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# Green Credits: A Bibliometric Analysis of Publications in the Web of Science

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**Abstract**

Sustainable development goals emphasize disseminating projects that do not pollute the environment. Green credit is one of the primary tools used to support and finance environmentally friendly projects. Thus, green credits appear to be a current research area. This research aims to conduct a bibliometric analysis of studies on green credits. To achieve this goal, we reviewed 2,630 studies published in the Web of Science database between 1980 and 2024. We presented the changes in the number of studies and citations over time, along with details about the most cited studies. In the literature review section, in particular, studies published recently were examined. Then, we categorize the studies based on document and index type, written language, countries, subjects, and citation categories. Our main results are: The most intense years for studies on green credits are 2022 and 2023. 98% of the studies were published in English, with over 80% being article-based. China leads the list of countries to conducting the most studies. The first three categories with the most studies are environmental sciences, green sustainable science technology, and economics. As the number of studies increased over time, citations also increased.

**Keywords**: Sustainable Development, Green Credits, Bibliometric Analysis, Web of Science

**JEL Codes**: E6, G2, O1

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## 1. Introduction

The protection of the environment is one of the basic elements of the sustainable development approach. Sustainable development goals ensure growth without harming the environment. To achieve this goal, production activities that harm the environment should be restricted and those that protect the environment should be encouraged. One of the most effective tools for accomplishing this is the credit system. External financing is often needed to make new investments or expand existing production projects. If credit institutions and banks consider the environmental impacts of the planned project when evaluating credit applications, an important step may be taken toward protecting the environment. At this point, the concept of "green credit" arises. Green credits consider the projects in which the credits will be used and the environmental impact of the projects to be used. Thus, environmentally sensitive investments are supported through green credits. Green credits play an important role in sustainable development because they direct investments to green areas and restrict environmentally polluting activities. However, green credits are a relatively new field of research, and the literature on this subject continues to expand. A bibliometric analysis of green credits will be a guide for future studies. This study will contribute to the literature because the number of bibliometric studies focusing on green credits is negligible.

In this study, the content and importance of the concept of green credits are explained. Then, in the literature review section, particularly current studies published on green credits are included. After the literature review, the fundamental principles and importance of the bibliometric analysis method were emphasized. In the last section, the findings from the bibliometric analysis are shared.

In the study, a search was made in the Web of Science database with the keywords "green credits" and 2,630 studies were found listed with these keywords. Studies cover the period 1980–2024. The distribution of the listed studies according to years, writing language, document type, index information, and subject categories is shown. Additionally, information about the most cited studies is provided.

## 2. Concept of Green Credits

Conducting economic activities by considering the awareness of environmental protection has led to the emergence of concepts such as sustainable development and green economy. A financial system that prioritizes environmentally friendly projects is needed to finance economic growth and development. Because of this need, the concept of green finance has come to the agenda. Green finance is a broad concept that includes different finance tools. One of these financing tools is green credit (Luo et al., 2017).

Green credits are one of the most used tools in green finance applications. Although there is no absolute definition of green credits, they can be generally expressed as a type of credits that encourage reduction in carbon emissions and energy efficiency and prioritize environmental protection. While green credits encourage environmentally friendly projects,

they reduce financial support for projects that cause environmental pollution. In other words, green credits are based on increasing the credit threshold of projects that require high energy consumption and increase carbon emissions (Zhang et al., 2021).

Green credits impose credit restrictions on projects that pollute the environment, causing the companies that implement these projects to change and transform. Difficult credit opportunities and increased credit force companies to comply with environmental sensitivity. Because providing credit advantages to companies that engage in environmentally compatible activities encourages them to adopt green policies. To benefit from the advantages offered to companies that implement green policies, companies may choose to change their policies. In line with this purpose, companies begin to invest in technologies that protect the environment and increase energy efficiency. Therefore, green credits are a guide and tool to encourage green transformation for companies (Cao et al., 2021).

Green credits provide financing support for projects that do not pollute the environment and have low carbon emissions. Thus, the allocation of funds to environmentally friendly projects is increased. It becomes easier to provide the capital needed to increase green investments. With their green credit policy, commercial banks do not provide credit opportunities to sectors and projects that have a high potential to pollute the environment and extensively use nonrenewable energies. In contrast, banks give priority to activities with high energy efficiency and the use of renewable energy (Yao et al., 2022).

Green credits not only contribute to environmental protection but also improve economic performance. Thus, green credits are tools that make it easier to achieve both environmental and economic goals. Green credit applications allow more resources to be allocated to innovations and increase the efficiency of investments in innovations. Increasing new investments and directing the increasing investments to productive areas also encourage economic growth. On the one hand, it becomes easier to achieve the sustainable economic growth target, and on the other hand, the negative effects of environmental degradation on human health are reduced (Wang et al., 2021).

The serious negative effects of environmental degradation on human health affect the behavior of not only financial institutions but also governments. Governments are reforming standards for environmental protection and updating legal frameworks to eliminate financial imbalances. Introducing common standards for credits for financial institutions operating in the country can ensure that the financing system operates more effectively. The standards introduced should be inclusive of all different mechanisms such as measurement, monitoring, and inspection (Song et al., 2019).

## 3. Literature Review

Studies on green credits have begun to increase rapidly, particularly since 2010. The years 2021, 2022, and 2023 saw the majority of work on this subject. Thus, in the literature review section, we focused on examining studies from these years. Studies for 2024 are also included. Most studies on green credits have been conducted in China. Although there are studies that focus on different countries or groups of countries, the number is still relatively small. Studies have

primarily examined companies that use green credits or banks that allocate green credits. Many studies have examined how green credit policies affect companies' green innovation activities and transformation processes. The effects of green credit policies on green innovation and transformation differ depending on the fields of activity and company size. However, green credits generally support green innovation activities. Wang and Li ((2022) examined how the green credit policies affect green technology innovations of enterprises. The analysis covers enterprises in China. The Chinese green credit guidelines significantly increase enterprises' innovation activities regarding green technology. The green credit guidelines promote new investments by increasing enterprises' value and reputation. Thus, the effectiveness of investments also increases. Yin et al. (2023) investigated how green credit policies affect corporate green innovation. They applied the DID method to the data of non-financial companies that traded on the Chinese stock market from 2007 to 2019. According to the results of the analysis, applying green credit restrictions to companies within the framework of green credit policies reduces the amount of green innovation made by companies. Moreover, not only the quantity of green innovation is decreasing but also its quality. Therefore, financing channels should be diversified. Deng et al. (2023) studied the relationship between green innovation and credits. They used data from BRICS countries for the period 2010–2019. Regression analysis in the study revealed a positive and significant relationship between green innovation and commercial credit activities. The relationship between green innovation and trade credit activities is valid for both trade receivables and trade payables. Berikhanovna et al. (2023) examined the effects of green credit policies on firms. They applied the panel regression method using data from companies operating in the green sector in Kazakhstan. In the study, they examined the companies in the SME category and tested whether there was a difference according to company size. The results show that green credit policies have a positive and significant impact on large enterprises' green innovation indicators. For small and medium-sized companies, the effect of green credit policies on green innovation is meaningless. Lin and Pan (2024) examined the effects of green credit policies on green transformation. They used data between 2009 and 2020 on heavily polluting enterprises in China. According to the DID analysis, green credit policies positively affect the green transformation of heavily polluting businesses.

Green credit policies affect not only green innovation but also all types of technological innovation and digital transformation. In general, green credits appear to have a positive impact on technological innovations and digital transformation. However, several factors differentiate the impacts of green credits. Some of these factors include the effectiveness of companies' control mechanisms, whether they are public- or private-sector companies, as well as their production capacity. Chen et al. (2022) examined the relationship between green credits and low-carbon technological innovations. They conducted an analysis using data from 2004 to 2019 on enterprises in China. Green credits positively influence low-carbon technological innovations. Green credits increase enterprises' R&D investments and managerial efficiency. Thus, there has been progress in low-carbon technological innovations. Furthermore, the positive effect of green credits is greater in state-owned enterprises. Shang and Niu (2023) studied the effect of digital transformation on green credits. In the analysis, they considered the banking sector and used data from banks in China between 2010 and

2021. The banks' adaptation to digital transformation has increased the volume of green credits in the banking sector. This effect is more evident at large-scale and public banks. Digitalization has a greater positive impact on green credits in periods when loose monetary policy is implemented, and financial control is strong. Wen et al. (2021) examined the effect of green credit policies on energy-intensive enterprises. Data from enterprises in China were used. According to empirical results, green credit policies negatively affect research-development intensity and total factor productivity. Additionally, green credit policies also have negative effects on the allocation efficiency of bank credits in energy-intensive sectors. Guo and Zhang (2023) examined the effects of a green credit policy on total factor efficiency. They used the DID method to study Chinese companies. The dataset covers the 2007–2019 period. The analysis reveals that green credit policies positively impact total factor productivity. Furthermore, they have observed that the positive effects of green credit policies on total factor productivity extend beyond heavily polluting sectors to those with less impact on environmental pollution.

Green credit policies also affect firms' stock prices, financing, and investment decisions. Financing and investment decisions have an impact on a company's financial inclusion and sustainable development performance. However, the resulting effects may vary. The effects of green credits depend on whether financing and investment decisions are short- or long-term, as well as the companies' economic and institutional characteristics. Shao et al. (2022) investigated how green credit guidelines affect enterprises' stock prices. In the analysis, they considered enterprises that excessively pollute the environment in China. The data pertain to enterprises with Group A shares. Green credit guidelines increase the risk of a collapse in the stock prices of enterprises that heavily pollute the environment. This effect is more evident in public enterprises and those in which information transparency and corporate governance are inadequate. Zhang et al. (2022) investigated how green credit guidelines affect the financing and investment decisions of enterprises. They used data from 2009 to 2015 on Chinese companies with Group A shares. Green credit guidance further restricts the financing and investment behavior of enterprises that excessively pollute the environment. Moreover, the restrictive effect of green credit guidelines is greater in publicly owned enterprises. Yang and Zhang (2022) examined the relationship between green credits and the financing of heavily polluting enterprises. They used data from 2004–2020 on heavily polluting enterprises with type A shares in China. Green credit policies restrict enterprises' long-term financing. Green credits also expand short-term financing for businesses. Thus, the effect of green credits on financing is different in the short and long term. Furthermore, green credits have a greater impact on non-public enterprises. Ai et al. (2023) investigated how green credit policies affect enterprises' interregional investments. The research covers data from 2009 to 2019 on heavily polluting enterprises in China. Green credit policies reduce long-term credit availability and government subsidies for enterprises that pollute the environment. As a result, interregional investments in heavily polluting enterprises decrease. Van Hoa et al. (2022) studied the effects of green credits, green investment, and financial inclusion on sustainable development. They conducted an analysis of the Vietnam example. They used 1986–2020 data from Vietnam and applied the ARDL method. Green credits, green investment, and financial inclusion positively impact sustainable development. Hu et al. (2023) examined the effects of green credits on the

financialization behavior of enterprises. In the research, they focused on heavily polluting enterprises with type A shares in China. Green credits reduce the financialization of heavily polluting enterprises. These effects are greater in state-owned enterprises. There is also spatial heterogeneity. The impact of green credits is more evident in the eastern regions. Hawash et al. (2022) researched the impact of green credits, green financing, financial inclusion, and foreign direct investments on sustainable development. In the study, they used data from manufacturing enterprises in Iraq. They used regression analysis in the study, covering the 2005–2021 periods. The effects of green credits, green finance, financial inclusion, and foreign direct investments on sustainable development are statistically significant and positive. Ding et al. (2022) studied how green credits affect the sustainable development of banks. The research was conducted on banks in China and includes bank data between 2007 and 2019. Green credits positively impact the sustainable development of banks. However, this effect varies depending on the size and business scope of banks. Green credits have a greater impact on the sustainable development of small-scale and regional banks.

Because green credit policies influence investment and financing decisions, companies' and banks' performances also change. The effects of banks' core competencies vary depending on their credit and reputation risks. The effects on firm performance mainly depend on whether the firms operate in highly polluting industries. Yao et al. (2021) discussed how the green credit policies implemented in China affect the performance of enterprises. According to the results of this research, green credit policies reduce the performance of companies in highly polluting industries. Green credit policies restrict enterprises' financing opportunities. Thus, the investment level of enterprises decreases, and their performance is negatively affected. These effects are more pronounced in public and large-scale enterprises. Luo et al. (2021) examined how green credit practices in China affected the core competencies of commercial banks. According to the results of the factor analysis, green credits have significant effects on overall bank competence. This impact varies depending on the bank's credit and reputation risk levels. Banks with high credit and reputation risks have a higher rate of improving their core competencies through green credit. Lian et al. (2022) investigated the relationship between green credits and the financial performance of banks in China. They used data from 34 commercial banks between 2007 and 2018 and applied the fixed-effects model. Green credits improve banks' financial performances. This effect is especially realized through the return rates on assets. Green credits positively affect the return rates of banks' interest-bearing assets.

The effects of green credit policies extend not only to businesses but also to banks. Green credit policies also help to reduce environmental pollution and disseminate environmentally friendly production activities. There are many studies on the relationship between green credits and the environment, and the number of studies is gradually increasing. These studies typically use $CO_2$ emissions as an indicator of environmental pollution, and they observe that green credit policies reduce $CO_2$ emissions. Yao et al. (2022) examined the impact of green credits on carbon efficiency. They used data from 30 provinces in China between 2003 and 2016. There is a statistically significant relationship between green credits and carbon efficiency. Using green credits increases carbon efficiency. In addition, green credits have a positive spatial spillover effect. W. Li et al. (2022) examined the effect of high-quality economic development on green credits and carbon emissions. The investigation covers provinces in China. They used data

between 2007 and 2020 from 29 provinces. There is a negative correlation between high-quality economic growth and carbon emissions. Additionally, the relationship between green credits and carbon emissions is also negative. This relationship is an "n-type" nonlinear relationship. Lyu et al. (2022) investigated the impact of green credits on carbon emissions. The research covers data from provinces in China between 2006 and 2016. Green credits reduce carbon emissions. This reducing effect is greater in the eastern regions. In addition, low-carbon technological innovations are an important tool for green credits to reduce carbon emissions. Liu et al. (2022) examined the effects of green credits on carbon emissions and the mechanisms by which these effects arise. The analysis covers 30 cities and provinces in China. According to the analysis results based on data between 2004 and 2019, green credits reduce carbon emissions. The impact of green credits is asymmetrical, as there are differences between regions in terms of income levels and financing barriers. In addition, environmental Research and Development activities strengthen the effect of green credits. Su et al. (2022) discussed how green credits affect air quality in China. According to the results of the Granger causality test, the impact of green credit policies on air quality varies according to the period. In the infancy of green credit policies, the impact of these practices on air quality could not be determined. Because during this period, the proportion of green credits is low. During the maturation period, the positive effects of green credits on air quality begin to emerge. Huang et al. (2024) examined the effects of green credits on reducing air pollution. In the analysis for provinces in China, they used data from 2006 to 2019. Green credits reduce air pollution. However, there is regional heterogeneity. The impact of green credits is more evident in regions with high levels of carbon emissions and economic development. Green credits have a spatial spillover effect. Green credits also help reduce air pollution in the surrounding regions.

In addition to the issues explained above, other studies have examined the effects of green credits on indicators such as energy efficiency, corporate social responsibility, and social health costs, as well as the factors that make the implementation of green credit policies difficult. Tan et al. (2022) examined the effects of green credit policies on energy efficiency in China. They conducted a sectoral analysis and examined 36 sectors in China. Green credit policies positively impact energy efficiency. However, the positive effects of green credit policies vary depending on the sector. This effect is higher in sectors with low public share and high trade openness. Additionally, targeting energy savings increases the impact of green credit policies. S. Li et al. (2022) examined the effects of green credit guidelines on corporate social responsibility. The analysis includes data from enterprises in China. There is a difference between enterprises that are restricted by green credit guidelines and those that are not. The increase in the social responsibilities of enterprises restricted by the green credit guidelines is greater. Rong and Hu (2023) examined the relationship between green credits and social health costs in China. The results show that green credit policies reduce social health costs. This effect is greater in provinces with high health expenditures per capita. Additionally, environmental pollution has an impact on the health of green credits. Qi et al. (2021) identified the challenges of green credit implementation in China. This study includes the perceptions of bank managers. Various characteristics of banks cause differences in managers' perceptions. Bank ownership structures and market shares are important factors that determine these perceptions. The obstacles faced

by rural commercial banks are greater than those faced by government-controlled commercial banks and joint-stock commercial banks.

Green credits are a green finance tool and a specific research topic. We could not find a bibliometric analysis specifically focused on green credits. However, in the literature, bibliometric analyses of green finance exist. Green finance is a subject that includes green credits; thus, it is important to determine whether the results of the bibliometric analyses conducted for green finance are similar to the results obtained from this study. Generally, the points highlighted in bibliometric analyses of green finance are similar. One common conclusion is that studies on green finance have rapidly increased in recent years. Developed countries have conducted the majority of these studies, while developing countries have made minimal contributions to the subject's literature. These studies focused on policy recommendations and conceptual explanations rather than applied analyses. For this reason, there is a need to increase the number of applied studies involving financial analysis. Zhang et al. (2019) carried out one of the bibliometric analyses on green finance. Most green finance studies focus on investment, governance, and policy. However, researchers have emphasized the inadequacy of studies using financial techniques and advocated for their expansion. In addition, developing countries have few studies on green finance, so they must conduct more studies on this subject.

The bibliometric analyses carried out by other researchers yielded similar results to those of Zhang et al. (2019). Malhotra and Thakur (2020) made a bibliometric analysis of studies conducted on green finance between 1990 and 2020. They examined publications in Google Scholar and Open Access. They emphasized that green finance is a research topic of increasing interest. The number of studies on this subject has increased rapidly, especially in the last five to ten years. One of the main goals of this study is to define green finance, taking into account the studies examined. Green finance is defined as a system that contributes to the creation of a sustainable economic system, and it is based on creating and using financial instruments that cause minimal damage to the environment. Cai and Guo (2021) conducted a bibliometric analysis of studies on green finance and determined the countries, universities, authors, and journals that publish the most on this subject. They reviewed the studies in Scopus. According to the findings of this study, developed countries generally contribute to the green finance literature. It is important for developing countries to accord importance to publishing on this subject in terms of the richness of the literature. Studies on green finance should not be limited to policy recommendations. Analyses should be carried out using financial techniques. Unfortunately, in the existing literature, studies based on financial techniques are scarce. Bhatnagar and Sharma (2022) examined studies on green finance between 1997 and 2021. They stated that studies on the subject started to increase after 2010 and increased rapidly by 2018. Developed countries are working more on green finance. Developing countries should contribute more to the literature by conducting more research on green finance. China and India have done the most work on this topic. Desalegn and Tangl (2022) conducted a bibliometric analysis of green finance publications. They reviewed the studies in Scopus. Most studies on green finance have been conducted in countries in the Asia-Pacific region. African and Arab countries make the least contribution to this issue. China is the country that publishes the most. Other countries should also contribute to the literature on green financing. Maria et

al. (2023) made some important findings in their study by examining the green finance literature. One of their key findings is that the green finance literature has undergone significant development, particularly since 2015. 2015 holds significance as it marked the signing of the Paris Agreement. Another observation is that the green finance literature is predominantly based on policy recommendations. Thus, this study provides guidance on what developing countries should do in relation to global climate change and green finance. Moreover, interdisciplinary journals publish the majority of studies on green finance. However, the authors stated that journals on economics and finance should pay more attention to green finance. They generally emphasized that the green finance literature has a heterogeneous structure. Mohanty et al. (2023) examined the green finance literature by including studies from the Scopus database in their analysis. Although studies on this subject have increased over time, there is still room for more, particularly on the expected returns and risks of green finance instruments. There is a gap in the literature in terms of studies examining the green finance policies of countries with different economic and demographic structures. The authors suggested a more comprehensive discussion of the study by utilizing various databases and scrutinizing different types of publications, including book chapters and proceedings. Because their study only included review articles. Sang (2024) revealed the literature's development by reviewing studies on green finance. The Scopus database included studies published between 1997 and 2024 in the bibliometric analysis. Studies on green finance have rapidly increased since 2015. Researchers from Asia-Pacific countries carried out most of the studies, with China ranking first. The largest number of studies are from China. Future studies should concentrate more on the risks associated with green financial instruments and thoroughly examine risk management policies for various countries.

## 4. Methodology

In the study, a bibliometric analysis method was applied. Bibliometric analyses are based on the principle of examining previous studies on a particular subject according to different criteria. These analyses use a variety of criteria, including publication year, keywords, research areas, and citation numbers. In addition, the distribution of studies by authors, countries, journals, institutions, and organizations can be determined through bibliometric analyses (Papadopoulou et al., 2021). In this sense, bibliometric analysis can be defined as a scientific literature review method using quantitative tools. However, bibliometric analyses have a rapidly changing and dynamic structure. Because new assessment tools and criteria have emerged, there is also a need to adapt the analyses to new conditions (Choudhri et al., 2015).

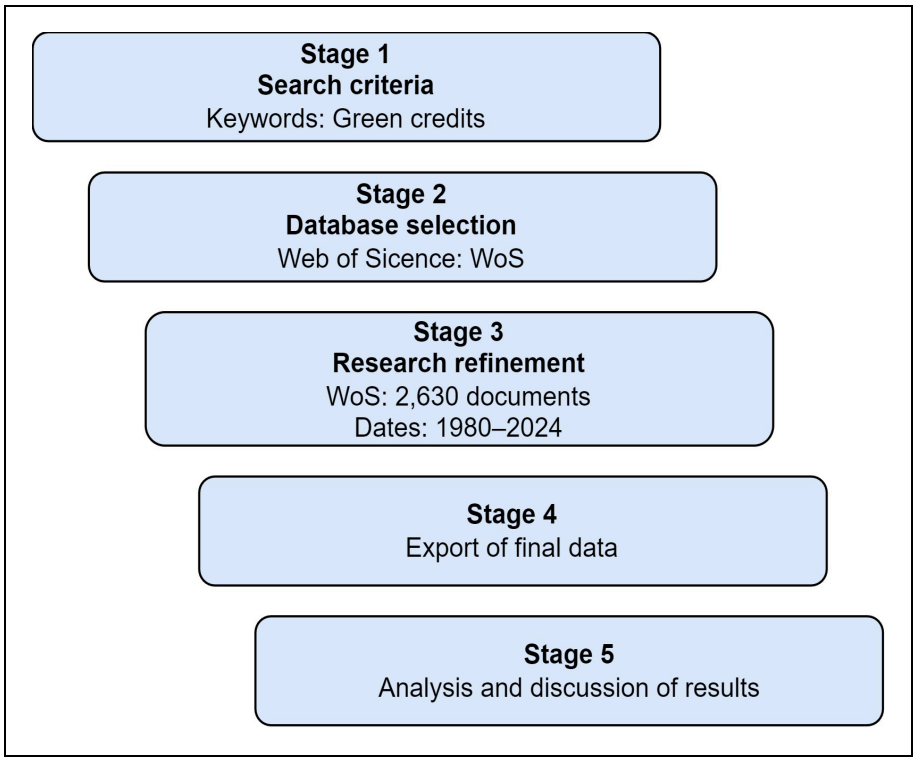
Bibliometric analyses enable readers to have a general perspective on the subject under investigation. Because it provides information about the most published researchers and the most cited studies on the subject, it serves as a guide for those who want to have information about the subject under investigation. It also provides an answer to the question of which disciplines the subject is a research area of. Thus, one can discern the perspective from which various disciplines approach the issue (Bonilla et al., 2015).

Several different steps need to be followed when conducting bibliometric analysis due to reasons such as the existence of different criteria to be determined and the fact that it is a

method that requires updating (see Figure 1). The first step in question is to determine the search criteria. It must be decided which keywords will be searched for. After determining the keywords, it is necessary to decide which database to search in. There are various databases, such as the Web of Science and Scopus. The studies listed may differ depending on the database used. The third step is to filter the search results. Filtering should be done within the scope of questions such as whether only articles or all publications will be evaluated and from which years studies will be examined. In the next step, the analysis results will be shared. It is important that the results obtained are discussed and interpreted (Ruiz-Real et al., 2018). The steps followed in the bibliometric analyses are summarized as follows:

**Figure 1**

*Stages of Bibliometric Analysis*




Source: Ruiz-Real et al., 2018

The abovementioned steps were followed in the study. First, keywords were determined, and searches were made with the words "green credits." We selected the Web of Science as the database. The primary reason for choosing this database is that it is comprehensive and frequently used by researchers.

The search in the Web of Science database listed 2,630 studies. We evaluated not only articles but also all document types to avoid narrowing the scope of the analysis. A total of 2,630 studies covered the years 1980–2024.

## 5. Results

We examined the number of studies conducted on green credits in the first stage. As shown in Table 1, the first study on the subject was published in 1980, and the number of studies published this year is 1. For some years, there have been no published studies on green credits. The number of studies published during the 1980–1997 period remained below 10. Since 2010, the number of studies has increased to more than 50. The number of studies on this subject has increased rapidly since 2010. The number of studies first exceeded 100, and the increase continued in the following years. The number of studies published on green credits amounted to 448 in 2022 and 498 in 2023.

**Table 1**

*Number of Publications by Year*

| Publication Year | Number of publications | Publication Year | Number of publications | Publication Year | Number of publications |
|---|---|---|---|---|---|
| 1980 | 1 | 1995 | 2 | 2010 | 56 |
| 1981 | 0 | 1996 | 2 | 2011 | 66 |
| 1982 | 1 | 1997 | 9 | 2012 | 77 |
| 1983 | 0 | 1998 | 10 | 2013 | 76 |
| 1984 | 1 | 1999 | 14 | 2014 | 80 |
| 1985 | 0 | 2000 | 8 | 2015 | 86 |
| 1986 | 1 | 2001 | 12 | 2016 | 93 |
| 1987 | 0 | 2002 | 8 | 2017 | 107 |
| 1988 | 0 | 2003 | 12 | 2018 | 138 |
| 1989 | 0 | 2004 | 8 | 2019 | 186 |
| 1990 | 0 | 2005 | 17 | 2020 | 187 |
| 1991 | 2 | 2006 | 26 | 2021 | 264 |
| 1992 | 2 | 2007 | 27 | 2022 | 448 |
| 1993 | 5 | 2008 | 38 | 2023 | 498 |
| 1994 | 1 | 2009 | 35 | 2024 | 26 |

Source: Web of Science

Following the distribution of the number of studies by year, the index information of the platforms where the studies were published was examined. Table 2 shows the index distributions. One thousand, three hundred and seventy of the studies on green credits are in the SCI-EXPANDED category and constitute 52.09% of the total studies. The studies in the SSCI category rank second. 41.41% of the total studies are in the SSCI category. In the ESCI category, there are 277 studies, which make up 10.53% of the total number of 2,630 studies. The share of studies published in other index categories within the total number of studies remained below 10%.

**Table 2**

*Index Distribution of Publishing*

| Index | Number of publications | Percentage (%) |
|---|---|---|
| Science Citation Index Expanded (SCI-EXPANDED) | 1370 | 52.09 |
| Social Sciences Citation Index (SSCI) | 1089 | 41.41 |
| Emerging Sources Citation Index (ESCI) | 277 | 10.53 |
| Conference Proceedings Citation Index–Science (CPCI-S) | 254 | 9.66 |
| Conference Proceedings Citation Index–Social Science & Humanities (CPCI-SSH) | 108 | 4.11 |
| Arts and Humanities Citation Index (A&HCI) | 59 | 2.24 |
| Book Citation Index – Social Sciences & Humanities (BKCI-SSH) | 38 | 1.44 |
| Book Citation Index–Science (BKCI-S) | 21 | 0.80 |
| Current Chemical Reactions (CCR-EXPANDED) | 2 | 0.08 |
| Index Chemicus (IC) | 1 | 0.04 |

Source: Web of Science

When we look at the distribution of published studies on green credits by document type, most studies are of the article type (see Table 3). Of the 2,630 published studies, 83.04% are article-type. Proceding paper-type studies come in second place. However, the number of studies in the proceeding paper type accounts for 12.36% of the total number of studies. According to the document type, the difference between the document types in the first two rows is high. The rate of studies in review articles and early access types is less than 5%, and the rate of studies in other document types is below 2%.

**Table 3**

*Publication Numbers by Document Type*

| The type of document | Number of publications | Percentage (%) |
|---|---|---|
| Article | 2184 | 83.04 |
| Proceeding Paper | 325 | 12.36 |
| Review Article | 116 | 4.41 |
| Early Access | 110 | 4.18 |
| Book Chapters | 46 | 1.75 |
| Editorial Material | 18 | 0.68 |
| News Item | 6 | 0.23 |
| Meeting Abstract | 3 | 0.11 |
| Letter | 3 | 0.11 |
| Book | 2 | 0.08 |
| Note | 2 | 0.08 |
| Book Review | 1 | 0.04 |
| Data paper | 1 | 0.04 |
| Retracted Publication | 1 | 0.04 |

Source: Web of Science

Table 4 reveals that the majority of studies published on green credits use English as their writing language. The number of studies written in English is 2603, and these studies constitute 98.97% of the total studies. Second are works written in Spanish. However, the percentage of studies written in Spanish among the total is less than 1%. Despite the existence of studies in languages like Portuguese, Turkish, French, and Russian, the total number of these studies is less than 7.

**Table 4**

*Number of Publications by Language*

| Language | Number of publications | Percentage (%) |
|---|---|---|
| English | 2603 | 98.97 |
| Spanish | 7 | 0.27 |
| Portuguese | 6 | 0.23 |
| Turkish | 3 | 0.11 |
| French | 3 | 0.11 |
| Russian | 2 | 0.08 |
| Chinese | 2 | 0.08 |
| Czech | 1 | 0.04 |
| Korean | 1 | 0.04 |
| Polish | 1 | 0.04 |
| Latvian | 1 | 0.04 |

Source: Web of Science

Table 5 provides the status of studies published on green credits by country. Given the substantial number of countries publishing on the subject, the table includes the top 10 countries with the highest number of publications. China is the country that publishes the most. China has conducted 989 studies on green credits, accounting for 37.6% of the total studies. The USA, India, and the UK follow China. The publication numbers of these countries are 586, 202, and 191, respectively. France is in tenth place, with 56 studies.

**Table 5**

*Most Broadcast Countries (Top 10)*

| Countries | Number of publications | Percentage (%) |
|---|---|---|
| China | 989 | 37.60 |
| USA | 586 | 22.28 |
| India | 202 | 7.68 |
| England | 191 | 7.26 |
| Australia | 125 | 4.75 |
| Canada | 89 | 3.38 |
| Italy | 82 | 3.12 |
| Germany | 66 | 2.51 |
| South Korea | 64 | 2.43 |
| France | 56 | 2.13 |

Source: Web of Science

One of the important elements of bibliometric analysis is determining the areas on which the studies focus. Table 6 shows the distribution of studies on green credits by Web of Science categories. The table enumerates the top 10 categories where the majority of studies have taken place. Most studies belong to the Environmental Sciences category. Four hundred and sixty-four studies have been published in this category, which is 24.56% of the total studies. Studies in the Green Sustainable Science Technology category come in second. The number of studies in the Green Sustainable Science Technology category is 422, which represents 16.05% of the total studies. There are 380 studies in the Economics category, and 349 in the Environmental Studies category. According to the information in the table, green credit is a common field of study in different scientific categories.

**Table 6**

*Distribution of Publications According to Web of Science Category (Top 10)*

| Web of Science Categories | Number of publications | Percentage (%) |
|---|---|---|
| Environmental Sciences | 646 | 24.56 |
| Green sustainable science technology | 422 | 16.05 |
| Economics | 380 | 14.45 |
| Environmental Studies | 349 | 13.27 |
| Energy Fuels | 277 | 10.53 |
| Business Finance | 236 | 8.97 |
| Engineering Environmental | 182 | 6.92 |
| Management | 113 | 4.30 |
| Engineering Civil | 101 | 3.84 |
| Construction Building Technology | 100 | 3.80 |

Source: Web of Science

We divide the citation information for studies on green credits into two main groups, meso and micro, based on their respective citation topics. Table 7 shows the distribution of citations by "meso" category. When we look at the topics in the top 10, sustainability science is in first place. Management, economics, supply chain, and logistics trail this topic in order. The number of publications is 598 for Sustainability Science, 266 for Management, 220 for Economics, 157 for Supply Chain and Logistics.

**Table 7**

*Citation Topics Meso (Top 10)*

| Citation Topics Meso | Number of publications | Percentage (%) |
|---|---|---|
| 6.115 Sustainability Science | 598 | 22.74 |
| 6.3. Management | 266 | 10.11 |
| 6.10 Economics | 220 | 8.37 |
| 4.84 Supply Chain and Logistics | 157 | 5.97 |
| 3.40 Forestry | 74 | 2.81 |
| 6.153 Climate Change | 68 | 2.59 |
| 4.18 Power Systems and Electric Vehicles | 54 | 2.05 |
| 6.263 Agricultural Policy | 53 | 2.02 |
| 4.61 Artificial Intelligence and Machine Learning | 47 | 1.79 |
| 3.45 Soil Science | 46 | 1.75 |

Source: Web of Science

Table 8 shows the micro-distribution of citations for green credits. The table displays the top 10 citation categories. Accordingly, most references belong to the Environmental Kuznets Curve title. The second most important topic is corporate social responsibility. The number of publications is 259 and 244, respectively. Starting with the fifth topic, the number of publications decreased to less than 100. Farmers are the tenth topic, and there are 32 publications.

**Table 8**

*Citation Topics Micro (Top 10)*

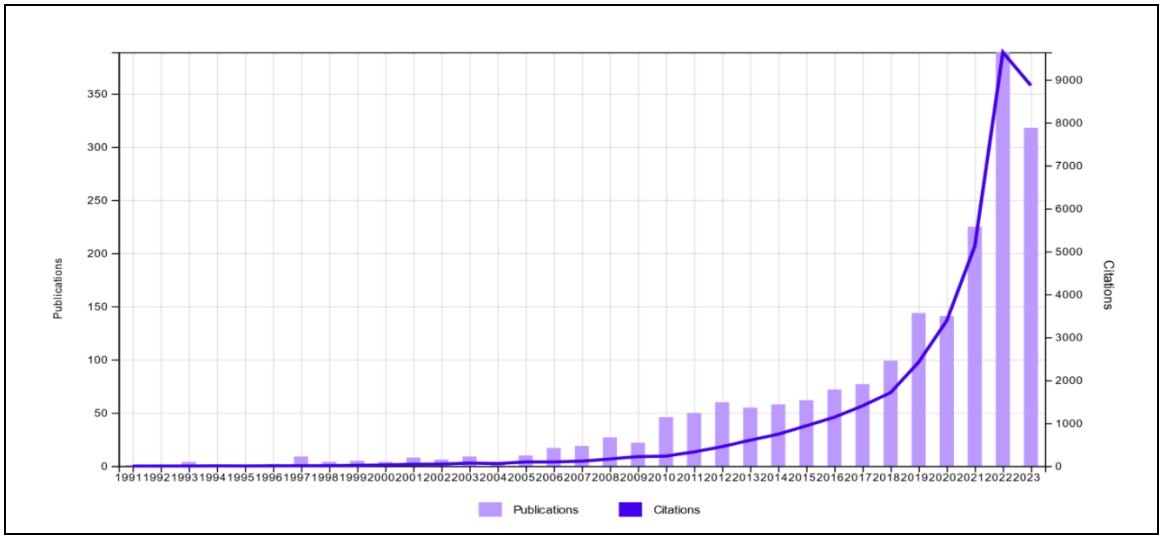
| Citation Topics Micro | Number of publications | Percentage (%) |
|---|---|---|
| 6.115.234 Environmental Kuznets Curve | 259 | 9.85 |
| 6.3.385 Corporate Social Responsibility | 244 | 9.28 |
| 6.115.1181 Life Cycle Assessment | 144 | 5.48 |
| 4.84.260 Supply Chain | 141 | 5.36 |
| 6.10.63 Corporate Governance | 84 | 3.19 |
| 6.115.880 Renewable energy | 64 | 2.43 |
| 6.115.284 Thermal Comfort | 63 | 2.40 |
| 3.40.627 Deforestation | 33 | 1.25 |
| 6.185.2293 Wikipedia | 33 | 1.25 |
| 6.263.898 Farmers | 32 | 1.22 |

Source: Web of Science

Figure 2 shows the number of studies and citations on green credits. Columns represent study numbers, and lines represent citation counts. The number of studies and citations has increased gradually over time. In 2022 and 2023, both study and citation numbers reached their highest values. In 2022, there were 448 studies and 11,233 citations, while in 2023, there were 498 studies and 14,625 citations.

**Figure 2**

*Number of Studies and Citations by Years*




Source: Web of Science

Table 9 lists the 10 studies published on green credits with the highest number of citations. The table also includes the total number of citations of the studies and the annual average number of citations.

**Table 9**

*Top 10 Most Cited Studies*

| Publication | Authors | Publication Year | Total Citation | Annual Average Number of Citations |
|---|---|---|---|---|
| Bioluminescence | Wilson and Hastings | 1998 | 464 | 17.19 |
| Microeconomics of Technology Adoption | Foster and Rosenzweig | 2010 | 459 | 30.60 |
| Giving green to get green? Incentives for and consumer adoption of hybrid vehicle technology | Gallagher and Muehlegger | 2011 | 423 | 30.21 |
| Solar energy: Markets, economics, and policies | Timilsina et al. | 2012 | 400 | 30.77 |
| Demand for green finance: Resolving financing constraints on green innovation in China | Yu et al. | 2021 | 386 | 96.50 |
| Do LEED-certified buildings save energy? Yes, but ... | Newsham et al. | 2009 | 377 | 23.56 |
| Globalization of Amazon soy and beef industries: Opportunities for conservation | Nepstad et al. | 2006 | 343 | 18.05 |
| Building information modeling for Sustainable Design and LEED® Rating Analysis | Azhar et al. | 2011 | 337 | 24.07 |
| How The way to induce private participation in green finance and investment | Taghizadeh-Hesary and Yoshino | 2019 | 333 | 55.50 |
| Green productivity growth in China's industrial economy | Chen and Golley | 2014 | 330 | 30.00 |

Source: Web of Science

According to Table 9, the study with the highest number of citations on green credits is "Bioluminescence" written by Wilson and Hastings (1998). The total number of citations of the study was 464, and the annual average number of citations was 17.19. The second is "Microeconomics of Technology Adoption" by Foster and Rosenzweig (2010). The total number of citations in this study is 459. Even though the total number of citations of the second-ranked study was less than that of the first-ranked study, the annual average number of citations was higher. The total number of citations of the tenth-ranked study was 330, and the annual average number of citations was 30. The name of the tenth study is "Green productivity growth in China's industrial economy" and was written by Chen and Golley (2014).

## 6. Conclusion and Recommendations

Green credits are one of the main financial tools used in achieving sustainable development goals and expanding environmentally friendly production activities. In recent years, the literature on this subject has expanded. Examining the Web of Science database reveals that studies on green credits began in 1980, but their number did not surpass 1 between 1980 and 1990. Even though the number of studies has gradually increased over time, it has gained momentum, especially in 2019 and afterward. In 2022 and 2023, the number of studies will exceed 400. Therefore, green credits are becoming an increasingly popular research area.

More than 80% of the studies are of the article type. In second place are proceeding paper type studies. The number of book chapters is 46, and its share in the total works is below 2%. Articles in the literature on green credits are predominant. In the index distribution of the studies, studies in the SCI-EXPANDED category are in first place. Studies in the SSCI category follow this. The share of studies in the SCI-EXPANDED category studies is 52.09%, whereas this share is 41.41% for studies in the SSCI category. Although there are different languages, such as Spanish, Portuguese, and Turkish, more than 98% of the studies are in English in terms of publication language.

When countries are compared, the country that publishes the most is China. Following China are the United States and India. However, studies involving implementation were mainly carried out on the Chinese example, and Chinese data were used.

Among the Web of Science categories, Environmental Sciences ranks first, while Green Sustainable Science Technology ranks second. Studies in the Economics category are third. Citation categories are presented under two main titles: meso and micro. Sustainability Science is ranked first according to the Citation Topics Meso distribution. The Environmental Kuznets Curve is according to Citation Topics Micro distribution. Along with the increased number of studies, citations also increased over time. The most cited study is the article Bioluminescence, published in 1998. The second most cited study is an article from 2010 called Microeconomics of Technology Adoption. The total citation count for both articles exceeds 450.

Despite the absence of a bibliometric analysis of green credits in the Web of Science database, this study's results bear similarities to bibliometric analyses of green finance. Similar to green finance, the majority of studies on green credit have taken place in China. The top 10 countries with the most green credits are mainly developed countries. Developing countries must also contribute to the relevant literature. These results are similar to those obtained in the studies conducted by Bhatnagar and Sharma (2022), Desalegn and Tangl (2022), Sang (2024), and Zhang et al. (2019).

In this study, we observed that studies on green credits began to increase rapidly, especially after 2010. Malhotra and Thakur (2020) also stated that research on green finance has shown a significant increase in the last 5–10 years. This period corresponds to 2010 and beyond. Moreover, Bhatnagar and Sharma (2022) emphasized that green finance studies increased rapidly in 2010 and thereafter. The results regarding the number of publications are similar to those of Malhotra and Thakur (2020) and Bhatnagar and Sharma (2022).

We used the Web of Science database in this study. Some bibliometric analyses on green finance used Scopus and Google Academic databases. These studies suggested the use of more comprehensive and diverse databases. Due to the use of the Web of Science database, our study differs from the studies conducted by Cai and Guo (2021), Desalegn and Tangl (2022), Malhotra and Thakur (2020), and Mohanty et al. (2023).

This study presents an analysis of the studies conducted so far on green credits and aims to provide guidance for future publications. An attempt has been made to present a review that will help researchers who plan to work on this subject in the future to determine which sources they should examine and from which aspects they should address the subject. However, this study has some limitations. One of these limitations is related to the database. In this study, publications in the Web of Science database were used as the basis. However, studies examining different databases such as, Scopus and Wiley, can also be conducted. Another limitation is related to the literature review. Although numerical information on all studies on the subject has been presented, studies in the field of economics have been discussed in the literature review section. Future research can also focus on different subject categories beyond economics.

Although there is an expanding literature on green credits, empirical studies generally focus on the Chinese example. Future studies, however, can compare the results by examining different countries. This allows the researchers to investigate where the results are similar and where they differ, as well as what factors contribute to these differences in different country samples. This study will provide valuable insights for future research. In order to effectively address the gaps in the existing literature, it is crucial to gain a comprehensive understanding of the relevant studies and how the subject has evolved over time.

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CONFLICT OF INTEREST
The author declares no conflict of interest.

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