that the strategies for pollution prevention executed by established businesses shall be the motive for corporate self-renewal. Cohen and Winn (2007) define sustainable entrepreneurship as the study of how opportunities bring future goods and services into existence, is discovered, created, and exploited, by whom, and with what economic, psychological, social, and environmental

consequences. Green entrepreneurship refers to a new company start-up in the environmental services industry based on the trend. Green entrepreneurship is the opportunity of entrepreneurs to establish new businesses focused on natural resources or natural conditions such as ecotourism, recycling, wastewater treatment and biodiversity (Nikolaou and Ierapetritis, 2011).

Similarly, green production and sustainability have more significant growth potential; these methods have combinedly produced a broad scope of opportunities for entrepreneurs concerning environmental, social, and economic goals, known as green or eco-entrepreneurs. Green entrepreneurs are those individuals who start up their business on the belief of sustainability with strong green values and who produce green products and services to transform their sectors to be more sustainable (Jolink and Niesten, 2013). In the business world, robust connections between their business and individuals' passion, enthusiasm, and values ideally make green entrepreneurs. Menguc and Ozanne (2005) classify environmental entrepreneurs as those who adopt proactive environmental strategies to identify new market opportunities and place ecological issues at the centre of the companies' management. Most entrepreneurs manifest an undelaying belief in the importance of environmental and social mindfulness as a severe economic success (Basdekidou, 2017). Researchers suggested that risk-taking tendency, internal locus of control, and desire for achievement are the most influential qualities (Chell, 2008). Green entrepreneurs are inherently motivated. Thus, their entrepreneurial activities have a notable direct effect on the natural environment and sustainability as a whole (Schaltegger, 2002).

Within green entrepreneurship literature, green innovation has gained popularity as the key influential factor and a critical determinant of green entrepreneurial excellence (O'Neill and Gibbs, 2016). The phenomenon of "green innovation" is frequently related to renewable energy (e.g., wind power and fuel cells). Nonetheless, the shift of a post-carbon economy relies on technological advancements in energy-related technologies: it requires a watershed on various degrees, from innovation in lifestyle to innovation in investment and governance (Kemp and Pontoglio 2011). Influential green innovators possess an inherent drive to advance through research and experimentation and, simultaneously, be able to generate successful business. They typically invest in the advancement of green products or technologies. By doing so, they evoke notable social and environmental gains by confirming the commercial viability of the business (Aerni 2010; Basdekidou, 2017). Ironically, it was found that green entrepreneurship is the outcome of market failures. Environmental economics signifies that market failures are critical factors responsible for present ecological problems. Several environmental and natural resources are yet not seamlessly assigned through the market, owing to the majority of those resources having no apparent economic value (Dean and McMullen 2007). The present inadequate environmental governance and lack of ecological mindfulness of evolving modern societies are two additional vital reasons implying the increasing environmental problems. Generally, lack of environmental consciousness on the section of modern societies allows firms free to degrade and use the limited natural resources limitlessly over critical capital and carrying capacity of ecosystems, and further deny compensating societies for environmental degradations for which they are responsible (Basdekidou, 2017).

Given the importance of green entrepreneurship fostering environmental sustainability, it has been stressed that further research is required to assess both internal and external challenges and problems faced by green entrepreneurs; thus, the challenges can be clearly understood and mitigated using ideal solutions (Mohammed et al., 2011). The OECD (2011) claimed that further research should be carried out on green entrepreneurship and green entrepreneurs in the quest for sustainability. Some notable connections exist between entrepreneurship and the environment. Thus, future explorations ought to be carried out to investigate the contribution of green entrepreneurship to sustainable development (Hall et al., 2010). Correspondingly, many researchers have admitted that green entrepreneurs can fuel a new economic start for modern economics. However, researchers have not yet realised the meanings and the terms of green entrepreneurship (Spangenberg et al., 2002; Basdekidou, 2017). More specifically, in developing countries like Sri Lanka, the research on green entrepreneurship is still in the infancy stage. Thereby, exploring what has been explored and what are the emerging trends in green entrepreneurship would be necessary for researchers and policymakers. Moreover, in light of the

expanding academic interest in green entrepreneurship, a bibliometric analysis of the field's structure and growth is essential. However, there have been few reports thus far on the outcomes of such analysis in this field.

Considering the above-stated issues and the fact that the number of green entrepreneurship publications rises dynamically each year, it was deemed that current research in this area required growth and updating. Thus, the primary objective of this article is to discover research patterns and trends in the scientific literature on green entrepreneurship via comprehensive, longitudinal, and up-to-date bibliometric study. Furthermore, it was designed to solve these specific research queries:

RQ1: What are the most influential authors, sources, and countries in the green entrepreneurship literature?

RQ2: What are the most influential publications in green entrepreneurship?

RQ3: How does the green entrepreneurship domain themes evolve over time?

RQ4: How are green entrepreneurship publications clustered?

RQ5: What is the conceptual structure of the domain of green entrepreneurship?

2. Literature review

The extant literature has absorbed how and why exiting firms in the economy have turned to more sustainable and environmentally accountable in the nascent green economy and has put forth notable consideration to the recognition of obstacles and antecedents related to established firms going green. The formalistic wisdom of green firms, as resulting from the study of large firms, tends to highlight the benefits of going green in terms of cost-advantage, innovation, revenue growth using product differentiation, transparency, declined firm inertia, robust risk management and enhanced linkages with outside stakeholders (Ambec and Lanoie 2008). The grant on green entrepreneurship is gripping discernible in the social mindfulness of corporate accountability towards the environment and the evolving significance of ecological sustainability in strategic business development (Demirel et al., 2019). Green entrepreneurs harness the intrinsic opportunities in environmentally pertinent market failures despite the paradox of green entrepreneurship might further originate from the fact that environmental welfare that turned from born greens is a public good and, thus, non-excludable (Dean and McMullen 2007). Green entrepreneurship can be viewed as implementing innovations related to sustainability, whose main objective is implementing and promoting a green economy (Farinelli et al., 2011). Green innovation can grant the creation of green entrepreneurship and green business. If innovation is the essence of entrepreneurship, then green entrepreneurs destroy existing conventional production methods, products, market structures and consumption patterns and replace them with superior environmental products and services (Gibbs and O'Neill, 2012). Green innovation encapsulates the mitigation of damaging environmental impacts and has been vastly discussed (Zailani et al., 2014). Ebrahimi and Mirbargkar (2017) posit that the green entrepreneurship approach is an outcome of innovation. It facilitates sustainability and a competitive advantage for the firm. Green entrepreneurship is related to the green economy. The notable thing of green entrepreneurship is the perseveration of the environment against the harmful impact of environmental degradation. Further, the viral goal of green entrepreneurship encompasses the ideal recycling of wastages, evoking renewable energy resources, and paying close attention to livestock and organic farming (Uslu et al., 2015). Investing in green enterprises produces desired profitability for the firms; as a result, it positively influences society's wellbeing. It is found that green entrepreneurial interventions in the economy developed sustainable development for firms and high green growth (Sarkar, 2013).

3. Methods

3.1 Search criteria

The present study aims to explore the green entrepreneurship domain. An exhaustive review of specific articles meaningfully contributes to the existing body of literature (Dhamija and Bag, 2020). Systematic literature reviews are extremely reliant on a suitable choice of keywords. It is a step-by-step process relating to five stages, i.e., screen, assemble, organise, draft and finally, present the results (Tatham et al., 2017). Thereby, a similar process has been adopted in the present work to categorise diverse themes grounded on designated keywords, followed by a prediction of the future scope of work concerning green entrepreneurship. Further, the data sources ought to be reliable and suitable to analyse, making delicate decisions (Rueda et al., 2007). The ISI, google scholar, WOS and Scopus databases are popular and reliable databases and contain up to date data. The present study was led in the Scopus Index, the most protuberant database used by researchers internationally. The search of the research article was limited to green entrepreneurship ranging from various combinations of keywords. In the Scopus advance search option, the group of keywords were merged with logical operators, "TITLE-ABS-KEY ("green entrepreneurship") OR TITLE-ABS-KEY ("sustainable entrepreneurship") OR TITLE-ABS-KEY ("green entrepreneurs") OR TITLE-ABS-KEY ("eco-entrepreneurship"). Consequently, the database viewed 120 documents corresponding with the term green entrepreneurship. In the second stage, business, management and accounting were chosen to filter the search. Other subject areas like computer science, arts and humanities, energy, engineering is excluded. After the exclusion process, 67 articles were identified. Afterwards, the author read the documents' abstracts to identify the most relevant research articles that focused on green entrepreneurship. This process led to the selection of 36 articles on green entrepreneurship. Further, this study restricted the search to journal articles published in the English language. The author selected only journal articles because only these can be considered "certified knowledge," subject to the review process (García-Lillo et al., 2017). Book chapters, conference proceedings were eliminated in this study. This aids in increasing the reliability of the results and aligns with existing practices in this type of study. Table 1 shows the main information drive from the Scopus data such as time period, sources, number of documents, keywords, authors.

Table 1 Main information about the data

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2002:2021
Sources (Journals, Books, etc)	43
Documents	21
Average years from publication	1.25
Average citations per documents	3.39
Average citations per year per doc	1.659
References	965
DOCUMENT TYPES	
article	21
DOCUMENT CONTENTS	
Keywords Plus (ID)	224
Author's Keywords (DE)	258
AUTHORS	
Authors	64
Author Appearances	128
Authors of single-authored documents	6
Authors of multi-authored documents	102
AUTHORS COLLABORATION	
Single-authored documents	19

Documents per Author	0.201
Authors per Document	0.49
Co-Authors per Documents	1.79
Collaboration Index	0.82

3.2 Bibliometric analysis

A growing number of studies are examining the progress of emerging research fields for detecting relevant topics to delineate research areas by using various techniques, such as bibliographic coupling, co-word analysis, or historiographic analysis. The bibliometric analysis uses bibliographic indicators to analyse the most critical literature from a specific field of research (Zupic and Čater, 2015). Bibliometrics is a set of mathematical and statistical methods used to analyse and measure the quantity and quality of books, articles, and other forms of publications. Bibliometric mapping is an important research topic in the field of bibliometrics. As more and more scientific discoveries occur and published research results are read and then quoted by other researchers, bibliometric indicators are becoming increasingly important (Danvila-del-Valle and Estévez-Mendoza, 2019).

3.3 Measurement technique

In the bibliometric literature, most attention is paid to the construction of bibliometric maps. Unlike most computer programs used for bibliometric mapping, VOS viewer pays special attention to the graphical representation of bibliometric maps. The functionality of the VOS viewer is beneficial for displaying large bibliometric maps in an easy-to-interpret way. VOS viewer constructs a map based on a co-occurrence matrix. The construction of a map is a process that consists of three steps. In the first step, a similarity matrix is calculated based on the co-occurrence matrix. In the second step, a map is constructed by applying the VOS mapping technique to the similarity matrix. And finally, in the third step, the map is translated, rotated, and reflected (Van Eck and Waltman, 2010). VOS viewer constructs a map based on a co-occurrence matrix. The construction of a map is a process that consists of three steps. In the first step, a similarity matrix is calculated based on the co-occurrence matrix. In the second step, a map is constructed by applying the VOS mapping technique to the similarity matrix. And finally, in the third step, the map is translated, rotated, and reflected (Van Eck and Waltman, 2010). In this study, descriptive and relational bibliometric indicators and tools were used. Countries and institutions provide a certain degree of socio-demographic context explanation. Publishing year frequency helps to visualise and establish stages in the history of research into this topic (Danvila-del-Valle and Estévez-Mendoza, 2019). Keywords help to understand authors' self-assessment of how the concepts and studies are classified and related in this context. This clarifies which of these concepts have not been subject to sufficient analysis. Main contributors and journals show who has conducted most research and which publication has served to accumulate the majority of those studies. Co-occurrence in authors provides a structure of research communities, and co-occurrence in citations helps to understand the intellectual framework. Finally, maps provide a clearer picture of what has been done and the communities involved and point to possible future research lines (Danvila-del-Valle and Estévez-Mendoza, 2019).

4. Results

Figure 1 shows the evolution trend of the worldwide research distribution in the field of green entrepreneurship from 2002 to 2022. The first article was published in 2002, and there were 10 articles in 2021. It shows that from 2008 onwards, there has been a significant increase in the green entrepreneurial study to date. The total number of documents related to green entrepreneurship in the Scopus database is 50. Of them, 44 were articles and the remaining 6 were review papers. Women entrepreneurs, game theory perspective, green entrepreneurship and sustainable development, university

entrepreneurial support, green entrepreneurship behaviour are the notable research topics identified in the Scopus database.

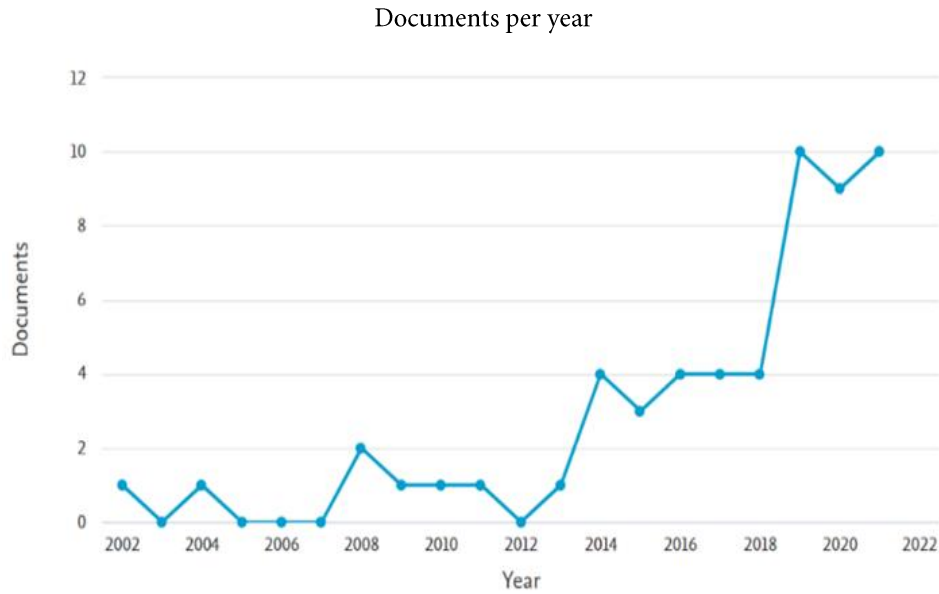


Figure: 1 Publishing year frequency

According to Figure 2, contribution towards the green entrepreneurship research by countries. Notably, the United Kingdom is in the first place in the effort of going greener. Further, China, Greece, the United States, Netherlands are the most significant contributors to the study on green entrepreneurship. It shows that developed countries have a more substantial concern about the "green entrepreneurship" initiatives. Conversely, in developing countries, the attention on green entrepreneurship is still in its infancy. Therefore, more research ought to be undertaken to flourish green entrepreneurship in developing country perspective. Additionally, it calls for researchers and economic policymakers to have a greater concern on the green entrepreneurial initiatives to support sustainability.

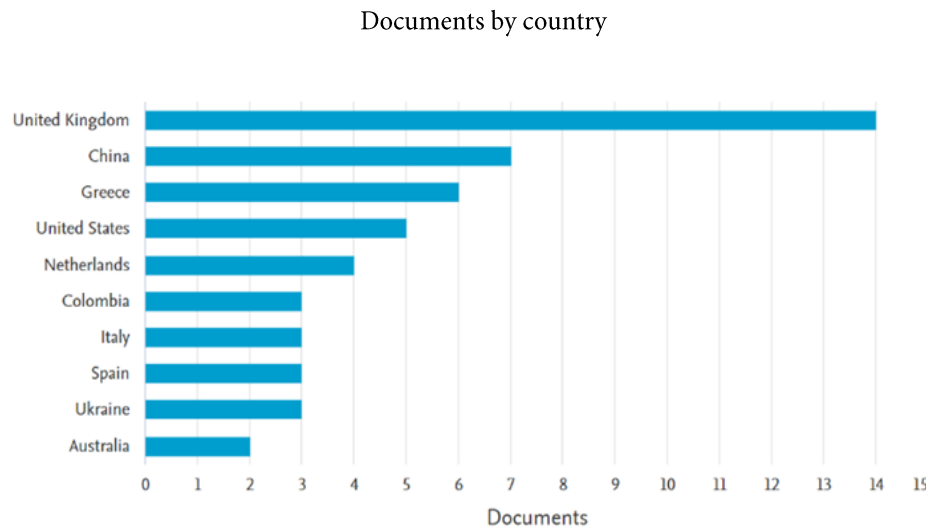


Figure: 2 Documents by county

Thematic evolution map

The next step is to analyse the main thematic evolution representing the main research sub-areas in the green entrepreneurship literature. Overall, it can be observed that the number of interconnections between themes grows over

time. Some motifs have steadily grown and developed, while others acquire prominence and emerge in the last sub-period. A Sankey diagram is created to study how these topic clusters (themes in Fig. 3) interact longitudinally and to identify the themes' primary evolutionary routes, as illustrated in Fig. 4. Each node in the Sankey diagram represents a topic cluster and is labeled with the term that appears most often and the accompanying sub-period. The node's size is proportional to the number of keywords associated with the subject. The evolutionary direction of the topic clusters is shown by the flow between nodes. The width of the edge is proportional to the index of inclusion between two connected topics.

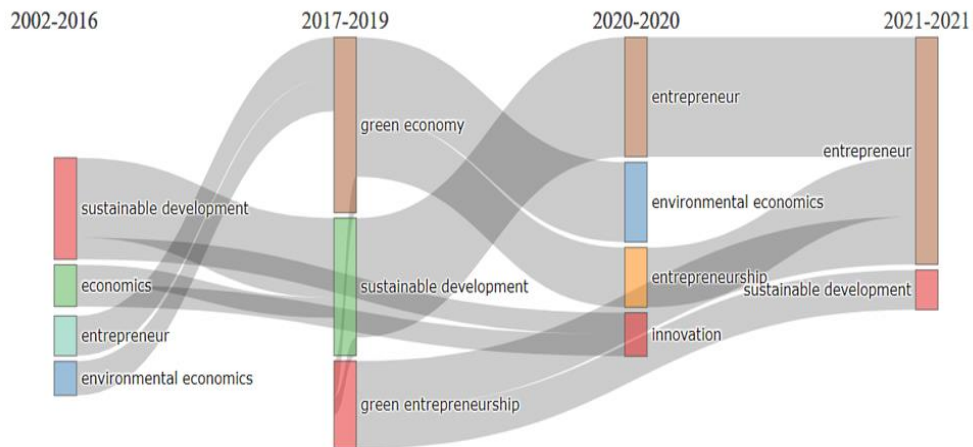


Figure: 3 Thematic evolution of green entrepreneurship literature

A thematic region is a collection of topics that evolve across time in distinct sub-periods. The study covered four time periods: 2002–2016, 2017–2019, 2020–2020, and 2021–2021. The disparities in the number of years included in the spans resulted from a significant increase in the number of publications in recent years. Figures 3 and 4 depict the obtained results. According to Figures 3 and 4, during the early green entrepreneurship domain, explorations were principally paid more attention to four sub-domains: sustainable development, economics, entrepreneurs, and environmental economics. During the second period (2017-2019), some new topics emerged, such as the green economy, green entrepreneurship. In the following period (2020), different sub-domains emerged concerning concepts such as environmental economics and innovation related to green. Inters tingly, present research focused on the topic of sustainable development.

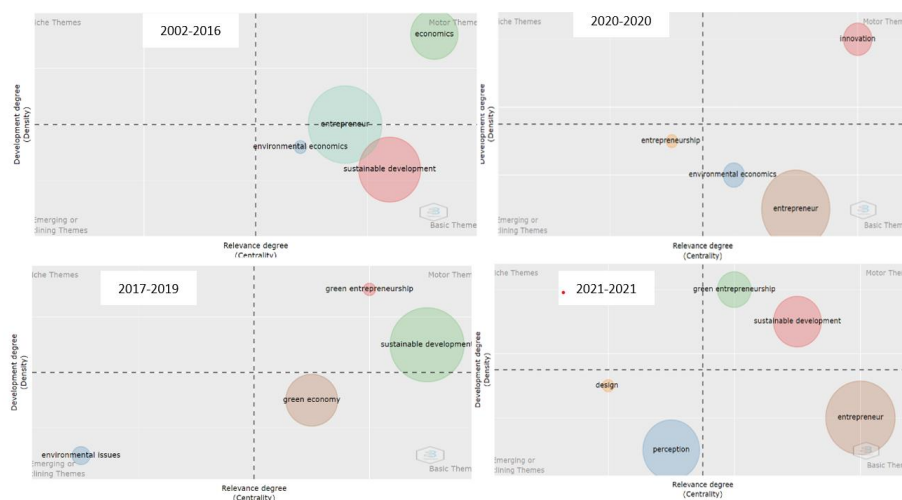


Figure: 4 Thematic maps

Collaborations among countries

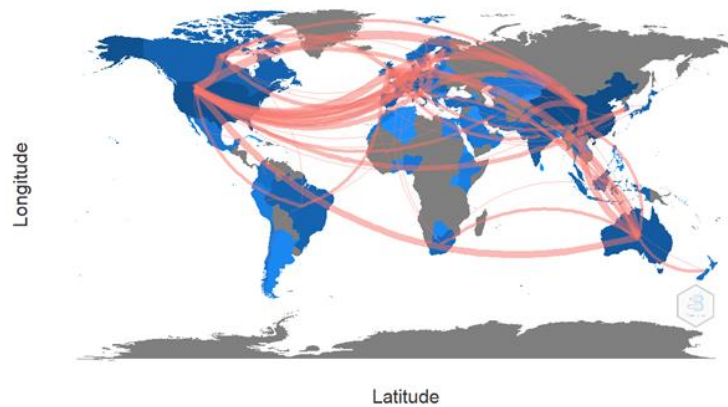


Figure: 5 County collaboration map

Concerning the collaborations between countries (see figure 5), as can be understood in the image, the USA becomes the most collaborative county, followed by Australia and European countries. The map shows that the intensified collaboration between countries is very high. Notably, the USA and Australia and European countries are the strongest of all the country's collaboration can be identified. The map also indicates that collaboration among developing countries is still in infancy nature.

Table 2 Most relevant sources

Sources	Articles
Sustainability (Switzerland)	14
Journal Of Cleaner Production	8
Small Business Economics	6
Business Strategy and The Environment	3
Sustainable Development	3
Academy Of Entrepreneurship Journal	2
Contributions To Management Science	2
Entrepreneurial Ecosystem: Perspectives from Emerging Economies	2
Environment And Planning A	2
International Journal of Entrepreneurial Venturing	2
International Journal of Entrepreneurship	2
International Journal of Entrepreneurship and Small Business	2
International Journal of Environmental Research and Public Health	2
Journal Of Entrepreneurship in Emerging Economies	2
Local Environment	2

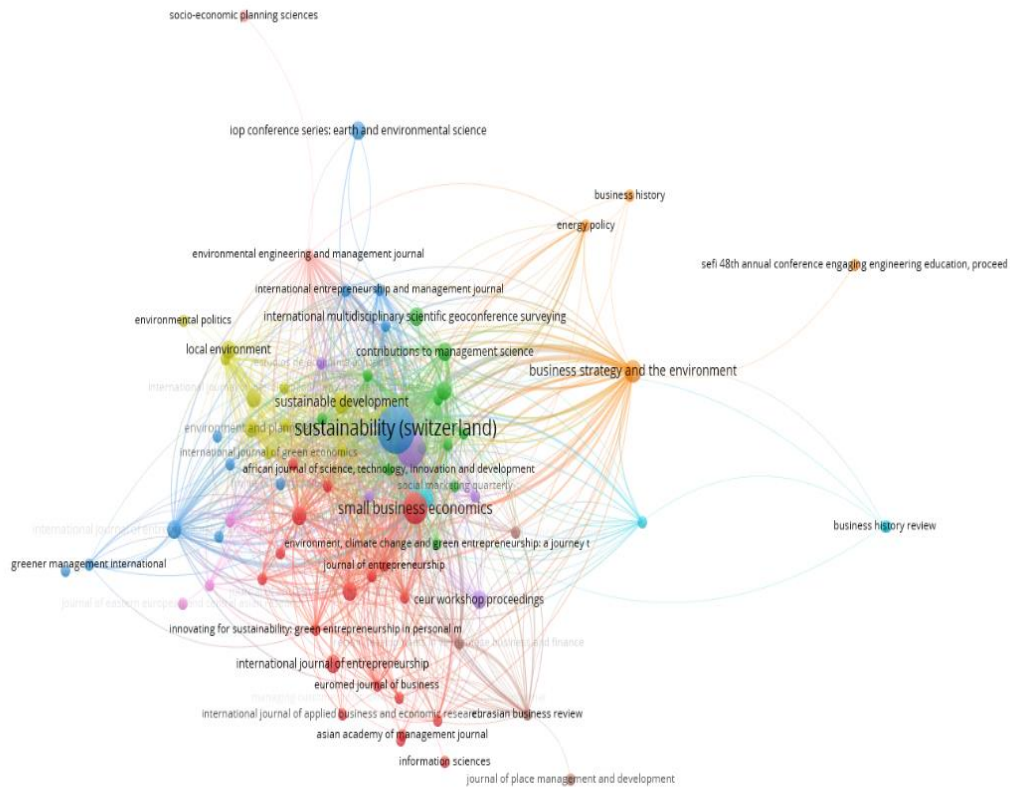


Figure: 6 Bibliometric cupelling analysis

As can be seen in Table 2 and figure 6, the most relevant and influential journals and the number of research publications published to date. Sustainability has the highest research publications (14 articles) in the field of green entrepreneurship. Journal Of Cleaner Production (8), Small Business Economics (6), Business Strategy and The Environment (3), Sustainable Development, Academy Of Entrepreneurship Journal, Entrepreneurial Ecosystem: Perspectives from Emerging Economies, International Journal of Entrepreneurial Venturing, International Journal of Entrepreneurship, International Journal of Entrepreneurship and Small Business, International Journal of Environmental Research and Public Health, Journal Of Entrepreneurship in Emerging Economies contains 2 articles respectively.

4.1 Citation analysis

Citation analysis was performed to identify the most influential research articles that contributed insofar in the domain of green entrepreneurship. Citation analysis grants the researcher to objectively categorise the most impactful research articles in the field and discover the connections between citing and cited articles and the publication taking the citations. The occurrence of the citation infers the significance of the research article; therefore, a most frequently cited article conveys noteworthy findings and notable contributions to the research domain. Citation analysis aids to check the noteworthy development in citations over time and distinguishing when critical articles were published and hence tracking their popularity. Citation counts can help the researcher track significant direction transformation in a specific research domain (Zupic and Čater, 2015).

Bibliometric studies offer a citation analysis of the research field, typically in the form of top-N lists of the most cited studies, authors, or journals in the examined area. Citations are used as a measure of influence. If an article is severely cited, it is recognised as vital. This proposition rests on the supposition that authors cite documents they reflect on as crucial for their work. Citation analysis can deliver information about the comparative influence of the publications, but

it cannot identify networks of interconnections among scholars (Usdiken & Pasadeos, 1995). Table 3 shows the synopsis of most cited articles in green entrepreneurship domain.

Table 3 The influential research papers found in the Scopus database on green entrepreneurship and its highest citation impact.

Authors	Title	Citation	Year
Allen Jc	Green Entrepreneurship: A Method for Managing Natural Resources?	204	2008
Vatansever Ç	What Color Is the Green Entrepreneurship in Turkey?	11	2016
Ebrahimi P	Green Entrepreneurship and Green Innovation for SME Development in Market Turbulence	81	2017
Melay I, 2017	Green Entrepreneurship in SMEs: A Configuration Approach	13	2017
Nikolaou Ie	A Typology of Green Entrepreneurs Based on Institutional and Resource-Based Views	23	2018
Grinevich V	Green Entrepreneurship in The Sharing Economy: Utilising Multiplicity of Institutional Logics	44	2019
Herman Le	Nurturing Green Product into Globalisation: Challenges and Opportunities Over Indonesian SMEs	8	2015
Hall J	From Green Technology Development to Green Innovation: Inducing Regulatory Adoption of Pathogen Detection Technology for Sustainable Forestry	16	2019
Haldar S	Green Entrepreneurship in Theory and Practice: Insights from India	4	2019
Tien Nh	Green Entrepreneurship Understanding in Vietnam		2020
Yi G	From Green Entrepreneurial Intentions to Green Entrepreneurial Behaviors: The Role of University Entrepreneurial Support and External Institutional Support	18	2021
Manimala Mj	Entrepreneurial Ecosystem: Perspectives from Emerging Economies	18	2015
Lebron Mj	When Social Identities Integrate: Schumpeterian Entrepreneurs Leading Green Entrepreneurship	6	2018
Ramírez Mc	Promoting Entrepreneurship Through a Community Learning Model – Case Study: Green Businesses	3	2019
Skordoulis M	Environmental Innovation, Open Innovation Dynamics and Competitive Advantage of Medium and Large-Sized Firms	16	2020
Qazi W	Impact Of Personality Traits and University Green Entrepreneurial Support on Students' Green Entrepreneurial Intentions: The Moderating Role of Environmental Values	31	2020
Yang X	The Evolution of New Ventures' Behavioral Strategies and The Role Played by Governments in The Green Entrepreneurship Context: An Evolutionary Game Theory Perspective	1	2021
Chu F	How Does Policy Perception Affect Green Entrepreneurship Behavior? An Empirical Analysis from China	1	2021
Zhao M	Pursuing Sustainable Development Through Green Entrepreneurship: An Institutional Perspective	1	2021

identified *viz.*, ecological efficiency, economic development, green entrepreneur, resource dependence, competitive advantage, economic and social effects, green manufacturing, innovations, natural ecosystem, social responsibilities, sustainability issues, green core competence, green innovation, green organisational identity, green start-ups, green technology, open innovation, sustainable innovation, industrial engineering, renewable energy, resource-based view, ecological entrepreneurship, entrepreneurial opportunities, environmental regulations, environmental values, corporate social responsibility, environmental challenges, environmental pollutions, environmental change, marketing orientation, pollution control, strategic orientation, availability of capital, entrepreneur motivations, green entrepreneurial practices, small and medium-sized enterprises, entrepreneurial inclination, eco entrepreneurship, efficiency-driven economies, emerging market economies, institutional change, hybrid market, knowledge creation, knowledge-creating companies, greening framework, social innovation.

Co-citation analysis

Co-citation analysis views the articles that cite a specific pair of references, garnering data from databases and using analytical and graphic display techniques (McCain, 1990). This implies citation may reflect the likeness of content and thus aid to identify groups of topics and authors and how they might be connected. Co-citation refers to the frequency with which two units are cited together (Small, 1973). A central assumption of co-citation analysis is that the more two items are cited together, the more likely their content is related. Co-citation connects documents, authors, or journals according to the way writers use them.

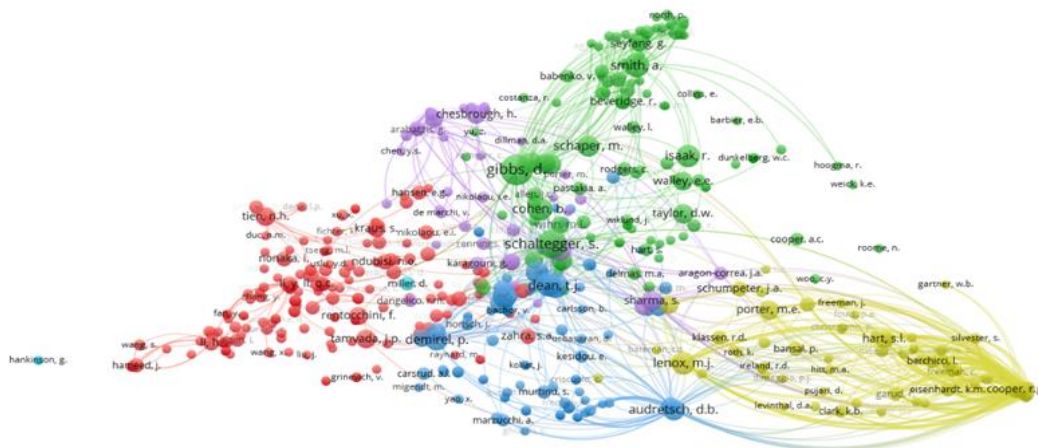


Figure: 9 Co-citation network of authors

This is a rigorous grouping principle repeatedly performed by subject-matter experts who cite publications they deem valuable and exciting. Since the publication process is time-consuming, the co-citation image represents the state of the field sometime before, not necessarily how it looks now or how it may look tomorrow. It is a dynamic measure that changes over time (Zupic and Čater, 2015). Figure 9 presents the visualisation of the intellectual structure for the periods, respectively. These visualisations were developed using VOS viewer. Cooper, R., Audretsch, D., Sharma, S., Chesbrough, H., Gibbs, D., Demiral, P., Smith, A., Cohen, B., Taylor, are the most central and bridging researchers in green entrepreneurship with the highest number of citations.



Figure:10 Word cloud of keywords of the green entrepreneurship research field

Bibliometrix is used to obtain information about the frequency of keywords in the green entrepreneurship domain. After this phase, versions of keywords with the same meanings are combined. The word cloud provides a clear and complete graphical depiction of prominent subjects in the green entrepreneurship study area. The most frequently used keywords in green entrepreneurship-related papers can be proffered intuitively. It may be utilised to map the conceptual structure of the study area, which aids in comprehending the essential aspects of text information in the green entrepreneurship sector as a whole. In Fig. 10 and table 4, keywords appearing well over three times are underlined, and the magnitude of the keywords is positively associated with the frequency of their existence in the data set. Hot topics such as sustainable development, entrepreneur, sustainability, green entrepreneurship, environmental economics, green economy, and innovation can be observed from the word cloud.

Table 4 Word cloud of keywords

Terms	Frequency
<u>sustainable development</u>	31
<u>entrepreneur</u>	22
<u>sustainability</u>	13
<u>entrepreneurship</u>	12
<u>green entrepreneurship</u>	10
<u>environmental economics</u>	9
<u>green economy</u>	9
<u>economics</u>	7
<u>innovation</u>	7

Historical citation analysis

The analysis of historical citations adds a dynamic dimension to the green entrepreneurship research. The historical citation network for the green entrepreneurship field is constructed using Bibliometrix's histNetwork and histPlot functions, as illustrated in Fig. 11.

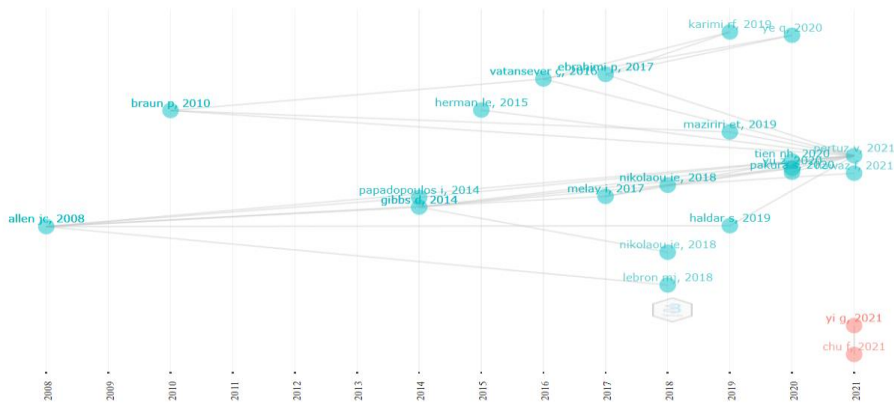


Figure:11 Historical direct citation network

This figure (see figure 11) depicts the citation linkages between the top twenty most often referenced local publications, illuminating the development of the research focuses of significant green entrepreneurship literature over time. Each node in this network represents a single article, while the connections between nodes reflect their citation relationship. If one article is referenced in a later paper, this establishes a citation link between the two works. The most intriguing feature of this visualisation is not the author/s' names per se, but rather their areas of interest in green entrepreneurship and the subsequent discussion that researchers initiate in the scientific field.

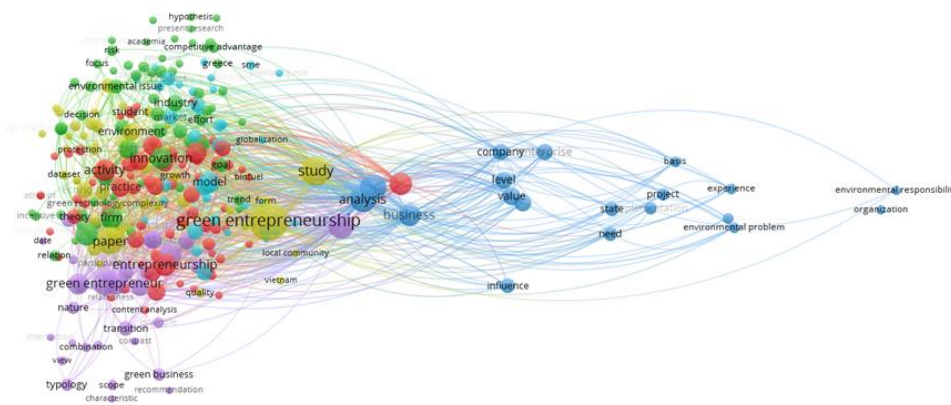


Figure: 12 The clusters in green entrepreneurship

As can be seen in figure 12, there are ten top compelling clusters identified. Cluster 1 includes 8 words green entrepreneurship behaviour, green entrepreneurship intention, green entrepreneurship development, green entrepreneurship education, green innovation, green product, green sector, green technology. Cluster 2 comprises 13 words ecological responsibility, environmental improvement, environmental management, environmental problem, environmental program, environmental taxes, green business development, green investment, responsible green entrepreneurship, environmental innovation, environmental product innovation, environmental process innovation, open innovation. Cluster 3 encapsulates 6 words business strategy, visionary champion, green start-up, R&D collaboration, synergetic partnership, CSR. Cluster 4 is made up of 8 items experiential knowledge, innovation management, intellectual property rights, green entrepreneurship model, market turbulence, organisational culture, social, environmental responsibility, sustainable development. Cluster 5 includes 7 words climate change issue, climate change adaptation, climate change mitigation, climate system, renewable energy source, ethical transformation, green transition. Cluster 6 comprises of 8 words engagement, external institutional support, green entrepreneurship policy, green self-efficacy, psychological mechanism, resource sustainability, university entrepreneurial support system, transformative change. Cluster 7 includes 8 words core entrepreneurial strategy, green technology development,

sustainable innovation, green political influence, governmental incentive, forward-thinking orientation, SWOT analysis, interactive learning. Cluster 8 encompasses 5 words evolutionary game theory perspective, greenwashing behaviour, innovation behaviour, social innovation. Cluster 10 includes 8 words green purchase intention, greenhouse effect, social media advertising, virtual community, corporate reinvention, diverse constellation, environmental philosophy, strategic entrepreneurship.

Conceptual structure

Researcher build the conceptual structure map of the green entrepreneurship study area using Bibliometrix's conceptual Structure function, as shown in Fig. 13. This function performs a multidimensional scaling analysis of keywords to determine the conceptual structure of a study area, as well as a K-means clustering analysis to identify keywords clusters that convey common ideas. Multidimensional scaling analysis is an exploratory analytical approach that may demonstrate the link between many variables in two dimensions and is useful for determining the geographical distribution of themes. In Fig. 13, keywords are dispersed as points in two-dimensional space because their distributions are increasingly similar the closer, they are displayed in the conceptual structure map. As depicted in figure 13, Bibliometrix automatically generates keyword cluster. Cluster 1 is composed of several important keywords *viz.*, ecosystem, competition, green entrepreneurship, green environment, sustainable development, pollution control, and ecological sustainability.

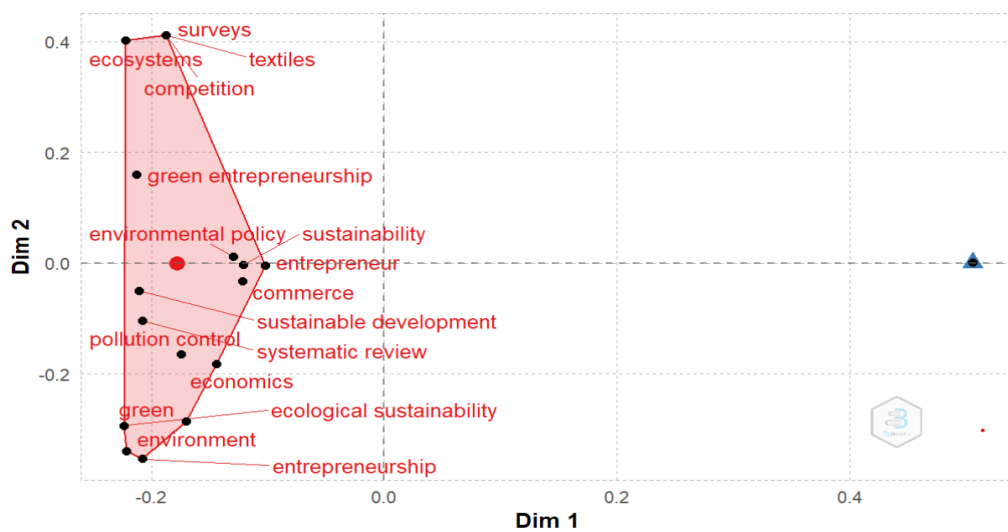


Figure: 13 Conceptual structure map

5. Discussion

Based on the analysis, several key themes were identified *viz.*, entrepreneurs' motives, environmental philosophy, green innovation, external factors and internal factors. Green innovation of the firm aid in sustainable green entrepreneurship. Further, green product innovation, green process innovation, green administrative innovation are influential factors in green entrepreneurship. Government takes several interventions to infuse green in organisations. Notwithstanding, there are some individual-related factors also identified as significant predictors *viz.*, green attitude, green behaviour, green self-efficacy and green entrepreneurship education. Further, external factors include variables external institutional support

system, greenwashing behaviour, university support, political support, and government incentives for green. Internal factors encapsulate organisational climate, business strategy, green technology adaptations, corporate social responsibility of the firm, reinvention, strategic renewal.

6. Conclusion

The economy's entrepreneurship field is turning into a new and compelling area of study within green entrepreneurship. Notwithstanding, as a nascent field, it is gaining notable popularity among researchers and policymakers in divergent parts of the world. This evolving popularity is owing to the concern that sustainability is a more significant concern within the entrepreneurship paradigm. However, the collaborations between countries and authors remain scarce. Thus, grounded on the previous studies in this field, it is pivotal to study the significance of green entrepreneurship to provide a better understanding of fostering sustainable practices in entrepreneurship. Paradoxically, entrepreneurs are not willing to be ready to react to the challenges. And they do not undertake any risk related to investing in green business. Further, the government and the universities have failed to recognise their role, and they fail to support the development of green entrepreneurship. Further, most of the studies on green entrepreneurship have been concerned with the developed country perspective. Ironically, there is very little research to date carried out in developing countries like Sri Lanka. Despite this, the findings are obscure and heterogeneous. Therefore, this calls for additional research on green entrepreneurship in the domain of sustainability, particularly in developing countries. The present paper provides a comprehensive overview of the studies carried out to date on green entrepreneurship to determine the research trends and popular matters. Thus, the present study sets a direction for those researchers who are willing to study green entrepreneurship. Further, this research provides past information, the current conditions in the domain of green entrepreneurship.

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