

BIBLIOMETRIC ANALYSIS OF GREEN ENTREPRENEURSHIP

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Abstract

The implementation of environmentally friendly activities and sustainable business models can contribute to reducing environmental pollution in the world. Green entrepreneurs can contribute to the realization of such activities. The aim of this study is to analyze the scientific development of the concept of green entrepreneurship. In order to achieve this objective, the bibliometric analysis method was applied. To increase the consistency of the study, the articles in Web of Science were considered as the unit of analysis. As a result of the searches, 100 journals, 552 authors, 195 articles, and 626 keywords were reached, and these articles were analyzed through the package in the R program. VOSviewer program was used to visualize the relationships of keywords. The first article on green entrepreneurship was published in 2007. The concept of green entrepreneurship has focused on sustainability, innovation, and management. It was concluded that the concept of green entrepreneurship is in the growth stage, the number of articles on this concept has increased rapidly over the years, the journal with the highest number of publications on the subject is Sustainability, and the country with the highest number of publications is China, and articles are mostly qualitative studies.

Keywords: Green Entrepreneur, Bibliometric Analysis, R Package, Sustainability

Jel Classification: Q57, C89, C88, Q01

YEŞİL GİRİŞİMCİLİK: BİBLİYOMETRİK ANALİZ

Öz

Çevre dostu faaliyetlerin, sürdürülebilir iş modellerin uygulanması, dünyadaki çevre kirliliğini azaltmasına katkıda bulunmaktadır. Yeşil girişimciler, bu tür faaliyetlerin gerçekleştirilmesine katkıda bulunabilmektedirler. Bu çalışmanın amacı, yeşil girişimcilik kavramının bilimsel olarak gelişimini analiz etmektir. Bu amacı gerçekleştirmek için bibliyometrik analiz yöntemi uygulanmıştır. Çalışmanın tutarlılığını arttırmak için Web of Science'te yer alan makaleler analiz birimi olarak değerlendirilmiştir. Taramalar sonucu, 100 dergiye, 552 yazara, 195 makaleye, 626 anahtar kelimeye ulaşılmış, bu makaleler R programında yer alan paket aracılığıyla analiz edilmiştir. Anahtar kelimelerin ilişkilerinin görselleştirmesi için VOSviewer programı kullanılmıştır. Yeşil girişimciliğe ilişkin ilk makaleye 2007 yılında ulaşılmıştır. Yeşil girişimcilik kavramının sürdürülebilirlik, inovasyon, yönetim alanlarına yoğunlaşmıştır. Yeşil girişimcilik kavramının büyüme aşamasında olduğu, bu kavrama ilişkin makalelerin sayısında yıllara göre hızlı bir artışa geçildiği, konuya ilişkin en fazla yayın yapan derginin Sustainability olduğu, en fazla yayın yapan ülkenin Çin olduğu, makalelerin yoğunlukla nitel çalışmalardan oluştuğu sonucuna ulaşılmıştır.

Anahtar Kelimeler: Yeşil Girişimci, Bibliyometrik Analiz, R paketi, Sürdürülebilirlik

Jel Sınıflaması: Q57, C89, C88, Q01

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1.Introduction

The problem of environmental conservation is gaining momentum along with requirements for sustainable development, and the burden on firms and their executives in the modern globalized business environment has greatly increased. The current business environment has demanded that not only firms but also individuals or entrepreneurs operate in such a way that it secures and conserves nature (Muo & Azeez, 2019). Increasing concerns for environmental wellbeing have introduced a new era of global trends and green entrepreneurship has been identified among them. The growing attention is on the part of consumers, investors, and policymakers motivated by having a sustainable business atmosphere (Yin et al., 2022).

The purpose of green entrepreneurship is to advocate the use of environmentally responsible agriculture and energy, thus saving costs for crops grown under organic farming. It is the process of using entrepreneurial principles to develop businesses that create growth, profitability & sustainability, and value for ecological communities and society at large (Ovharhe & Okolo, 2022). Sustainability is a key requirement for the continued survival of every living species, which makes this type of entrepreneurship even more essential in addressing global concerns like climate change and resource depletion (Misztal & Kowalska, 2023). Green entrepreneurs can leverage these transformations into businesses, technologies, and strategies that benefit both environmental and social progress at a wide scale (Soomro et al., 2020a; Sürücü et al., 2023).

Beyond business success, green entrepreneurship has a mission. It aims to ensure the sustainable development of local communities and the environment. These efforts are led by green entrepreneurs, who emphasize finding new forms that either reduce energy or contribute to sustainable practices (Drago & Gatto, 2022). They are involved in more and fairer economic systems with no harmful environmental impacts (Willemsen & van der Veen, 2014; Misztal & Kowalska, 2023).

Green entrepreneurship remains underrepresented in the mainstream, most likely due to several factors, including socioeconomic-cultural and intellectual biases. Green entrepreneurs often face difficulties in a business-as-usual environment, which is well entrenched with conventional entrepreneurial models (Demirel et al., 2019). Nevertheless, green entrepreneurship boosts the power of companies that identify and exploit unique opportunities while continuing to operate

sustainably by adding up all environmental activities towards enhancing their overall sustainability (Makhloufi et al., 2021).

This paper uses a Bibliometric Analysis research method to study the scientific progress of green entrepreneurship. The study attempts to provide an integrated vision of how the concept has developed over time in academic literature, delineating its intellectual evolution and underlining breakthroughs. Such an analysis is important because it identifies shortcomings in extant research and areas that deserve further examination. It also provides important implications for green entrepreneurship researchers and practitioners, such as how to construct a roadmap for future studies in this area.

This paper is valuable because it uses in-depth bibliometric analysis to depict the progress and directions of green entrepreneurship research. This delineates top publications, authors & keywords and offers an in-depth insight into the field. The paper also presents a schematic model of the literature, which can be differentiated into central themes such as conceptual basics, main causes, important attributes, and exercises subject to circular economy principles that effectually address these root drivers' challenges and bottlenecks' effects. In addition to contributing significantly to academic discussion, this comprehensive review has policy and practical implications for authorities - as well as businesspeople who aim at developing green entrepreneurship towards sustainable development.

2. Literature Review

2.1. Overview of Green Entrepreneurship

Green entrepreneurship is defined as business ventures that try to find solutions to environmental and social challenges by using new, sustainable ways of doing things. In simple words, it refers to the integration of environmental concerns into basic economic activity and a strategic management plan of a business that identifies profit along with ecological sustainability (Duran, 2024). This is an approach defining green entrepreneurs who prioritize reducing environmental impact and promoting sustainable development (Abdelwahed et al., 2023; Allen & Malin, 2008).

The ambit of green entrepreneurship consists of developing a very wide range—from the development of eco-friendly products to implementing sustainable business practices and green technologies. It is multi-disciplinary and intersects between environmental science, business management, and social entrepreneurship. Green entrepreneurs will, in all likelihood, express

such zeal for environmental conservation by developing businesses that create economic value accompanied by the well-being of the planet (Alvarez-Risco et al., 2021; Anghel & Anghel, 2022).

Another approach is proactive green entrepreneurship, where businesses act very efficiently and ensure less ecological impact. This consists of using renewable sources for energy, reducing wastage through recycling and upcycling, and using efficient resource management systems (Lotfi et al., 2018; Gevrenova, 2015). By adopting these practices, green entrepreneurs not only enhance their sustainability but also set standards for others to follow in practicing environmental stewardship.

In addition, green entrepreneurship is often energized by a strong ethical foundation, in which the reasons for starting and operating a business are rooted in profound responsibilities to be stewards of the environment and promoters of social justice. The element of such ethics differentiates green entrepreneurs from traditional entrepreneurs, as the former make most of their business decisions based on the principles of sustainability and community well-being, rather than profit maximization at any cost (Cooke, 2020; Demirel et al., 2019). It is this ethical orientation that becomes very important in consumer trust and credibility, given that these consumers are becoming more aware and demanding transparency and accountability from businesses that serve them.

Other than individual business practices, green entrepreneurship also plays a very significant role in influencing public policy and regulatory frameworks. Green entrepreneurs also, in many cases, lobby for environmental policies that will accommodate sustainable development and green business practices. Their active involvement in policy dialogues allows for the change of an atmosphere in which other companies operate toward more sustainable practices and enables the shifting of economies to greener paths (Alwakid et al., 2020; Alwakid et al., 2021).

Green entrepreneurship is not confined to startups or small businesses, but large conglomerates are also moving towards green entrepreneurship as part of their corporate strategy. It helps to be driven by the understanding that there could be long-term financial benefits in such sustainable practices as savings due to energy efficiency and benefits that accrue from a positive brand reputation and customer loyalty (Makhloufi et al., 2022; Polas et al., 2022). Therefore, green entrepreneurship could also be regarded as a contributor to the realization of the overall corporate sustainability initiatives.

Another very important aspect of green entrepreneurship is the scope for innovation it leaves. Green entrepreneurs are pioneers in formulating new technologies and business models to tackle environmental challenges. Such innovation ranges from breakthroughs in clean energy technologies to novel methods of waste reduction and sustainable agricultural practices (Drago & Gatto, 2022; Trapp & Kanbach, 2021). Last but certainly not least, innovation in creating new markets and economic opportunities that are conducive to goal achievement for sustainable development is yet another motivation for green entrepreneurship.

Lastly, green entrepreneurship is entirely linked with the concept of a circular economy, where there is a change in focus toward designing out waste and keeping products and materials in use for as long as possible. Green entrepreneurs are playing a significant part in embracing the principles of a circular economy through the development of products that are more durable, repairable, and recyclable (Reza-Gharehbagh et al., 2023; Makki et al., 2020). This, in effect, helps minimize environmental depletion while adding value to the respective business and consumers at large by resulting in improved longevity of product life cycles and lowering new raw materials.

2.2. Theoretical Foundations of Green Entrepreneurship

The theoretical bases of green entrepreneurship, then, are rooted in an approach in which environmental goals are integrated with entrepreneurial practices toward the creation of economic value through environmentally beneficial innovations and practices. This conceptual frame integrates entrepreneurship's innovative and risk-taking characteristics with a commitment to environmental stewardship as a response to an urgent call for sustainable development (Gibbs & O'Neill, 2014).

Green entrepreneurs can discover, and exploit market opportunities created by the increasing demand for sustainable products and services by using their environmental understanding and entrepreneurial skills to design solutions that meet ecological problems (Alwakid et al., 2020).

Green entrepreneurship is a part and parcel of the wider concepts of sustainability and environmentalism. Sustainability is being able to meet the needs of the present generation without jeopardizing the ability of future generations to meet their needs. It involves economic, social, and environmental dimensions. In its real essence, green entrepreneurship closely synchronizes with this definition and conjoins economic success with a positive impact on the environment. Environmentalism revolves around the advocacy of the protection and preservation of the environment. In this scenario, green entrepreneurs usually surface from an

established or strong environmental ethos driven by a desire to contribute to ecological well-being through business ventures themselves (Allen & Malin, 2008). The two goals are encapsulated in the relationship between green entrepreneurship and the achievement of business success on one hand and fostering environmental sustainability on the other.

The study of green entrepreneurship is built on several theoretical models and approaches that provide unique insights into the harmonization of environmental and entrepreneurial objectives. It generally suggests that a firm's competitive advantage derives from its unique resources and capabilities. This translates to resources that supply green entrepreneurs with environmental knowledge, sustainable technologies, and eco-friendly processes to innovate and differentiate products and services.

Ecological Modernization Theory postulates that it is possible to combine economic development with environmental protection. It argues that sustainable industrial practice is increased by technological innovation and institutional changes. Green entrepreneurs embody this theory through the development and innovation of technologies and business models that mitigate environmental degradation while also contributing to economic growth at the same time (Gibbs & O'Neill, 2014).

The Triple Bottom Line (TBL) extends the traditional accounting framework to include social and environmental performance as well as economic performance. Green entrepreneurship embodies the TBL approach in achieving profit, people, and the planet. Such a holistic view encourages businesses to consider the broader impacts of their activities and to pursue goals that support overall sustainability.

These theoretical bases can be considered quite strong, with concepts outlining principles and practices within green entrepreneurship. That is, they bring out the multidimensional aspect of green entrepreneurship—one that does not just look at economic gain but seeks to contribute to environmental sustainability and social well-being positively. This integrated approach is required to ensure the development of a sustainable and resilient economy in the face of ever-growing environmental challenges.

2.3. Drivers of Green Entrepreneurship

The concept of green entrepreneurship is a melting pot of environmental awareness, social consciousness, policy and institutional influences, economic incentives (in that the business prospects override other concerns), market demand and technological advances. All these

factors combined are creating an ecosystem that naturally allows green entrepreneurs to blossom, which in turn helps and supports good sustainable business practices.

The awareness of our environment and its importance for providing the air we breathe is essential for individuals and corporations to embrace the green movement. Social responsibility plays a major role in motivating individuals and some corporations to pursue green entrepreneurship. The public is becoming more conscious of environmental problems such as climate change, pollution, and resource depletion. As a result, there is an expectation for businesses to play a role in addressing these issues responsibly. Sustainable practices and environmental impact reduction are becoming increasingly common requests from consumers, investors, and other stakeholders at large companies. Entrepreneurs above have increased awareness about the environment, hence feeling forced to integrate environmental concerns in their business model and ensure that they develop environmentally friendly products or services (Abdelwahed et al., 2023; Alwakid et al., 2021).

Policy and Institutional Influences on Green Entrepreneurship Policies and regulations with an eye towards sustainability have been implemented by world governments, as there is continuously increasing pressure from the government regulatory agency on businesses. This includes pro-environment policies, like tax incentives and subsidies for companies adopting environmentally friendly practices; or strong regulations punishing ecologically damaging actions. The implementation of these policies not only promotes a green business environment, which encourages innovation and the creation of sustainable solutions by entrepreneurs (Alwakid et al., 2020; Chygryn 2017), but also aligns with international agreements and frameworks, such as the Paris Agreement. This global support makes sustainable practices essential for many businesses.

Similarly, economic incentives and market demand are also key factors in promoting green entrepreneurship. The sheer number of consumers looking for eco-friendly solutions opens doors to a lot of greener business ideas. There is a growing portion of consumers who are prepared to pay more for environmentally friendly, locally-sourced and sustainably made products. Consequently, interest among consumers in green products motivates businesses to innovate and create environmentally friendly items (Demirel et al., 2019; Lotfi et al., 2018). Secondly, a growing number of investors are considering sustainability criteria when choosing where to invest, and this encourages people seeking financial aid as well.

Technological development and innovation are key in the support for green entrepreneurship. This means that the door is always open for entrepreneurs to innovate and bring more efficient, less costly, and environmentally friendly solutions through the development of new technology or practices. Green entrepreneurs are given the tools to effectively address environmental challenges with innovations in renewable energy, waste management, sustainable agriculture, and green manufacturing (Drago & Gatto) 2022; Trapp & Kanbach). Also, abrasive growth in the field of information technology and digitalization allows various green businesses not only to access a more comprehensive marketplace but also to make their own process simple for themselves which further mark-up ESG optimistically.

To conclude, the ecological motives for green entrepreneurship are quite diverse; in addition to environmental concern and social responsibility, it is driven by institutional-policy conditions, economic-industry factors, or technological change.

2.4. Characteristics and Practices

Green entrepreneurship has a dynamic approach characterized by a sustainable business model, green innovation with technology integration, a high concern for ethics enabling social responsibilities, and a green marketing strategy that reflects changing consumer behavior.

Business models and practices that support sustainability are core to green entrepreneurship. These businesses are intended to exist with minimal negative environmental impact, primarily consisting of resource-efficient designs that promote waste reduction and use renewable energy sources. Lifecycle thinking is an aspect of green entrepreneurship, and often, they care about what happens to the product or service throughout its lifecycle, from production through disposal. It would both improve sustainability and, is often the most cost-effective manner leading to additional efficiency (Lotfi et al., 2018; Gevrenova, 2015). Regulatory change and volatility in asset price relating to climate may impact the company's strategy but those that are being made sustainable will be more resilient, provided it is done so with an eye on long term resilience of business.

Green entrepreneurship involves implementing green innovations and integrating technology. Advanced green technologies such as solar, wind, and other renewable energy systems, sustainable agricultural products, efficient transportation services, and water infrastructure renovation are all areas where entrepreneurs develop strategies to ensure that these solutions meet environmental goals while also being economically viable. The technological progress they deliver leads to the establishment and diffusion of novel designs in situ, which help us

decouple from potential traps that degrade modern business sustainability (Drago & Gatto 2022; Trapp & Kanbach 2021). Green entrepreneurs can also play a significant role in this area by improving the performance of their businesses through high technology integration. This can help reduce environmental footprint and replace previous practices (Chen et al., 2023).

Green entrepreneurs also hold important significance to ethical considerations and thrust corporate social responsibility (CSR) for them. These companies are fully transparent and accountable in how they operate, so their operations positively impact the environment as well as society overall. This includes ethical practices like fair labor conditions, giving back to communities where businesses operate, and responsibly sourcing materials. Green entrepreneurs focus on producing social value and building rapport with their stakeholders, leading to greater brand loyalty and a good reputation (Allen & Malin 2008; Abdelwahed et al., 2023). Designed to provide a social and public benefit beyond company objectives, CSR initiatives are typically workforce targeted community outreach programs providing environmental education with non-profits.

Green marketing and consumer behavior are the most important for green entrepreneurs. As people become more aware of environmental problems, they tend to look for sustainable goods and services. In introducing green marketing strategies, aspiring green entrepreneurs seize this trend displaying the numerous environmental benefits of their offering. For green marketing to be effective, it should focus on the clear communication regarding an organization's sustainable practices and include eco-labeling designed for consumers as a certification that explains environmental standards of products (Nguyen et al., 2023; Polas et al., 2022). Consumer awareness is important to create products they will find useful and relevant, which in turn should make the market more widespread.

In summary, the traits and behaviors of green entrepreneurship are encapsulated by sustainable business models, innovation in green space, ethical approach to doing business, and strategic activities to ensure their presence is felt due to strong practices applied during marketing. These dimensions of the green entrepreneurs are not only going to set them apart as different from conventional business structures but will also enable their rise with primacy in leading towards sustainable transition. Green entrepreneurs can attain financial success and help our planet and society by making a commitment to environmental stewardship.

2.5. Challenges and Barriers

For the growth and development of green entrepreneurship, there are numerous challenges as well as bottlenecks that come its way. Market and institutional barriers, operational and financial challenges, regulatory and policy constraints, as well as cultural and social barriers

Market, as well as institutional barriers are major hurdles for green ventures. The market for green products and services is typically a nascent market, with less consumer awareness and demand in comparison to traditional markets. This, in turn, can prevent green businesses from reaching economies of scale and compete against more traditional non-green companies (Makki et al., 2020; Uslu et al. 2025). Moreover, the presence of institutional obstacles such as inadequate infrastructure support systems and a lack of green financing or sufficient market stimulus can further impede these business models (Farinelli et al., 2011).

The firm is also facing significant operational and financial challenges. The initial costs for green entrepreneurs also tend to be higher than average, with requirements regarding specific technologies, sustainable materials, and conformity to environmental standards (Burzyńska et al., 2018; Nordin & Hassan, 2019). Accessing finance can be particularly difficult, as investors may perceive green businesses to be riskier. The other is that maintaining profitability and sustainability can be a precarious balance to walk, and without sufficient financial resources operational efficiencies are harder/impossible (Mrkajic et al., 2019).

Policy and regulatory limitations may also make it challenging for green entrepreneurs. Finally, some regulations are designed to be in support of sustainability but overall may create barriers that undermine innovation and increase compliance costs (Alvarez-Risco et al., 2021; Block et al., 2020). Unstable, ever-changing policies can cause ambiguity which makes it difficult for green businesses to plan future activities. Furthermore, green entrepreneurs are now experiencing a challenge of operate across global market since the lack of harmonized international standards also occurs (Cooke 2020).

Cultural and social barriers are also major challenges. Indeed, green entrepreneurs usually face substantial obstacles in the form of deeply entrenched consumer habits as well as social norms that support mainstream (non-green) products and practices (Silajdzic et al., 2015). It can be a challenging and resource-intensive task to educate consumers about the benefits of environmentally friendly products and to bring about changes in their behavior. Additionally, resistance to organizational and community change can pose social barriers that prevent the implementation of green practices (Amankwah & Sesen, 2021; Tien et al., 2020). How to

navigate within these customs and social structures is a concern for environmentally friendly entrepreneurs seeking to gain the support of communities.

Green entrepreneurship, in summary, involves challenges and barriers related to the market, operational, regulatory, and cultural circumstances. It takes the right market conditions, regulations, funding opportunities and social acceptance to get all those pieces in place. While facing significant obstacles, green entrepreneurs have the potential to be powerful change-makers in propelling a sustainable economy.

2.6. Impact and Outcomes

Green entrepreneurship results are outcomes of several dimensions, such as economic performance, environmental sustainability, and social well-being. A unique positive correlation between green entrepreneurial activities among traditional entrepreneurs makes an interesting conclusion.

From the perspective of the economy, green entrepreneurship helps business performance creating new markets for and giving it a competitive advantage. After all, a step towards sustainability also represents an investment in the efficiency of the company and reduces costs in most cases. These green companies may even serve a type of demographic that is willing to pay more for sustainable, environmentally conscious goods and services. Also, green entrepreneurship can help to establish the brand value and reputation of a company which improves customer loyalty and sales rate (Chen et al., 2023; Makhloufi, 2023) In addition to directly providing economic incentives for one company, these benefits also lead broader advances in the economy by promoting green industrial innovation and job growth (Mrkajic et al. 2023).

Green entrepreneurship navigates environmental impact and supports sustainability by decreasing eco footprints. At the forefront of environmental mitigation technologies and practices are green entrepreneurs. They work tirelessly every day to solve the problems impacting our beautiful planet. This includes developing renewable energy solutions, implementing waste reduction techniques, and establishing sustainable sourcing processes for materials. These green businesses work towards environmental objectives before they can lower greenhouse gas emission, conserve natural resources and enhance biodiversity (Nguyen et al., 2023; Polas et al., 2022). Several positive findings related to nature and carbon records can be accompanied by sustainability or ecology measurements. For example, 1) in terms of environmental fair trade, it is important to examine the connection between green

entrepreneurship activity and corporate social responsibility, and explain a sustainable approach; 2) use monetary efficiency metrics to address key definitional issues with management performance standards that are favorable as a result of PARCS.

Not only from a social point of view, green entrepreneurship has been triumphant in community building and societal well-being. Green companies are the kind of businesses that give back to local people by generating employment, making economic contributions, and investing in community projects, they also significantly enhance social equity by ensuring, for instance, fair wages, and they engage communities in their sustainability practices underpinning collaborative ownership (Alvarez-Risco et al., 2021; Tien et al., 2020) Moreover, green businesses can stimulate social innovation by responding to societal issues linked to health, education, and basic services through environmentally sensitive pathways (Silajdzic et al., 2015).

An in-depth comparative analysis with traditional entrepreneurship emphasizes the distinctiveness in both their manner and impact. Most of the traditional entrepreneurship focuses on maximizing financial returns, which is just happy at face value ignoring damaging effects to environments and lifestyles. Green entrepreneurship, on the other hand, has embedded in its main objectives a triple bottom line of profit for people and the planet, ensuring that economic endeavors do not come at an environmental or social cost (Schaper 2016; Cooke 2020). This comprehensive method positions green entrepreneurship as a more sustainable and responsible business model, something that is now being acknowledged and respected in the present-day economy (Gibbs & O'Neill, 2014).

Finally, green entrepreneurship is likely to have multiple economic and non-economic impacts on the environmental development of society everywhere. Green entrepreneurs have an important role in pushing for a more sustainable - and just- global economy by encouraging sustained business practices, environmental stewardship through policy changes, and community involvement. Their process, in contrast with traditional entrepreneurial models, highlights the need for sustainability to be incorporated into business strategies in ways that counter tackle global challenges currently.

2.7. Future Directions and Research Gaps

The field of green entrepreneurship is rapidly evolving, and there are several emerging trends that warrant closer study for potential support measures. One significant development is the integration of digital technology into green business. For example, to enhance transparency in

the supply chain, proponents are suggesting the use of blockchain. To manage energy more efficiently, there is a growing adoption of Internet of Things technology, and for optimizing resource use, artificial intelligence is being increasingly utilized. In addition to this, the circular model of the economy, which focuses on the re-use and preservation of raw materials, opens serious gates to entrepreneurs in the field of “green prospects”.

While developments have been made, many key questions still exist. More extensive studies on the long-term economic implications of green entrepreneurship are needed, especially in different regional contexts and sectors (Makhloufi et al., 2022). Broader adoption necessitates understanding the scalability of green business models and which market conditions make them applicable. However, studies on the behaviorist perspective of green entrepreneurship in terms of motivations behind and processes followed for making such decisions by green entrepreneurs have not been explored (Gibbs & O’Neill 2014).

It is suggested that future research can delve deeper into policy and regulation as a more vital contributor to green entrepreneurship development or decline. This is an issue which could be promoted through normative comparative studies across countries with a variety of regulatory norms. Considering the space where social entrepreneurship meets green entrepreneurship may also yield guidance on dealing with environmental and social problems at once (Abdelwahed et al., 2023). The acceptance of interdisciplinary research drawing on environmental science, economics, and business management could lead to a better understanding of sustainability challenges and promote integrative solutions.

The message for policy and practice is clear. Policymakers should create space to encourage green business by providing stimulus such as tax relief, grants, and subsidies for the financing of sustainable businesses (Alwakid et al., 2021). Furthermore, we anticipate the emergence of green entrepreneurship through initiatives like policies that support research and development in green technology and the implementation of mechanisms to facilitate easier access to affordable or no-cost funding for environmental initiatives. Additionally, educational programs focused on sustainability and entrepreneurship may be introduced to equip aspiring entrepreneurs with the essential knowledge for achieving success (Alvarez-Risco et al., 2021).

In reality, the application of a larger-scale sustainability philosophy through incorporating environmental and social criteria into your core strategy can be beneficial from a business perspective. Vibrant interlinks have occurred around businesses, governments, and NGOs to improve the outcomes of green entrepreneurship initiatives as well as to promote a conducive

milieu for sustainable innovation (Tien et al., 2020). In addition to measuring impact companies should communicate their sustainable efforts clearly and transparently in order to win the trust of their consumers or any other associated stakeholders.

3. Methodology

Bibliometric analysis examines quantitative and qualitative information in scientific publications, articles, books, and other academic sources (Li & Zhao, 2015). This examination method aims to understand the literature within a given research field, identify trends over time, and evaluate the types of information available on specific topics. Bibliometric analysis contributes to revealing the developmental progression of a particular area of study and provides insight into emerging subjects within that domain (Guo et al., 2019; Donthu et al., 2021). Increasingly, this technique is utilized to investigate various facets of scientific inquiry (Ellegaard & Wallin, 2015). It serves as a means to scrutinize the academic outputs of authors, institutions, and countries. (Wang et al., 2020). Additionally, bibliometric analysis can recognize trending issues and shifts related to a defined concept. (Wang et al., 2010). Of note, this examination approach has the capability to uncover gaps within the literature. (Donthu et al., 2020). The method encompasses explorations of authors, citations, publications, and keywords.

The analysis mentioned is applicable in various fields (Gaviria-Marin et al., 2018). In the field of management science, it has been utilized in areas such as operations research and management science (Merigo & Yang 2017), knowledge management (Gaviria-Marin et al., 2019), safety culture (Van Nunen vd, 2018), and risk management (Nobanee et al., 2020). In the field of entrepreneurship, it has been used in papers related to bibliometrics, entrepreneurship and crisis (Xu et al., 2021), entrepreneurial universities (Forliano et al., 2021), and academic entrepreneurship (Skute et al., 2019).

Articles from the Web of Science database were utilized in this study. The articles were accessed by searching for "green entrepreneurship" and other relevant keywords related to green entrepreneurship. The raw data was sourced from the Web of Science with plain text and was processed using the "bibliometric" package in the R program. It's worth noting that the accuracy and correlation integrity of the results derived from this process are noted to be different from those obtained using other bibliometric analysis tools, such as VOSviewer, which is primarily limited to visualization. The bibliometric package was used in this process.

The relationship between keywords was visualized with the help of The VOSviewer software (Van Eck and Waltman, 2017). A software program, VOSviewer developed specially for creating and visualising bibliometric maps. (Van Eck and Waltman, 2010). Alternatively, networks can be established using the major terms extracted from text-mined literature with VOSviewer (Bukar et al., 2023). It maps graphically where these networks are into one holistic network (Kirby, 2023).

4. Findings

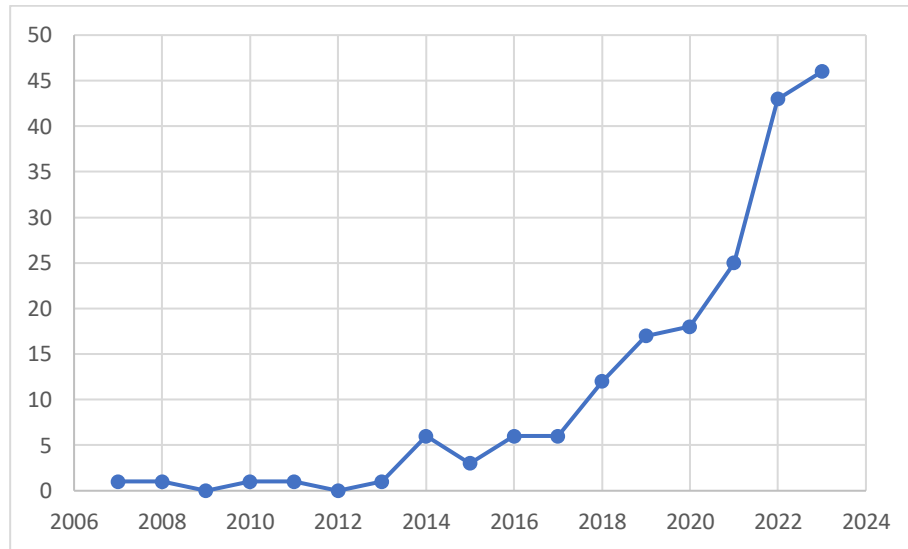
This study investigates the scientific development of the green entrepreneurship concept and is intended to inform future green entrepreneurship studies through bibliometric analysis. For this purpose, 195 articles, 100 journals, 552 authors, 626 keywords in the WOS accessed, and accessed articles and authors keywords were analyzed through the “bibliometrics” package in the R program. Table 1 provides general information about the analyzed articles.

Table 1. Information on the Articles

Description	Results
Time Interval	2007:2024
Articles	195
Annual Article Growth Rate	13.01
Average Age of Articles	3.51
Averages Citation Per Article	15.46
Keywords	626
Author	552
Number of Single Authored Article	22

The first green entrepreneurship article was identified in 2007, and the last one is dated 2024. We discovered 195 articles at an average age of 3.51 years. Thus, it could also be justified that Green Entrepreneurship concept is contemporary. The annual article growth rate was determined to be 13 percent.

Figure 1. Trend in Green Entrepreneurship Research Publications (2006-2024).



The trend analysis of green entrepreneurship research publications from 2007 to the present shows a consistently high and increasing interest in the field over the past two decades. From 2007 to around 2012, there was a low volume of publications, indicating that green entrepreneurship as a research topic was in its early stages. It is reasonable to assume that during this time, the research community began to recognize the importance of incorporating environmental concerns into entrepreneurial activities, although it was not yet widely acknowledged.

There is a significant increase in the articles starting from 2013 with gradual rise which indicates an increasing awareness and interest towards the topic. The increase indicates green entrepreneurship was slowly being recognized as a key area of research, potentially influenced by mounting global concerns over sustainability and the roles businesses could play in counteracting environmental harm. However, for the years post-2015 there is a significantly upward trend suggesting that serious attention to this concept has increased within academics.

The transition largest starts in 2019 when the number of publications suddenly increases dramatically. Some drivers behind this boom are greater international awareness of climate change, new more stringent environmental regulations, and the increased prominence of

sustainability in business operations. The large number of publications at this time evidenced the fact that green entrepreneurship had moved beyond a niche subject to become an area bonded in scientific space. Academics from different realms could have been discovering novel approaches of taking sustainability with entrepreneurship, as it would also be how society should see the importance on environmental welfare.

The concept of green entrepreneurship has already been extensively explored and is expected to continue growing until 2024. This trend reflects the increasing importance of environmentally sustainable businesses. The steady growth in publications also indicates the evolving nature of this field, with research frontiers and key interest areas changing over time.

In the past two decades, there has been an increasing research interest in green entrepreneurship, as evidenced by the trend analysis on publications. Initially started as a response to environmental issues, green entrepreneurship has now become established and recognized in academic circles for addressing major challenges in sustainable ways. Continuing research in this area highlights the significance of green entrepreneurship in promoting environmental protection and encouraging more sustainable practices.

Figure 2. Top Journals Publishing Green Entrepreneurship Research

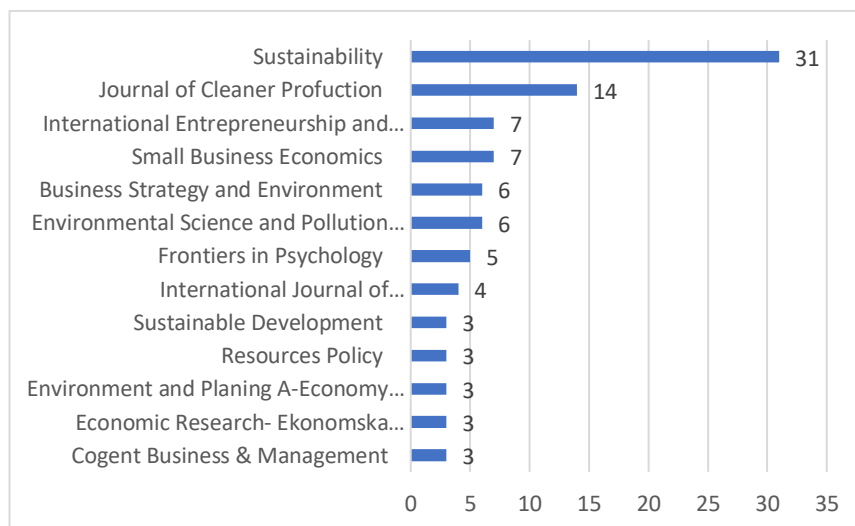


Figure 2 shows journals in which articles on green entrepreneurship were published. Accordingly, “Sustainability” published 31 articles on green entrepreneurship. The majority of the publications related to this concept were realized in this journal. Apart from this, “The Journal of Cleaner Production” includes articles on green entrepreneurship with 14 articles. The

fact that Sustainability is published monthly may have contributed to the fact that this journal contains many green entrepreneurship articles.

Table 2. Top Contributing Authors in Green Entrepreneurship Research

Authors	Articles
Makhloufi L	6
Gao Y	4
Gibbs D	4
Haldar S	4
Mondal S	4
Alvarez-Risco A	3
Del-Aguila-Arcentales S	3
Gupta H	3
Hussain S	3
Meirun T	3
O'neill K	3
Singh S	3
Soomro Ba	3
Tsai Sb	3

Table 2 shows the authors who wrote most green entrepreneurship articles. Accordingly, L. Makhloufi is the person who wrote the most green entrepreneurship articles. The majority of his articles in WOS are articles on the impact of the green entrepreneurship orientation on concepts such as eco-innovation, environmental performance (Makhloufi et al., 2022; Makhloufi, 2023; Makhloufi et al., 2024).

Table 3. Top Contributing Institutions in Green Entrepreneurship Research

Affiliation	Articles
Jilin University	7
Indian Institute of Technology	5
Bucharest University of Economic Studies	4
Dalian University of Technology	4
Harbin Institute of Technology	4
Ministry Of Education and Science of Ukraine	4
University College Dublin	4
Islamic Azad University	4
Mae Fah Luang University	4

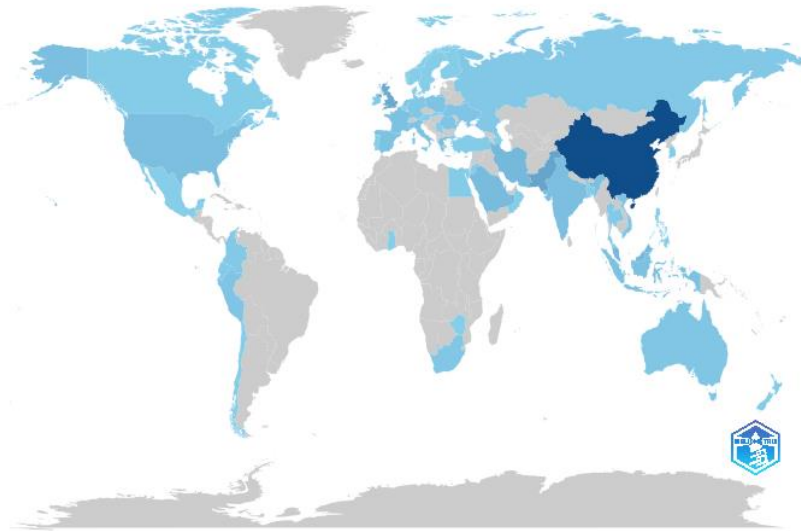
Table 3 shows the institutions with the highest number of publications in green entrepreneurship. This table shows the institution to which the authors belong, with the authors from Jilin University having the highest number of articles on green entrepreneurship.

Table 4. Top Contributing Countries in Green Entrepreneurship Research

Country	Frequency
China	123
Pakistan	38
UK	34
Iran	20
Malaysia	20
Greece	17
Saudi Arabia	17
India	14
USA	14
France	12
Indonesia	12
Italy	11
Spain	11
Poland	10
Vietnam	10

Table 4 shows the countries with the highest number of articles on green entrepreneurship. It is determined that China has the highest number of articles. The reason for the predominant number of green entrepreneurship articles coming from China may be that it is one of the countries with the highest levels of environmental pollution. Pakistan ranks second. Pakistan is one of the worst-performing countries in the world in terms of environmental pollution. Researchers may have turned more to green entrepreneurship articles to find solutions to the problems they face in their countries.

Figure 3. Geographical Distribution of Green Entrepreneurship Research Publications



The geographical representation of green entrepreneurship research publications provides us with some key understanding about the regions within which academic contributions on this topic are located in a global perspective. The most salient result of the analysis is that green entrepreneurship as a research subject has been largely conducted in China. This is probably due to China's major pollution burdens, and the Chinese government ensuring a strong policy on sustainability as well as green technologies. This has led China with an innovation focus and strong environmental research investments to be one of the worldwide leaders in this field.

Apart from China, other Asian countries such as India, Japan and South Korea have also exhibited high levels of research output on green entrepreneurs. This regional focus reflects the

increasing awareness of sustainable procedures in these highly dynamic economies. On the other hand, a number of contributions to HAEC are from European countries, with Germany and UK being major contributors, followed by Italy. In these countries, there are generally robust education and research institutions that put a high emphasis on sustainability, among other things, trying to embed green behaviour into company operations.

In addition, the map shows a growing enthusiasm for green entrepreneurship in places like Southeast Asia, South America and Africa. One of the characteristics of sustainability research and publication is that increasing contributions comes from countries, notably, Brazil in their studies on environmental justice or South Africa (but also Indonesia). Nonetheless, research in those regions are relatively less than the global leading countries suggesting a window of opportunity for advancing green entrepreneurship research.

On the other, researchers barely done any work in a few country of central Asia are shown on map as well some Middle eastern and African counties. There are a number of reasons this research gap may exist, including financial constraints and the lack of an infrastructure that would help assist in environmental fields. Resource mobilization and international collaboration efforts are required to make more communities in these regions contribute effectively towards green entrepreneurship.

Thirdly, the research locations could be influenced by national policies and institutional support. In general, results have shown that countries with strong government support for sustainability and green technologies lead to higher research output. It highlights how policy frameworks can drive straightforward academic and practical developments in green entrepreneurship.

Table 5. Most Cited Articles in Green Entrepreneurship Research

Article	DOI number	Total Citation
Dixon & Clifford (2007)	10.1108/09534810710740164	571
Demirel et al. (2019)	10.1007/S11187-017-9933-Z	358
Allen & Malin, (2008)	10.1080/08941920701612917	296

Silajdzic et al. (2015)	10.1016/J.Jclepro.2014.07.004	215
Ebrahimi & Mirbargkar (2017)	10.1007/S40821-017-0073-9	207
Yi Gf, 2021, Int Entrep Manag J	10.1007/S11365-020-00649-Y	191
Mrkajic et al. (2019)	10.1007/S11187-017-9943-X	171
Gibbs & O'Neill (2014).	10.1068/A46259	156
Makhloufi et al. (2022)	10.1002/Bse.2902	138
Zhao et al. (2020)	10.1016/J.Seps.2019.100757	114

Table 5 shows the most cited articles. The most cited article on green entrepreneurship is "Ecopreneurship – A New Approach to Managing the Triple Bottom Line," written by Sarah Dixon and Anne Cliford in 2007. Using semi-structured interviews, micro-ethnographic research, and literature review, Dixon and Clifford found a strong relationship between entrepreneurship and environmentalism. This article is also one of the first published articles on green entrepreneurship. The reason why this article is highly cited maybe because it is one of the first studies on the subject.

Table 6. Most Frequently Used Keywords in Green Entrepreneurship Research

Keywords	Frequency
green entrepreneurship	95
sustainable development	21
sustainability	20
green innovation	15

sustainable entrepreneurship	12
entrepreneurship	11
ecopreneur ship	9
green entrepreneurship orientation	8
green economy	7
green entrepreneurial intention	7
green absorptive capacity	6
green entrepreneurial orientation	6
environmental entrepreneurship	5
green entrepreneurs	5

Table 6 shows the most frequently mentioned keywords in the articles. Accordingly, the most frequently mentioned keywords other than green entrepreneurship itself are sustainable development, sustainability, green innovation, sustainability, entrepreneurship. The main goal of green entrepreneurship is to ensure a sustainable future. Therefore, it seems reasonable that researchers frequently use keywords related to sustainability at the most.

Figure 4. Word Cloud of Key Terms in Green Entrepreneurship Research

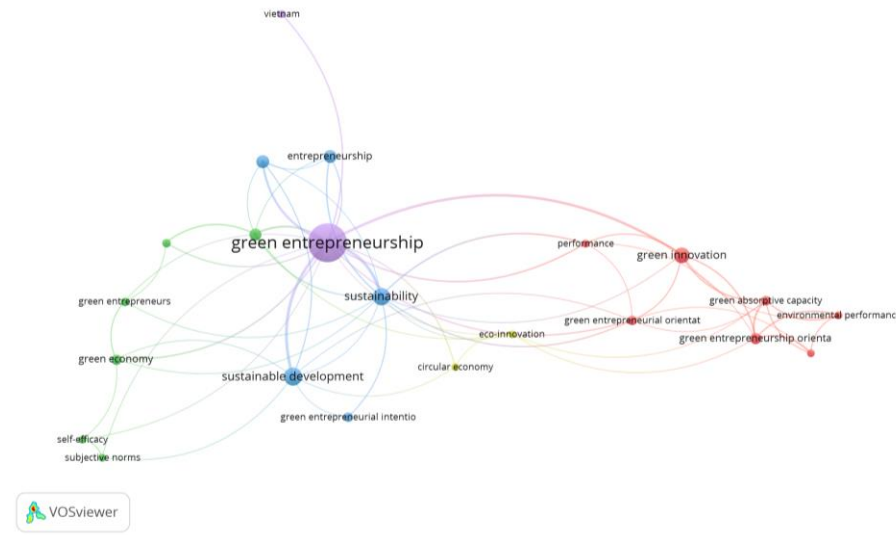


The word cloud analysis of green entrepreneurship revealed the following key themes and concepts represented in this field. The most central and major term is green entrepreneurship, which is clearly the focus of the study. Other terms in Types of text that range around it are also important and key to understanding green entrepreneurship. One of the most frequent terms in the word cloud is sustainability. On the one hand, it is the main and central public category, and, on the other hand, sustainability serves as the focus of the attention that is drawn to it as the primary stream of public life.

At the same time, sustainable development is quite popular, which indicates the association of green entrepreneurship with ensuring long-term socio-almost everyone's psychological and environmental well-being. Another important process in word count is green innovation. It emphasizes the need for innovation in green entrepreneurship, and it plays a leading role in addressing environmental issues and fostering sustainability. Compared to the above words, green innovation shows that research in this area is characterized by innovation-focused practices and technoscapes that optimize the negative impact on the environment.

Eco-friendly, renewable energy, and environmental impact are three other such terms. These words show the focus of green entrepreneurs on constructive action that helps the environment, the use of renewable forms of energy, and the most basic method of straining with its negative impact. The last four expressions are sustainable business and green technology. In general, these phrases represent a combination of green entrepreneurs and individuals 'economic activities, whereby the profitability of the business is the fundamental element, and in practice, entrepreneurs prove to be both ecological conscious and socially responsible.

Figure 5. Co-occurrence Network Analysis of keywords related to green entrepreneurship



The findings of green entrepreneurship keyword co-occurrence network analysis provide important implications for the existing research landscape in field. In the center of the network, they have identified as a core concept of "green entrepreneurship," which means their main focus area in academic literature. Its centrality serves to emphasize just how crucial the term is, signaling that it is a core concept imbricated within many other significant areas - in short something we could say defines research on this subject.

One of the biggest discoveries is that green entrepreneurship and sustainability are closely linked. This operator's impact-centered close-fit embodies that sustainability is an inherent and connecting feature of green entrepreneurship by targeting built-in objectives to drive sustainable activities as well as ecological saving. There is also a large correlation between the network and "sustainable development" supporting our idea that green entrepreneurship intends to achieve far broader sustainable development goals.

The research also illustrates the notion of "green innovation," a term that is closely related to green entrepreneurship. From this connection, it is clear that innovation in green businesses represents a significant facet of their operations with the creation of new forms or variations on environmentally conscious products and services. The use of terms such as "performance" and "environmental performance" in the context of green improvement corresponds to an

understanding that this form innovation is truly about output, showing how it includes both economic success imperatives with environmental wellbeing benefits.

In addition, the network displays numerous clusters that each represent a different sub-theme in green entrepreneurship. The cluster highlighted in Figure 5 links green entrepreneurship to "green economy" and "self-efficacy," implying that researchers are keen on the economic forces driving green entrepreneurial activities as well as individual impulses. Another group consists of terms like "circular economy" and "eco-innovation" pointing toward new tendencies as well a growing investigation effort in researching sustainable economic models and novel ecological solutions.

Thus, the inclusion of country-level terms such as "Vietnam" is interesting in highlighting the importance that regional-based studies, along with case analysis, play in understanding various aspects relating to green entrepreneurship. Such a regional focus could shed light on the particular challenges and opportunities green entrepreneurs face in different parts of the world, thus making a more comprehensive portrait.

Less connected terms such as - subjective norms - found by the network may represent new or underexplored areas in green entrepreneurship research. These peripheral keywords provide hints of the possible areas that might be overlooked in literature to target for future research, which allows room for improvement and adds more value as a part of knowledge discovery.

5. Conclusion

Over the years, green entrepreneurship has attracted attention as it enables people to contribute to vital areas, such as the environment, while lending fuel for economic growth. Green entrepreneurship implies that a new model of sustainability drivability has to be embedded within core business practices. This paper has thus presented a widespread bibliometric review intended to help in following the growth and diffusion of scientific research on green entrepreneurship.

One important result is an unmistakable uptrend in green entrepreneurship research from 2007 which shifts into a more rapid growth mode since around 2017. The research activity increase highlights the increasing global interest and recognition of green entrepreneurship as an important field. Much of the published work is qualitative-oriented and grounded in conceptual or theoretical foundations on green entrepreneurship. Thus, there are constructive opportunities

for more research and determinate longitudinal quantitative studies on green entrepreneurship with sustainability, the green economy and/or thematic innovation.

In sum, "Sustainability" was the journal with more publications on green entrepreneurship and we observed that it plays a central role in better understanding/promoting research work within this domain (Bibliometric Analysis). L. Makhloufi appeared as the most frequent author, addressing pivotal topics like green entrepreneurship orientation and its effects on eco-innovation with respect to environmental performance. Institutionally, Jilin University is the most prolific in contributions and China as a country comes out strongest with highest results which might be reflective of its large environmental problems coupled with an excellent policy framework supporting sustainable practice.

The distribution of research publications varies significantly, with high output in China, various European countries, and other Asian nations. However, the increasing global interest in green entrepreneurship, particularly from emerging regions like Southeast Asia, Latin America, and Africa, indicates that it is a promising area to invest in. These findings underscore the significance of enhancing international cooperation and developing research capacity in underrepresented regions.

The analysis of keyword co-occurrence revealed a strong connection between green entrepreneurship and concepts such as sustainability, sustainable development, and green innovation (Figure 5). These connections showcase various aspects of green entrepreneurship, including its environmental and alleviation dimensions. Additionally, the analysis identified areas of emerging interest and potential research gaps in the relationship between green entrepreneurship and broader sustainability goals, suggesting potential future inquiry into how these dynamics interact.

The study concludes that, green entrepreneurship is critical in the promotion of sustainable development. The study highlights how crucial it is to create an ecosystem that helps green entrepreneurs with supportive policies, financial perks, and technology. Future research can address the identified gaps in the literature and build on existing theoretical foundations to enrich our understanding of green entrepreneurship as a key player in fostering an economy that is more sustainable and resilient at both the local and the global level.

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