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Evaluating Green Economy Strategies Through Multi-Criteria Decision Analysis: A Systematic Review

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ABSTRACT

Green economy transition needs efficient metrics to evaluate the trade-off between environmental, economic, and social objectives. This paper review articles on Multi-Criteria Decision Analysis (MCDA) in green economy strategies published between 2010 and 2025 based on the Dimensions.ai database. After following a designed PRISMA method, 1626 articles were filtered and examined through bibliometric mapping and qualitative analysis. The findings demonstrate that Journal of Cleaner Production, Sustainability, and Renewable and Sustainable Energy Reviews are the most fruitful journals and China and Europe are the countries that present most of the research. AHP, TOPSIS, and hybrid approaches are some of the common MCDA methods which have been used in renewable energy planning, waste management, sustainable transport, supply chain optimization, and policy evaluation. The results suggest that MCDA assists in making the decisions more transparent, participatory, and evidence-based. Nevertheless, there are still difficulties, such as subjective approaches, unreliable information, and insufficient research of the world. All in all, this paper demonstrates the value of MCDA in aiding the green economy approach and suggests more comprehensive, technology-based approaches to procedure in the future.

1. Introduction

Green Economy (GE) is a notion that has been actively discussed over the past twenty years as one of the ways to pursue the Sustainable Development Objectives (SDGs). The GE focuses on low-carbon and socially inclusive growth, unlike the traditional growth models which tend to focus on economic growth at the expense of ecological and social well being. It is concerned with the minimization of environmental risks, alleviation of climate change, the support of renewable energy, the establishment of responsible consumption and production, and the establishment of

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green jobs [1]. Such global organizations like the United Nations Environment Programme (UNEP) and the OECD have pointed out the contribution of GE towards attainment of global sustainability goals.

The Green Economy involves various approaches in multiple fields, such as the use of renewable energy, sustainable transport, waste management, circular economy, and addressing the eco-innovation policy. The analysis of these strategies should be conducted systematically since in many cases, decision-makers have contradictory goals: economic development can be in the rivalry with environmental protection or social justice. An example is in choosing the most sustainable energy technology where there is a trade-off between cost, environment, technological capabilities and the acceptance by people [2]. On the same note, waste management policies should be such that they are efficient in terms of recycling, cost effective and social inclusion.

In the absence of a systematic evaluation framework, governments, industries and stakeholders will run the risk of making decisions which are either biased or short-term based and which are not in line with the sustainability objectives. Multi-Criteria Decision Analysis (MCDA) offers a powerful group of instruments to be used when it is necessary to analyze the alternatives in which a considerable number of and all too many criteria can be evaluated. MCDA is the best tool to use in an assessment of the Green Economy as it enables decision-makers to consider economic, environmental, and social aspects at the same time, unlike the single-criterion approaches. The most common methods including AHP, ANP, TOPSIS, VIKOR, and PROMETHEE, fuzzy methods, and even hybrid ones assist in organizing the problems, weighting of criteria and ranking the alternatives. As an example, renewable energy projects can be prioritized using MCDA, or sustainable transport solutions can be chosen, or the best waste management strategies can be identified. It is a vital methodology in filling the gap that exists between the theory and practice in sustainability evaluation due to its flexibility and adaptability. This study aims to conduct a systematic review of MCDA applications in evaluating Green Economy strategies. The key objectives are:

i. To identify and categorize the various MCDM techniques applied in the context of GE.
ii. To analyze the application domains where these methods are most frequently employed (e.g., energy, waste, transportation, supply chains).
iii. To map the publication trends, leading countries, institutions, and authors contributing to this field.
iv. To examine the strengths, limitations, and methodological gaps in the existing literature.
v. To suggest future research directions that can strengthen the role of MCDA in advancing Green Economy transitions.

By addressing these aspects, the study not only consolidates existing knowledge but also offers a forward-looking perspective to guide policymakers, researchers, and practitioners in effectively utilizing MCDA for sustainable development within the Green Economy paradigm.

1.1 Novelty and Contributions

Compared to other reviews done in past, which concentrate on sectors or individual MCDA techniques, the study is a holistic systematic review that combines bibliometric mapping with a qualitative synthesis to investigate global research trends of 2010 to 2025. It is the only source that integrates quantitative bibliometric knowledge which traces the best journals, authors, and countries with thematic analysis revealing how research has developed and the gaps in research. This is a twofold strategy that adds to the already existing knowledge of how MCDA methods are informing green economy analyses and provides practical advice on how more comprehensive and technological-oriented sustainability approaches can be created in the future.

2. Literature Review

By examining the relationship between green economy studies and Multi- Criteria Decision-Making (MCDM) approaches, this literature review addresses bibliometric trends, methodological use and gaps in the literature to present a complete picture of the current and future development of sustainable decision analysis.

2.1 Past Bibliometric Analysis on green Economy

A summary of the past bibliometric studies on the investigation of the green economy is offered in Table 1, which identifies the most important authors, the aim of the study, and the databases, as well as the key findings. Taken together, these studies demonstrate the development of the green economy literature, thematic areas, and the current tendencies in research in the global areas of sustainability.

Table 1
Summary of past bibliometric analysis on green economy research

No.	Author(s)	Purpose of study	Database used	Key findings
1	Manish and Singh [3]	To analyze the global research landscape, trends, and hotspots in green economy studies and evaluate their evolution and conceptual development.	Web of Science (WoS)	409 documents (2002-2022); 158 publications in the period between 2014-2019; China first in the number of publications; India is 23rd; the key themes are green economy, transition, and energy; tourism is not well researched.
2	Kaur and Negi [4]	To understand the role of inclusive green finance in promoting financial and economic inclusion within the digital economy and fostering green growth.	Dimensions and PubMed	Inclusive green finance plays an important role in green economic development; robust connection between digital financial inclusion and green innovation; China has been found as one of the key contributors.
3	Tran and Khoa [5]	To provide a comprehensive bibliometric overview of research on the circular economy in e-commerce, identifying developments, key themes, and emerging trends.	Scopus	Biblioshiny in R was used to analyze 151 publications (2008-2024); three stages of research and six primary themes, such as circular e-commerce, consumer behavior, and green policies.
4	Fauzi et al., [6]	To review and analyze the literature on green hotels through bibliometric analysis, focusing on environmental sustainability within the tourism industry.	Web of Science (WoS)	Determined key themes in the context of the theory of planned behavior and consumer intention; marked the contribution of green hotels to the marketing of sustainable tourism as an element; mentioned incentives and green marketing as motivation.
5	Apriantoro et al., [7]	To examine the trajectory, scope, and growth of green economy research in Scopus-indexed publications within a sustainable development framework.	Scopus	Analyzed 859 publications; annual growth rate of 17.98%; environmental science had the highest publications in 2022; China and the Chinese Academy of Sciences are leading contributors.

Table 1
Continued

No.	Author(s)	Purpose of study	Database used	Key findings
6	Dar et al., [8]	To provide bibliometric and network analysis insights into the progression of sustainable economic development, focusing on the role of green finance and FinTech integration.	Scopus and Dimensions	Analyzed 665 publications (2015–2023); FinTech enhances green finance effectiveness; study highlights the importance of policy support and investor engagement in sustainable development initiatives.
7	Krastev and Krasteva-Hristova [9]	To explore the evolution, trends, and challenges in green finance research and its role in promoting environmentally friendly investments and sustainable development.	Scopus	Analyzed 436 publications (2016–2024); China, the UK, and Pakistan lead in research output and citations; green finance plays a pivotal role in energy efficiency, renewable energy, and sustainable economic growth.
8	Muhmad et al., [10]	To examine publications on green finance initiatives and renewable energy development, highlighting trends and the role of international collaboration in addressing climate change.	Scopus	Analyzed 128 publications (2010–2023); significant growth in annual publications; China leads in research output, the US also highly active; confirms positive relationship between green finance and renewable energy development.
9	Puspita [11]	To examine the development and trends of green economy research published in leading journals on Islamic financial economics.	Dimensions	Analyzed 1183 publications; highlighted growth in green economy research within Islamic financial economics; text analytics revealed emerging themes and research directions.
10	Zhu et al., [12]	To review and summarize literature on the green economy, highlighting research trends, thematic areas, and global contributions from 2016 to 2022.	Web of Science (WoS)	Analyzed 1,022 publications; green economy research increased significantly since 2016; Asia and Europe are leading regions; future research expected to focus on green economy strategies for climate change mitigation and global economic growth.
11	Mentel et al., [13]	To analyze the size, structure, and dynamics of research on green and renewable energy innovations, identifying main topics, trends, and research gaps over the last decade.	Web of Science	Analyzed 1,144 publications; performance analysis revealed dominant countries, journals, and annual publication trends; science mapping highlighted co-citation, co-occurrence, and bibliographic coupling patterns.
12	Ali et al., [14]	To explore research trends, hotspots, and emerging fronts in green finance and sustainable development across top emerging green economies.	Scopus	Published articles analyzed 2001-2022; China is the largest producer of research; energy efficiency, carbon reduction, regional development, green innovation, and circular economy transitions are the main hotspots.

2.2 Past Literature on Application of MCDM Method on Green Economy

Previous sources of literature on the use of MCDM methods in the green economy focus on systematic methods of determining sustainability criteria. There is research primarily on the

methods of calculating weight and ranking techniques in order to prioritize the green strategies according to the environmental, economic and social performance indices.

2.2.1 Past literature on weight and ranking methods

Previous researchers about weight calculation in MCDM suggest the existence of different methods of allocating the relative weight of criteria in decision-making. Research examines subjective approaches, which rely on expert opinion, and objective approaches, which are based on data characteristics so that the methods come out with accurate and balanced ratings as illustrated in Table 2.

Table 2
Summary of past literature on subjective and objective weighting and ranking method

No.	Author(s)	Purpose of study	Method used	Key findings
1	Wang Chen et al., [15]	To develop a comprehensive fuzzy MCDM approach for green supplier selection, considering both economic and environmental criteria in green supply chain management.	Fuzzy AHP, Fuzzy TOPSIS	The fuzzy AHP effectively determined the importance of economic and environmental criteria; fuzzy TOPSIS successfully evaluated and ranked suppliers; the approach demonstrated applicability and efficiency in supporting environmentally sustainable supplier selection.
2	Si et al., [16]	To evaluate the application of MCDM methods for selecting appropriate green technologies for retrofitting existing buildings, considering multiple environmental, economic, and social criteria.	AHP	AHP was successful in helping to formulate and rank the problems to be solved and the control technologies, like variable speed drive, were on the top of the list when evaluated by the environmental and economic criteria; it was advised to include the social criteria, including the satisfaction of the occupants, in order to have the comprehensive sustainability assessment.
3	Khoshnava et al., [17]	To develop a hybrid MCDM approach to identify and prioritize the most effective green economy (GE) and SDGs variables for implementing sustainable development (SD).	ANP DEMATEL	DEMATEL confirmed that there were key interrelated variables; ANP ranking identified the most influential variables in all the three pillars of environmental; sustainable growth; sustainable development with green economy ranked first in weights.
4	Khoshnava et al., [18]	To examine the influence of green infrastructure (GI) criteria on implementing the green economy (GE) within sustainable development using hybrid MCDM methods.	ANP	ANP prioritized GI criteria for three GE indicators; affordability and resource efficiency had the highest weights (61% and 21%, respectively), showing their critical role in enabling GE implementation

Table 2
Continued

No.	Author(s)	Purpose of study	Method used	Key findings
5	Pham et al., [19]	To establish an indicator system and evaluate the sustainable development level of Hai Phong city from 2010 to 2021 across social, environmental, and economic dimensions.	Delphi	The SDI of Hai Phong rose by 1.033 in 2021 after 0.422 in 2010, recording a relatively sustainable development as of 2020; SDI was hurt by the 2012 economic recession and Covid-19 pandemic in 2019; there are recommendations to improve the integration of policies in terms of the economy, society and environment; approach can be applied to other areas.
6	Rampasso et al., [20]	To identify and analyze critical success factors (CSFs) for bioeconomy development in Brazil, incorporating Life Cycle Assessment (LCA), and propose guidelines and a roadmap for national policies in emerging economies.	Delphi	It has identified seven CSFs with top priorities, such as database, data regionalization, professional training, public policies, public resources, market issues, and case reporting; proposed guidelines and roadmap offer practical development strategies of sustainable bioeconomy, study overcomes gaps in the LCA-bioeconomy research in developing economies.
7	Stević et al., [21]	To develop a novel rough–fuzzy MCDM model for evaluating sustainable production in forestry firms in the Eastern Black Sea Region, contributing to circular economy objectives.	PIPRECIA MARCOS	Fourth alternative ranked as the best; sensitivity analysis confirmed robustness; comparison with other methods demonstrated applicability and effectiveness; novel Rough PIPRECIA–Fuzzy MARCOS integration highlights methodological contribution.
8	Karbassi Yazdi et al., [22]	To identify the best locations for constructing green energy facilities in India and support CO_2 emission reduction, aligning with national renewable energy targets and global sustainability goals.	FF-WASPAS MEREC	The location of NP Kunta in Andhra Pradesh was chosen as the most appropriate location out of the 11 sites; political strategies and objectives were the top priority variables, and the hybrid MCDA model proved to be highly accurate and delivered actionable implications on the green energy planning and policy development in India.
9	Ali et al., [23]	To investigate the contribution of Multi-Criteria Decision-Making (MCDM) methods in advancing circular economy initiatives through a systematic review and bibliometric analysis.	AHP–TOPSIS	MCDM is progressively being applied to strike a balance between energy, cost, environmental and social considerations in the evaluation of a circular economy; combinations of AHP-TOPSIS are standardized, yet there is no agreed pattern of choice; the most important drivers of circular economy implementation were found to be financial.

Table 2
Continued

No.	Author(s)	Purpose of study	Method used	Key findings
10	Fedajev [24]	To conduct a comparative analysis of Balkan countries' sustainable competitiveness in 2020 and 2023, evaluating strengths and weaknesses across multiple development dimensions and deriving policy implications post-pandemic.	Entropy-based PROMETHEE	There were considerable changes in rankings between 2020 and 2023; Croatia retained the leading place; other nations had significant changes in the advantages and disadvantages; results demonstrate how pandemic recovery policies influence sustainable competitiveness and inform specific recommendations on the policies.
11	Fang [25]	To evaluate urban green economy development competitiveness by analyzing multiple dimensions such as resource efficiency, renewable energy, environmental policies, innovation capacity, and green technology development, supporting effective policy formulation and sustainable urban growth.	TODIM–VIKOR	The suggested 2TLNN-LogTODIM-VIKOR approach is efficient to assess the competitiveness of the urban green economy; offer clear understanding about the city assets and liabilities; assist in making policy, investment and sustainable urban development policies.
12	Sun [26]	To evaluate regional ecological environment quality and circular economy development, addressing local environmental problems, national ecological policy goals, and sustainable socio-economic development.	ENTROPY GIS	The suggested evaluation system successfully incorporates the environment, resource, and economic aspects; offers a unified approach to the evaluation of the circular economy development and the quality of ecological environment in a region; supports the decision-making process related to sustainable development of the region.
13	Wang et al., [27]	To develop a comprehensive measurement system for regional green economy development and evaluate sustainable development trends and subsystem coordination in Shandong Province.	ENTROPY TOPSIS	The model accurately reflected Shandong Province's green economy development from 2010–2016; identified how different indicators influence sustainable development; demonstrated strong practicability and addressed gaps in regional green economy assessment.
14	Eşiyok et al., [28]	To determine and compare the environmental performance rankings of G7 countries and Turkey using the Global Green Growth Index (GGGI) from 2010–2020, contributing to sustainable development insights.	CRITIC ,ENTROPY EDAS	Germany was the best country in terms of environmental performance whereas Turkey scored lower than the developed nations. The most significant criterion that had an impact on rankings was found to be efficient and sustainable use of resources.
15	Rađenović and Rajić [29]	To evaluate and rank EU27 countries based on circular economy performance indicators, providing insights into the effectiveness of circular economy initiatives.	MCDM	Among EU27 members, Lithuania became the best-performing country in circular economy. The paper makes a case on the applicability of MCDM in combining numerous indicators in the evaluation of overall performance.

2.3 Novelty and Research Gap of the presented study

2.3.1 Research gap

Although the number of studies on green economy strategies has increased, the majority of literature researches are on a specific sector or on separate indicators, including environmental impact, economic growth or social development. There are limited all-inclusive assessments of more than one criterion in the economic, environmental, and social perspective. Moreover, even though Multi-Criteria Decision Making (MCDM) methods are becoming more widely used, there is a lack of systematic reviews that summarize their applications, which determine the methodological tendencies, and the effectiveness of their use in supporting policy and strategic decision-making related to the green economy. Moreover, most of the literature is based on using one MCDM method and does not consider hybrid or integrated methods that can enhance precision and effectiveness.

2.3.2 Novelty of the study

This paper is a systematic review of how MCDM methods are used in the determination of green economy strategies that offer a comprehensive and systematic review of the literature that exists. It determines the most popular MCDM methods, critical criteria used, and gaps in the methodology, providing an understanding of the new trends and the best practice. The research paper also highlights the possibility of the hybrid MCDM approaches in improving the decision-making in the green economy strategy formulation. This work helps to fill in gaps in the fragmented research and points to the underrepresented areas and bring a more holistic picture of evaluating the green economy, as well as a roadmap to future studies and practice.

3. Methodology

The present research is based on a systematic review method to analyze the current research trends, methodology, and practical usage of Multi-Criteria Decision Analysis (MCDA) in references to Green Economy (GE) strategies. The review model will combine the bibliometric mapping and qualitative synthesis to guarantee an adequate examination of literature published within the period of 2010 and 2025. Table 3 presents an overall illustration of the research methodology in terms of the workflow.

3.1 Database Selection and Search Parameters

The search terms to be utilized are on different elements of the topic including the nature of search query, and search ethnicity. The bibliographic data were mainly obtained by using the Dimensions.ai database since it was selected due to its broad scope of peer reviewed journal articles, conference papers and grey literature. To achieve the inclusion of all the pertinent researches, the following Boolean query was utilized in the title, abstract, and key word fields: “green economy (OR) circular economy) and (Multi-criteria Decision Making (OR) MCDM (OR) MCDA (OR) Multi-criteria Decision Analysis”. The search limit was set to January 2010 - June 2025 so that the recent and the foundations of applying MCDA to green economy evaluation could be included. The first search resulted in 1,626 documents.

3.2 Inclusion and Exclusion Criteria

The documents retrieved were filtered based on predetermined parameters to ensure that the dataset remained adequate and relevant. Inclusion Criteria includes english written publications, journal articles that are peer-reviewed, literature on the explicit application of MCDA or MCDM to

the situation of green or circular economy strategies, and research in sustainability related industries, including renewable energy, waste management, transport, supply chain or policy assessment. Exclusion Criteria include non-english articles, abstracts of conferences, book chapters, editorials and review notes, and proceedings that do not refer to the theme of the green economy or lack the use of MCDA methodologically. Duplicate records upon intense screening, 1626 articles were narrowed down to be used in a bibliometric and qualitative analysis.

3.3 Extraction and Analytical Tools of Data

A systematic data retrieval template was also created to provide bibliographic data including author, year of publication, country, journal title, number of citations, and methodology. Two significant methods of analysis were used:

i. Bibliometric Analysis: This was carried out with VOSviewer and entailed representation of the patterns of publications, co-occurrence of keywords, citation relations and identification of top authors, institutions, countries and journals involved in MCDA-GE research.
ii. Qualitative Content Analysis: Narrative synthesis was conducted to analyze methodological applications, strengths, and limitations and contextual information based on the selected case studies.

This combination guaranteed both the quantitative and qualitative analysis of how MCDA can be applied to sustainable decision-making in the green economy environment.

Table 3
Integrated Methodology Workflow for Systematic Review of MCDA in Green Economy

Step	Objective	Method/Tool	Outcome
1. Database selection	Identify relevant literature	Dimensions.ai	Comprehensive dataset of peer-reviewed journals, conference papers, and grey literature
2. Search strategy	Retrieve relevant studies	Boolean search: ("Green Economy") AND ("Multi-Criteria Decision Making")	Initial set of publications across 2010–2025
3. Inclusion/ exclusion criteria	Filter relevant studies	Inclusion: English, peer-reviewed article, MCDA applied to green/circular economy; Exclusion: chapters, conferences, non-English, editorials, duplicates	Final set of eligible publications (1626)
4. Data extraction	Capture bibliographic and methodological info	Structured template	Extracted fields: year, journal, country, methodology, application area
5. Bibliometric analysis	Map research trends and intellectual structure	VOSviewer	Publication trends, citation networks, Top Researchers, top country, Top 10 articles
6. Qualitative analysis	Evaluate methodological use and case applications	Narrative synthesis	Strengths/limitations of MCDA methods, case study insights, identification of research gaps

4. Bibliometric Result and Analysis

The analysis and bibliometric result are the measures of the quantitative overview of the research trends, productivity, and impact in a particular sphere. Through the analysis of publications, referencing, authors, and sources, it determines the impactful research, the top journals, and the new issues. Such a strategy can be used to map knowledge structures, identify gaps in the research, and learn how scholarship has developed. It provides information on the most productive authors, countries, institutions, essential methodological and thematic trends, on which future research directions and policy-making decisions are made.

4.1 Publication, Research Publications by Field, Citation Trends in MCDA Green Economy

The review of the publications published in 2010-2025 shows that there is a definite increasing tendency in the research on green economy strategies and MCDM application [30, 31]. The first (2010-2013) and the second (2014-2017) phases of development were followed by the gradual increase (2018-2020). Since 2021, the growth is exponential, indicating the overall high level of interest worldwide, the growing number of funds, and implementation of decision-making systems such as TOPSIS, AHP, and VIKOR. This trend shows that there has been a change in exploratory research to the applied evaluations with a well-built literature base after the year 2019, which means that there are prospects of comparative analysis and systematic reviews of this field as depicted by Figure 1.

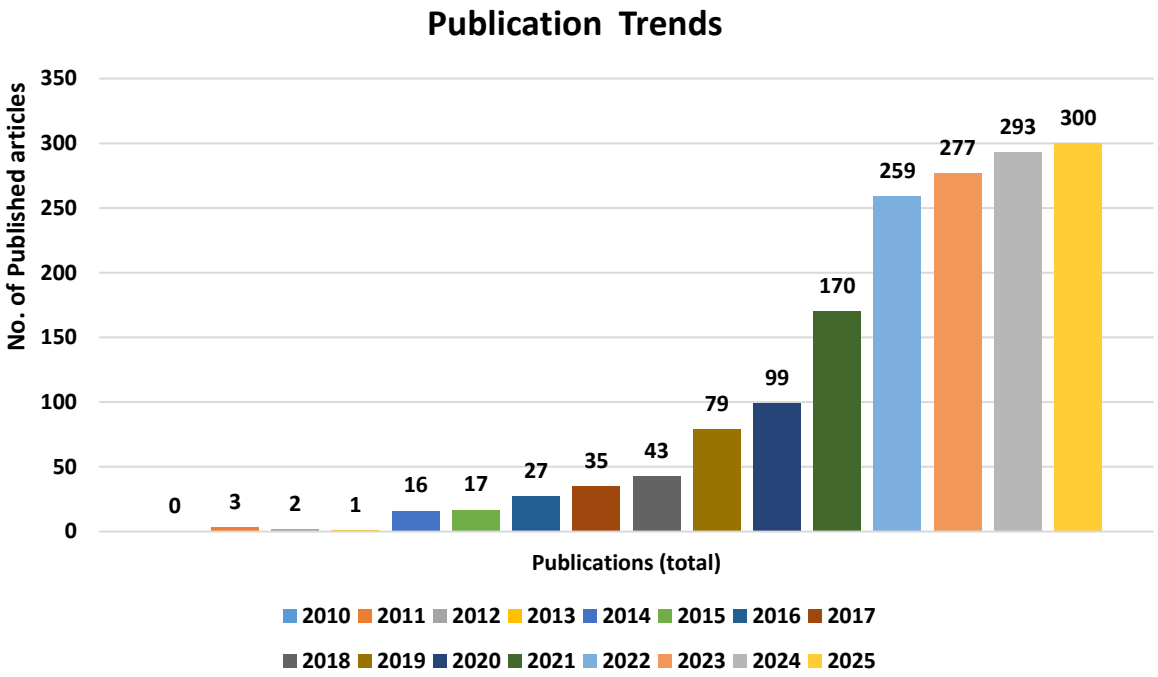

Fig. 1. Annual Publication Trends in Green Economy and MCDM Research (2010–2025)

The involvement of the research fields based on ANZSRC 2020 shows that the research involving the strategy of green economy and MCDM applications is largely limited to the field of Engineering (430 publications), Commerce, Management, Tourism and Services (331), and Environmental Sciences (282) as illustrated in Figure 2. The best areas of research reveal that the focus of research in assessing sustainable practices is the technical solutions, strategic

management methods, and even the environmental factors. The Built Environment and Design (275) and Human Society (243) are also particularly influential showing the interdisciplinary essence of green economy studies that combine the urban planning, the impact on the society and the policy frameworks. Information and Computing Sciences (242), Economics (197), and Earth Sciences (88) also have other contributions of note, featuring data-driven modeling, economic analysis, and resource assessment aspects in multi-criteria decision-making applications. Biological, Physical, and Chemical Sciences together with Law, Health, and Humanities are also less represented which may indicate the opportunities to enhance cross-disciplinary options of systematic reviews of the green economy strategies.

The data trend in citation between 2010 and 2025 shows a growth curve, which indicates the growing scholarly acknowledgment of the study on the strategy of the green economy and the use of multi-criteria decision-making (MCDM) models. The first years (2010-2014) provide little citation (0-17), which shows underlying researches with low exposure. Citations increased exponentially between 2015 and 2018, with 55 to 674, indicating that the research in the field started gaining momentum and importance in the field of sustainability, environmental management, and policy-based research.

Since 2019, the citations have increased exponentially with its highest in 2024 (11,109) followed by a slight fall in 2025. This growth rate underscores the rise of MCDM-based methods in assessing green economy strategies and the increase in the significance of the systematic review to pool and synthesize these studies. The trend indicates the maturation and world interest in this research area demonstrated in Figure 3.

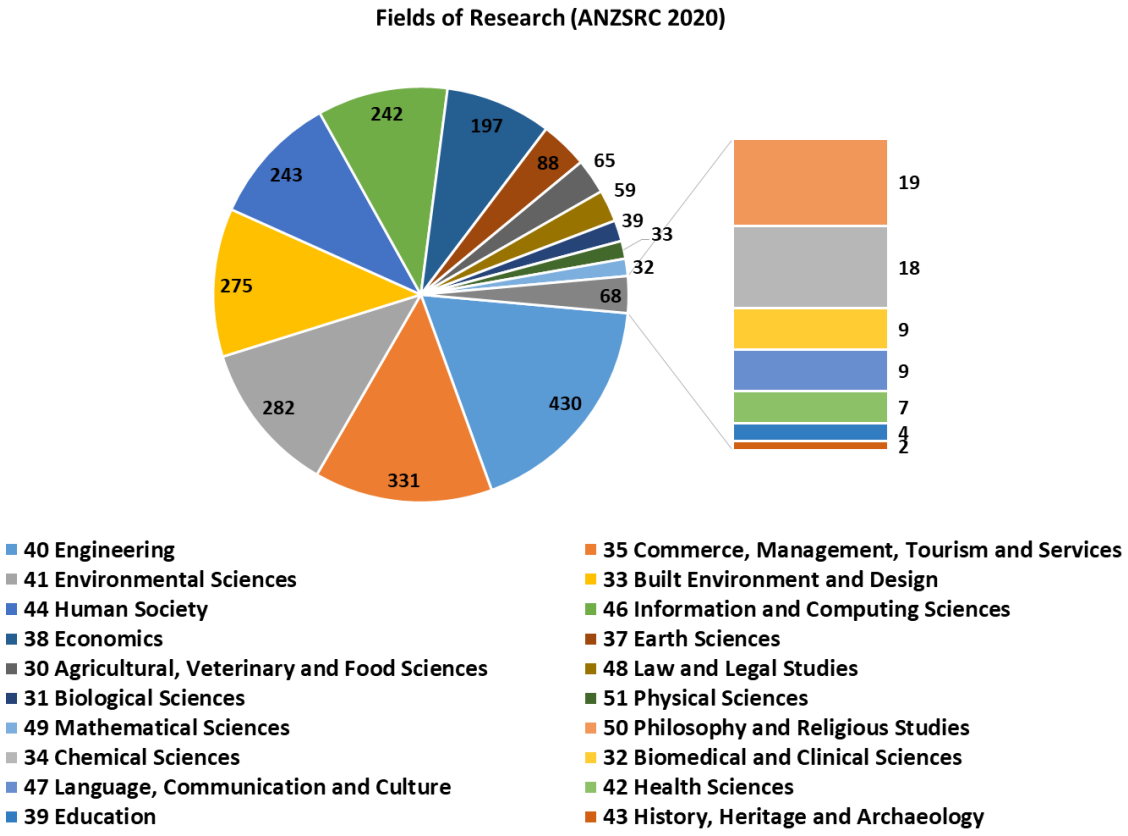

Fig. 2. Distribution of research publications by field (ANZSRC 2020) in green economy and MCDM studies

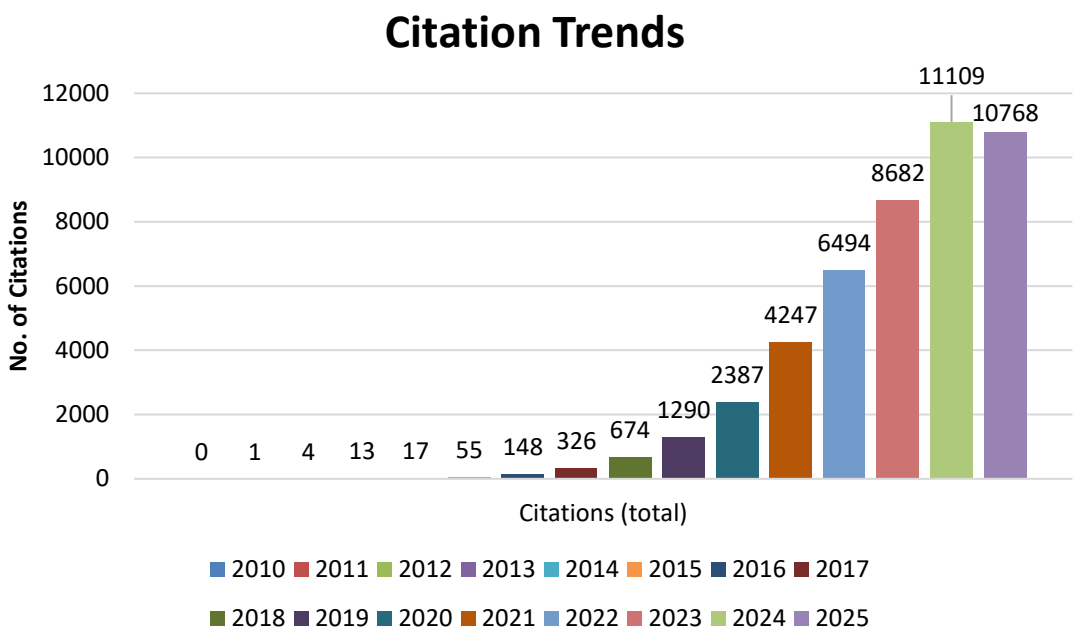

Fig. 3. Annual citation trends for green economy and MCDM research (2010–2025)

4.1 Co-authorship Analysis

The analysis of the co-authorship indicates that there is a robust research network of the major researchers working in intersection of green economy strategies and the multi-criteria decision-making (MCDM) [32]. Pamucar Dragan has 16 publications and 400 citation points so far, which shows his active participation in the sphere of methodological development. The most influential contributors are Luthra, Sunil (11, 1244 citations), Mangla, Sachin Kumar (7, 1125) and Govindan, Kannan (6, 784), as they have played major roles in the integration of sustainability, supply chain management and MCDM frameworks as depicted in Figure 4.

Other influential writers like Gupta, Himanshu (9, 701), Mardani, Abbas (8, 770), and Phan, Thi Thu Hien (5, 567) have high citation effects, and this indicates a worldwide cooperation among different regions. The network has been showing increasing interdisciplinarity in the sense that, it connects engineering, environmental science, and management fields to facilitate better decision making in the assessment of strategies in sustainable and green economies.

Fig. 4. Co-authorship network and citation impact of leading authors in green economy and MCDM research

The country-specific analysis of the bibliometric assessment indicates that the studies on green economy strategies and MCDM applications are distributed all over the world as Figure 5 demonstrates, with China being the frontrunner with 442 documents and 12, 280 citations, then India (155, 6691) and the United Kingdom (116, 4968). Such nations are highly productive in academic research and international cooperation in sustainability and decision-making. The other significant stakeholders are Italy, Turkey, Iran, and the United States, and they represent the growing interest of the developed and emergent economies in adopting MCDM methods in green policy evaluation.

It is important to note that the investment in Asia and Middle East is growing, and countries like Malaysia, Spain, Taiwan, and Saudi Arabia are also characterized by high levels of engagement. European nations, such as Poland, Greece, and Lithuania make their contributions in terms of collective and methodological improvements. The extensive international spread of the geographic area highlights the international research network that devotes its attention to the global sustainability challenges through the multi-criteria decision analysis.

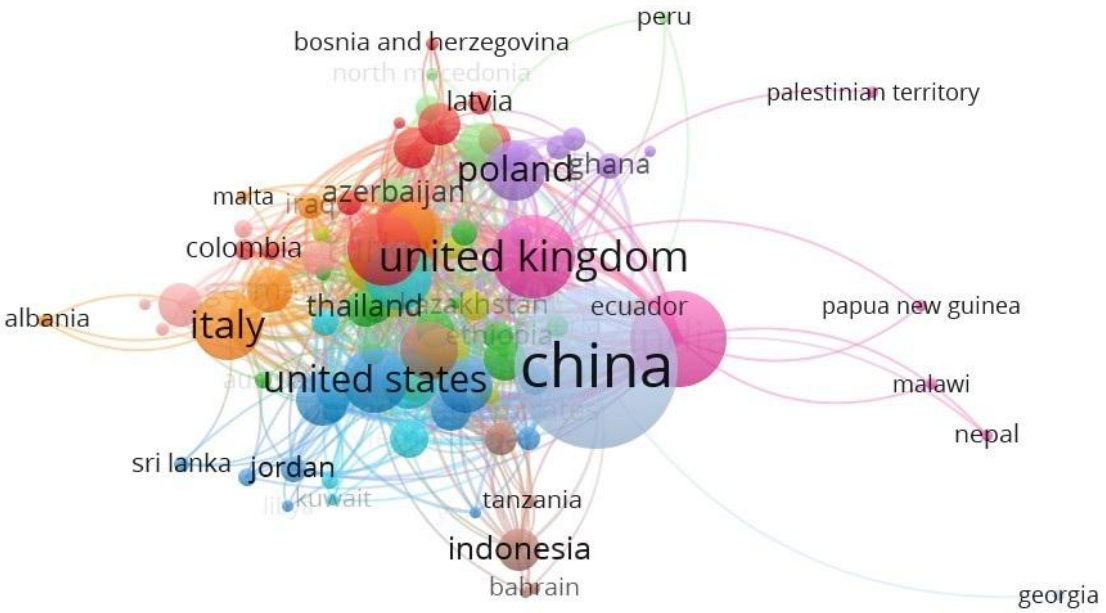

Fig. 5. Country-wise distribution of publications and citations in green economy and MCDM research (2010–2025)

The organizational co-authorship analysis brings out the fact that major academic institutions in Asia and Europe are promoting research on green economy strategies and multi-criteria decision-making (MCDM) as indicated in Figure 6. Some of the most productive contributors are University of Belgrade (18 documents, 360 citations), Sichuan University (17,428), and University of Tehran (16,308). The high-impact institutions that include University of Technology Malaysia (11,1038), the Graphic Era University (11,765), and Sapienza University of Rome (9, 668) have great influence and international collaboration in the research on sustainability. King Abdulaziz University (9, 919), University of Economics Ho Chi Minh City (9,833) and University of Southern Denmark (7,846) are other essential contributors with different geographical representation. All these institutions focus on interdisciplinary cooperation, which is the integration of engineering and management and environmental sciences to help develop systematic and data-driven assessments of green economy strategies, but MCDM methods.

Fig. 6. Organizational co-authorship network of leading institutions contributing

4.2 Citation Analysis

A citation analysis is an essential part of bibliometric research, which can be applied to determine the influence and impact of a research on a specific field. Document analysis allows the investigators to define the most referred articles, discover significant contributions, and point out the influential authors. This is also supplemented by source analysis in terms of analyzing journals and publication outlets to identify the most productive and the most highly cited sources. Collectively, the analyses present an in-depth insight into knowledge sharing, research patterns, and the most popular journals that advance the field in a particular area [33]. This Figure 7 shows the most-cited documents obtained out of the bibliometric dataset. The review identifies the visible influences and the strong research works that are impacting the future of research into the field of sustainability and the field of circular economy.

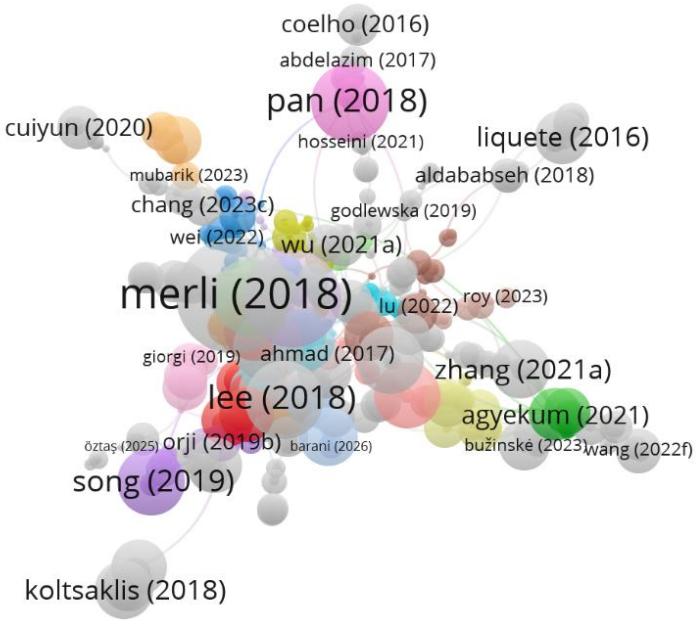

Fig. 7. Citation analysis of document types on green economy strategies

The citation analysis of the top ten most influential documents in the field of Green Economy Strategies MCDA is a holistic approach to the intellectual structure and significant contributions to the given domain as presented in Table 4.

Table 4
Citation analysis of the top 10 most influential documents

Author	Citations	Paper Title	Major Contributions
Merli [34]	1067	How do scholars approach the circular economy? A systematic literature review	Provides a systematic review of Circular Economy (CE) research; identifies macro, meso, and micro levels of CE implementation; emphasizes cleaner production and sustainability integration.
Kamble [35]	773	Achieving sustainable performance in a data-driven agriculture supply chain: A review for research and applications	Explores IoT, blockchain, and big data in sustainable agriculture; proposes a data-driven agri-supply chain framework linking technology and sustainability.
Lee [36]	497	Comparative analysis of MCDM methods for ranking renewable energy sources in Taiwan	Compares MCDM methods (WSM, VIKOR, TOPSIS, ELECTRE) for renewable energy ranking; provides sensitivity analysis for energy policy design.
Pan [37]	495	Advances and challenges in sustainable tourism toward a green economy	Reviews sustainable tourism strategies through green energy, infrastructure, and technology; aligns tourism with green economy principles.
Nizami [38]	480	Waste biorefineries: Enabling circular economies in developing countries	Proposes waste biorefineries as sustainable solutions for waste-to-energy and resource recovery; emphasizes LCA-based evaluation.
Moktadir [39]	409	Drivers to sustainable manufacturing practices and circular economy: A perspective of leather industries in Bangladesh	Identifies and ranks sustainability drivers using graph theory; focuses on circular economy integration in manufacturing.
Song [40]	373	Technological challenges of green innovation and sustainable resource management with large scale data	Discusses big data applications for sustainability; explores environmental pollution, green innovation, and data-driven resource management.
Chen [41]	364	Effects of the entropy weight on TOPSIS	Enhances classical TOPSIS by adjusting entropy weighting; improves robustness of MCDM evaluations.
Olabi [42]	359	Assessment of the pre-combustion carbon capture contribution into SDGs using novel indicators	Evaluates carbon capture technologies and their alignment with UN SDGs; introduces 87 sustainability indicators.
Gupta [43]	321	Industry 4.0, cleaner production, and circular economy: An integrative framework for evaluating ethical and sustainable business performance	Integrates Industry 4.0, cleaner production, and CE using MCDM and BWM; provides framework for sustainability assessment.

The analysis of the sources shows that the Journal of Cleaner Production is the most popular publication platform, as it contains the highest number of documents (84) with the most citation (7268), which can be seen as the dominance of the sustainability and green economy research. The next one is Sustainability with 168 documents and 3759 citations that demonstrates its broad focus and multidisciplinary approach to environmental management and policy as presented in Figure 8.

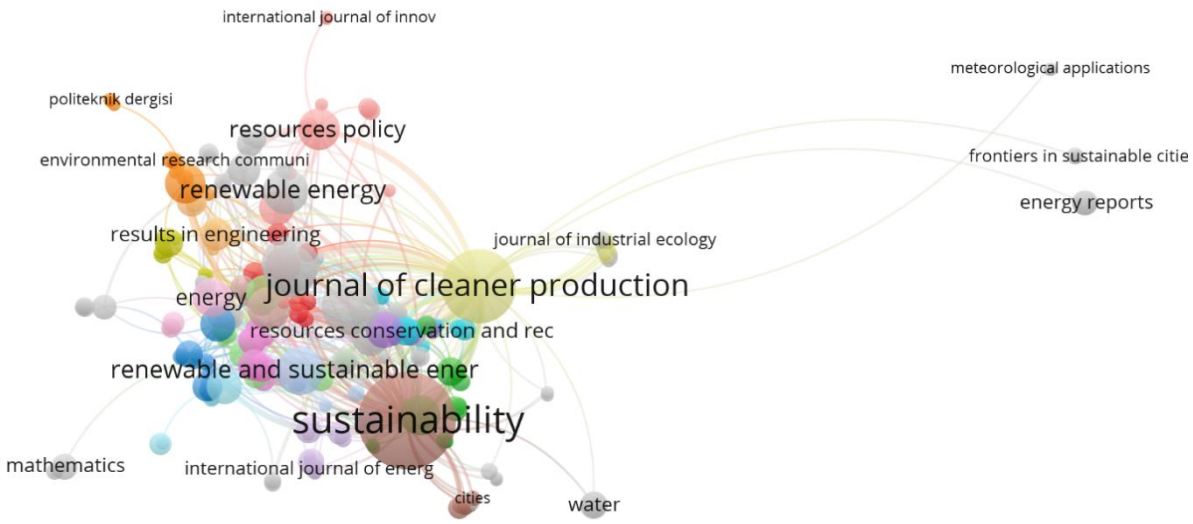

Fig. 8. Source-wise citation analysis of journals in green economy and MCDA research

The analysis of the source of the top 10 journals brings out the most active sites of publication in terms of research on assessing green economy strategies using Multi-Criteria Decision Analysis (MCDA) as indicated in Table 5. The Journal of Cleaner Production is the most dominant publication in terms of sustainability and environmental studies with a total of 84 publications and 7268 citations. Its CiteScore is very high (20.7) and the impact factor is 10 (2025) which depicts its great academic impact and worldwide applicability. The next one is Renewable and Sustainable Energy Reviews which has 28 publications and 2342 citations and the highest CiteScore (38.0) and impact factor (16.3) among all the listed journals, making it the most influential in terms of scholarly impact.

Table 5
Top 10 most productive and highly cited sources

Rank	Source	Documents	Citations	CiteScore 2025	Quartile	Impact Factor (2025)	Publisher	SNIP	SJR	h-Index
1	Journal of Cleaner Production	84	7268	20.7	Q1	10	Elsevier	2.231	2.174	354
2	Sustainability	168	3759	7.7	Q1	3.3	MDPI	1.113	0.688	207
3	Renewable and Sustainable Energy Reviews	28	2342	38.0	Q1	16.3	Elsevier	4.077	3.901	464
4	Renewable Energy	25	1214	17.6	Q1	9.1	Elsevier	2.035	2.08	270
5	Environmental Science and Pollution Research	45	1146	10.6	Q1	5.8	Springer	1.084	1.044	212
6	The Science of the Total Environment	13	1140	16.4	Q1	8.0	Elsevier	1.835	2.137	339

Table 5
Continued

7	International Journal of Production Economics	3	1055	20.2	Q1	10.0	Elsevier	2.668	2.833	248
8	Energies	44	866	7.3	Q1	3.2	MDPI	1.027	0.713	175
9	Sustainable Cities and Society	18	807	22.4	Q1	12.0	Elsevier	2.509	2.869	156
10	Journal of Environmental Management	21	741	14.4	Q1	8.4	Elsevier	1.79	1.994	268

Sustainability by MDPI meets the criteria of impact factor with a moderate level of 3.3, however, it is leading in the number of publications (168), which indicates its extensive scope and the possibility of interdisciplinary research publication. Renewable Energy, Environmental Science and Pollution Research, and The Science of the Total Environment are also playing a significant role in bridging renewable technologies and environmental management as well. Their impact factors of 5.8 to 9.1 show high level of scientific validity in enhancing research in sustainable development. In general, Elsevier has the highest number of journals with 7 of the 10 top ranking journals and the next two are MDPI and Springer. This discussion suggests that, high-impact and Q1-ranked journals will be the center of knowledge development in the field of MCDA-based research on green economy to provide high-quality and high-visibility in the sphere of worldwide academic activity.

5. Qualitative Analysis

The qualitative analysis will give a detailed insight into the application of the Multi-Criteria Decision Analysis (MCDA) methods in assessing and optimization of green economy strategies in various sectors. Although the bibliometric information displays the trends of research and case of citations, this section will focus on the diverse methodology, case use, the strength, and the limitations that have been established in the literature reviewed.

5.1 Methodological Evaluation

MCDA is one of the ways of solving the issues of sustainable development, especially in relation to the green economy. The MCDA methodology allows the evaluation of options over several (often contradictory) criteria by using the analysis to make better choices in areas including renewable energy, waste management, urban development, and policy development [44]. A wide variety of MCDA methods have been used to rank options in these areas; the five most applied include AHP, TOPSIS, VIKOR, PROMETHEE, and DEMATEL [45,46]. For example, AHP is an orderly process that breaks down complex decisions into hierarchical layers, and it can be used to create the relative weights of the criteria and options through a series of pairwise comparisons. On the other hand, TOPSIS evaluates the options based upon how close they are to the ideal solution and far away from the negative-ideal solution. These methods are popular because of their ease of use, adaptability, and ability to evaluate both quantitative and qualitative information. Since green economy initiatives typically involve many different types of data, this is a major advantage.

In recent years there has been a growing body of literature that emphasizes the combination of hybrid MCDA methodologies to improve decision-making effectiveness and diminish the

subjectivity associated with distributing weights in multi-criteria evaluations [47-48]. Examples of these hybrid methodologies include AHP-TOPSIS; this hybridization provides researchers with the opportunity to capitalize upon the advantages of each methodology (AHP can provide structural support to problem-solving and obtain criterion weights, while TOPSIS can provide an unambiguous ranking method). In addition, fuzzy logic and entropy weighting methodologies have proven to be successful in dealing with the uncertainty that typically exists when utilizing large amounts of complex environmental data. Fuzzy logic is successful at modeling uncertain or subjective information that is typically expressed using linguistic terms. In many cases, environmental data used in sustainability evaluations may be qualitative in nature, incomplete or both [49]. Entropy weighting is successful at determining criterion weights objectively by calculating the degree of dispersion of the data, thereby minimizing the influence of subjective opinion [26].

MCDA methods are crucial within renewable energy for determining Hybrid Renewable Energy Systems (HRES), which incorporate net present cost, operating cost, and renewability fraction, and they have been used in short-term energy yield forecasting of photovoltaic systems [50], and in multi-stage stochastic programming for hydrogen fuelling stations [51]. Additionally, MCDA has been utilized in evaluating sustainable energy consumption in industrial sectors across various countries [27] and in the assessment of energy systems using fuzzy AHP, fuzzy VIKOR, and TOPSIS to manage non-cooperative opinions [52].

MCDA methods have also been employed in the assessment of raw material efficiency and waste management practices in industry using methods such as VIKOR and TOPSIS [53]. Sustainable waste valorization process selection is another application of MCDA that involves the combination of AHP with advanced Interval Valued Fermatean Fuzzy sets and CODAS [48]. This research demonstrates an overarching framework for selecting sustainable waste valorization processes based on economic, environmental, technological, and social-governance criteria, utilizing AHP-IVFFS and CODAS. DEMATEL is also applied to optimize maintenance of waste-to-energy plants [54].

MCDA also supports decision making in sustainable drainage system design alternatives through the integration of indicators such as resilience, hydraulic performance, pollution control, and energy analysis, utilizing entropy weight and TOPSIS [55]. Fuzzy MCDA methods have also been used in the selection of electric vehicles for sustainable transportation [56]. In addition, carbon audits in industries like iron and steel enterprises utilize evaluation systems derived from carbon audit theory and the driving force-state-response (DSR) model, aligning with sustainability objectives [57].

Collectively, MCDA methodologies, especially when hybridized and enhanced with fuzzy logic or entropy weighting, offer robust tools for traversing the complex decision landscapes of the green economy. Moreover, these methodologies support a systematic evaluation of sustainability initiatives through the integration of multiple and disparate criteria and the mitigation of uncertainty, leading to increased effectiveness and sustainability in decision-making outcomes.

5.2 Case Study Insights

As empirical applications demonstrate, Multi-Criteria Decision Analysis (MCDA) has been a staple in the assessment and implementation of green economy strategies in a wide variety of sectors. Techniques like AHP (Analytic Hierarchy Process) and TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) are so popular in renewable energy planning to evaluate alternatives in terms of such factors as economic cost, carbon emission reduction, energy

efficiency, land use impact, and social acceptance. Some of the sub-criteria of these dimensions are initial investment, cost of operation and maintenance, rate of CO2 reduction, renewability, and popular opinion. As an example, these criteria have been used in comparing the solar, wind, hydro, and biomass projects to determine the most sustainable energy mix that can be used in a region. Equally, in sustainable transport, MCDA models have been applied to rank the available modes of transport based on fuel consumption, infrastructure cost, air quality effect, the travel time and noise pollution in favor of low-carbon urban mobility planning.

MCDA has led policy-makers and industrial bodies in the field of circular economy and industrial sustainability and informed them on the strategies to implement to recycle waste and reuse resources and manage green supply chains. Sustainable production practices are regularly measured by using criteria that include: material recyclability, energy recovery efficiency, economic feasibility, social inclusiveness, and technological maturity. The evaluation process is narrowed down to sub-criteria such as level of waste segregation, optimization of the logistics and the creation of local employment. Moreover, the MCDA models that are based on fuzzy logic have also improved the decision-making during uncertainty, especially in evaluating the policy options and environmental governance structures. Taken together, the case studies show the flexibility and analytical rigor of MCDA in terms of combining environmental, social, and economic goals. It is not only able to promote evidence-based decision-making but also balance trade-offs between competing sustainability objectives, therefore, promoting a more holistic and data-driven way of achieving the transition to the green economy.

5.3 Strengths and Limitations

The main advantages of MCDA are that it is systematic, transparent, and flexible enough to accommodate various sustainability indicators. It empowers the policymakers and researchers to coordinate various objectives and preferences of the stakeholders during decision making. Nevertheless, there still exist constraints especially in subjectivity of expert judgement, inconsistent weighting processes and lack of integration with dynamic modelling packages such as artificial intelligence and system dynamics. The second discrepancy is also the lack of focus on social equity indicators that prevents overall sustainability evaluations.

5.4 Emerging Research Gaps and Future Directions

The future studies should be concerned with the development of standardized MCDA frameworks of green economy evaluation to be able to address uncertainty, dynamic policy environment, and integration across disciplines. It is also suggested in the synthesis that MCDA should be used with machine learning, and big data analytics to increase predictive accuracy and responsiveness. More cross-country comparative studies are also required to determine the effects of MCDA-based decisions on the sustainability changes in countries and green policy success.

6. Conclusion

This systematic review proves that Multi-Criteria Decision Analysis (MCDA) is a powerful and multifaceted technique to assess the strategies of the green economy in various sectors. MCDA can be used to support decision-making processes by policymakers, researchers, and practitioners by integrating environmental, economic, and social criteria to enable them to cope with complex sustainability issues. The review identifies that hybrid MCDA methods, including AHP-TOPSIS, Fuzzy ANP, and VIKOR are popular in such fields as selection of renewable energy, sustainable city

development, circular economy, and formulation of eco-policies where more informed trade-offs can be made between conflicting goals.

The bibliometric analysis performed in the research gives additional information on the research field of green economy and MCDA applications. It marks the most prolific journals, powerful publications, and presiding power authors, demonstrating that such areas as Journal of Cleaner Production, Renewable and Sustainable Energy Reviews, and Sustainability are the most discussed in the academic world. The trends in citations and publication patterns indicate the rise in the use of MCDA techniques in the evidence-based decision-making related to sustainability and the trend of increased interdisciplinarity in the research connecting industrial ecology, renewable energy, and the practice of circular economy.

Taken together, the results suggest that, MCDA will not only facilitate the overall sustainability assessment, but also enhance transparency and repeatability of the decision-making process. Further studies ought to work on combining MCDA with new technologies such as artificial intelligence, big data analytics, and life cycle assessment and improve participatory techniques that would include the views of stakeholders.

To sum up, the analyses made using both bibliometric and qualitative approaches confirm that MCDA is an effective decision-support model to facilitate green economy processes, resilient development scenarios, and sustainable policy and investment decision-making in the global context.

Author Contributions

Conceptualization, S.K.S. and S.S.G.; methodology, S.K.S., S.S.G., D.B. and S.M.; software, S.K.S.; validation, S.K.S., S.S.G., and D.B.; formal analysis, D.B. and S.M.; investigation, S.K.S. and S.S.G.; resources, S.K.S.; data curation, S.K.S.; writing—original draft preparation, S.K.S., S.S.G., and D.B.; writing—review and editing, S.K.S., S.S.G., D.B. and S.M.; visualization, S.K.S. and S.S.G.; supervision, D.B. and S.M.; project administration, D.B. All authors have read and agreed to the published version of the manuscript.

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The data will be available on reasonable request to the corresponding author.

Conflicts of Interest

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

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References

[1] Hariram, N. P., Mekha, K. B., Suganthan, V., & Sudhakar, K. (2023). Sustainalism: An integrated socio-economic-environmental model to address sustainable development and sustainability. *Sustainability, 15*(13), 10682. https://doi.org/10.3390/su151310682

[2] Hauschild, M. Z., McKone, T. E., Arnbjerg-Nielsen, K., Hald, T., Nielsen, B. F., Mabit, S. E., & Fantke, P. (2022). Risk and sustainability: Trade-offs and synergies for robust decision making. *Environmental Sciences Europe, 34*(1), 11. https://doi.org/10.1186/s12302-021-00587-8

[3] Manisha, K., & Singh, I. (2025). Investigating green economy studies using a bibliometric analysis. *Journal of the Knowledge Economy, 16*(2), 10021–10053. https://doi.org/10.1007/s13132-024-02237-9

[4] Kaur, A., & Negi, P. S. (2025). A systematic literature review and bibliometric analysis on inclusive green finance with an emphasis on the digital economy and green growth. *Journal of Money and Business*. Advance online publication. https://doi.org/10.1108/JMB-09-2024-0053

[5] Tran, A. V., & Khoa, B. T. (2025). Global research trends in circular economy: A bibliometric analysis in E-commerce. *Human Behavior and Emerging Technologies, 2025*(1), 8645845. https://doi.org/10.1155/hbe2/8645845

[6] Fauzi, M. A., Han, H., Loureiro, S. M. C., Ariza-Montes, A., & Wider, W. (2025). Bibliometric analysis on green hotels: Past, present and future trends. *Journal of Hospitality and Tourism Insights, 8*(1), 241–262. https://doi.org/10.1108/JHTI-01-2024-0121

[7] Apriantoro, M. S., Widyastuti, H., El Ashfahany, A., & Murtadla, A. A. (2024). Sustainability and green economy in developmental paradigms: A bibliometric analysis of scholarly trends and transformations. *Indonesian Interdisciplinary Journal of Sharia Economics, 7*(2), 4587–4610. https://doi.org/10.31538/iijse.v7i2.4786

[8] Dar, B. I., Badwan, N., & Kumar, J. (2024). Investigating the role of Fintech innovations and green finance toward sustainable economic development: A bibliometric analysis. *International Journal of Islamic and Middle Eastern Finance and Management, 17*(6), 1175–1195. https://doi.org/10.1108/IMEFM-01-2024-0018

[9] Krastev, B., & Krasteva-Hristova, R. (2024). Challenges and trends in green finance in the context of sustainable development—A bibliometric analysis. *Journal of Risk and Financial Management, 17*(7), 301. https://doi.org/10.3390/jrfm17070301

[10] Muhmad, S. N., Cheema, S., Mohamad Ariff, A., Nik Him, N. F., & Muhmad, S. N. (2024). Systematic literature review and bibliometric analysis of green finance and renewable energy development. *Sustainable Development, 32*(6), 7342–7355. https://doi.org/10.1002/sd.3093

[11] Puspita, A. T. (2023). Text analytics on green economy using Bibliometrix. *Economics and Sustainability, 1*(1), 1–12. https://doi.org/10.58968/es.v1i1.415

[12] Zhu, J. J., Zhang, R., Kanhalikham, K., Liu, Z., & Shen, X. (2023). Green economy studies amongst the global climate change challenge between 2016 and 2022: A bibliometric review. *Frontiers in Ecology and Evolution, 11*, 1168437. https://doi.org/10.3389/fevo.2023.1168437

[13] Mentel, G., Lewandowska, A., Berniak-Woźny, J., & Tarczyński, W. (2023). Green and renewable energy innovations: A comprehensive bibliometric analysis. *Energies, 16*(3), 1428. https://doi.org/10.3390/en16031428

[14] Ali, H., ul Abideen, Z., & Jafar, A. (2024). Mapping the evolution of green finance research and development in emerging green economies. *Resources Policy, 91*, 104943. https://doi.org/10.1016/j.resourpol.2024.104943

[15] Wang Chen, H. M., Chou, S. Y., Luu, Q. D., & Yu, T. H. K. (2016). A fuzzy MCDM approach for green supplier selection from the economic and environmental aspects. *Mathematical Problems in Engineering, 2016*(1), 8097386. https://doi.org/10.1155/2016/8097386

[16] Si, J., Marjanovic-Halburd, L., Nasiri, F., & Bell, S. (2016). Assessment of building-integrated green technologies: A review and case study on applications of Multi-Criteria Decision Making (MCDM) method. *Sustainable Cities and Society, 27*, 106–115. https://doi.org/10.1016/j.scs.2016.06.013

[17] Khoshnava, S. M., Rostami, R., Zin, R. M., Štreimikienė, D., Yousefpour, A., Strielkowski, W., & Mardani, A. (2019). Aligning the criteria of green economy (GE) and sustainable development goals (SDGs) to implement sustainable development. *Sustainability, 11*(17), 4615. https://doi.org/10.3390/su11174615

[18] Khoshnava, S. M., Rostami, R., Zin, R. M., Štreimikiene, D., Yousefpour, A., Mardani, A., & Alrasheedi, M. (2020). Contribution of green infrastructure to the implementation of green economy in the context of sustainable development. *Sustainable Development, 28*(1), 320–342. https://doi.org/10.1002/sd.2017

[19] Pham, H. T., Dao, A. P. V., & Vu, L. H. (2023). An assessment of sustainable development using Delphi technique and multicriteria decision-making method: A case study of Hai Phong City. In *International conference on "global changes and sustainable development in Asian emerging market economies* (pp. 519–536). Springer. https://doi.org/10.1007/978-3-031-68842-3_30

[20] Rampasso, I. S., Quelhas, O. L., Anholon, R., Silva, D. A., Pontes, A. T., Miranda, J. D., & Dias, J. O. (2021). The bioeconomy in emerging economies: A study of the critical success factors based on Life Cycle Assessment and Delphi and Fuzzy-Delphi methods. *The International Journal of Life Cycle Assessment, 26*(6), 1254–1266. https://doi.org/10.1007/s11367-021-01913-1

[21] Stević, Ž., Karamaşa, Ç., Demir, E., & Korucuk, S. (2025). Assessing sustainable production under circular economy context using a novel rough-fuzzy MCDM model: A case of the forestry industry in the Eastern Black Sea region. *Journal of Enterprise Information Management, 38*(1), 261–291. https://doi.org/10.1108/JEIM-10-2020-0419
[22] Karbassi Yazdi, A., Tan, Y., Birau, R., Frank, D., & Pamučar, D. (2025). Sustainable solutions: Using MCDM to choose the best location for green energy projects. *International Journal of Energy Sector Management, 19*(1), 146–180. https://doi.org/10.1108/IJESM-01-2024-0005
[23] Tighnavard Balasbaneh, A., Aldrovandi, S., & Sher, W. (2025). A systematic review of implementing Multi-Criteria Decision-Making (MCDM) approaches for the circular economy and cost assessment. *Sustainability, 17*(11), 5007. https://doi.org/10.3390/su17115007
[24] Fedajev, A. (2025). Assessing sustainable competitiveness of Balkan economies using the entropy-based PROMETHEE method. In *Building economic resilience: Strategies for sustainable growth and competitiveness* (pp. 73–92). Springer. https://doi.org/10.1007/978-3-031-96428-2_4
[25] Fang, J. (2025). LogTODIM–VIKOR framework for fuzzy multiple-attribute group decision-making and applications to urban green economy development competitiveness evaluation. *International Journal of Fuzzy Systems*. Advance online publication. https://doi.org/10.1007/s40815-025-02010-3
[26] Sun, X. (2021). Green city and regional environmental economic evaluation based on entropy method and GIS. *Environmental Technology & Innovation, 23*, 101667. https://doi.org/10.1016/j.eti.2021.101667
[27] Wang, M., Zhao, X., Gong, Q., & Ji, Z. (2019). Measurement of regional green economy sustainable development ability based on entropy weight-topsis-coupling coordination degree—A case study in Shandong Province, China. *Sustainability, 11*(1), 280. https://doi.org/10.3390/su11010280
[28] Eşiyok, S., Ariş, E., & Antmen, F. (2023). Ranking and evaluation of G7 countries and Turkey by gggi indicators using ENTROPY, CRITIC and EDAS methods. *Çukurova Üniversitesi Mühendislik Fakültesi Dergisi, 38*(3), 647–660. https://doi.org/10.21605/cukurovaumfd.1377228
[29] Rađenović, Ž. J., & Rajić, M. N. (2024). Assessing circular economy performances of selected countries using MCDM methods: Promethee vs. CoCoSo. In *Navigating the circular age of a sustainable digital revolution* (pp. 59–90). IGI Global.
[30] Amiruddin, M. Z. B., Samsudin, A., Suhandi, A., Coştu, B., & Prahani, B. K. (2025). Scientific mapping and trend of conceptual change: A bibliometric analysis. *Social Sciences & Humanities Open, 11*, 101208. https://doi.org/10.1016/j.ssaho.2024.101208
[31] Sahoo, S. K., Choudhury, B. B., Dhal, P. R., & Hanspal, M. S. (2025). A comprehensive review of multi-criteria decision-making (MCDM) toward sustainable renewable energy development. *Spectrum of Operational Research, 2*(1), 268–284. https://doi.org/10.31181/sor21202527
[32] Kumar, R., & Sahoo, S. K. (2025). A bibliometric analysis of agro-based industries: Trends and challenges in supply chain management. *Decision Making Advances, 3*(1), 200–215. https://doi.org/10.31181/dma31202568
[33] Hassan, W., & Duarte, A. E. (2024). Bibliometric analysis: A few suggestions. *Current Problems in Cardiology, 49*(8), 102640. https://doi.org/10.1016/j.cpcardiol.2024.102640
[34] Merli, R., Preziosi, M., & Acampora, A. (2018). How do scholars approach the circular economy? A systematic literature review. *Journal of Cleaner Production, 178*, 703–722. https://doi.org/10.1016/j.jclepro.2017.12.112
[35] Kamble, S. S., Gunasekaran, A., & Gawankar, S. A. (2020). Achieving sustainable performance in a data-driven agriculture supply chain: A review for research and applications. *International Journal of Production Economics, 219*, 179–194. https://doi.org/10.1016/j.ijpe.2019.05.022
[36] Lee, H. C., & Chang, C. T. (2018). Comparative analysis of MCDM methods for ranking renewable energy sources in Taiwan. *Renewable and Sustainable Energy Reviews, 92*, 883–896. https://doi.org/10.1016/j.rser.2018.05.007
[37] Pan, S. Y., Gao, M., Kim, H., Shah, K. J., Pei, S. L., & Chiang, P. C. (2018). Advances and challenges in sustainable tourism toward a green economy. *Science of the Total Environment, 635*, 452–469. https://doi.org/10.1016/j.scitotenv.2018.04.134
[38] Nizami, A. S., Rehan, M., Waqas, M., Naqvi, M., Ouda, O. K., Shahzad, K., & Pant, D. (2017). Waste biorefineries: Enabling circular economies in developing countries. *Bioresource Technology, 241*, 1101–1117. https://doi.org/10.1016/j.biortech.2017.05.097
[39] Moktadir, M. A., Rahman, T., Rahman, M. H., Ali, S. M., & Paul, S. K. (2018). Drivers to sustainable manufacturing practices and circular economy: A perspective of leather industries in Bangladesh. *Journal of Cleaner Production, 174*, 1366–1380. https://doi.org/10.1016/j.jclepro.2017.11.063
[40] Song, M., Fisher, R., & Kwoh, Y. (2019). Technological challenges of green innovation and sustainable resource management with large scale data. *Technological Forecasting and Social Change, 144*, 361–368. https://doi.org/10.1016/j.techfore.2018.07.055

[41] Chen, P. (2021). Effects of the entropy weight on TOPSIS. *Expert Systems with Applications, 168*, 114186. https://doi.org/10.1016/j.eswa.2020.114186
[42] Olabi, A. G., Obaideen, K., Elsaid, K., Wilberforce, T., Sayed, E. T., Maghrabie, H. M., & Abdelkareem, M. A. (2022). Assessment of the pre-combustion carbon capture contribution into sustainable development goals SDGs using novel indicators. *Renewable and Sustainable Energy Reviews, 153*, 111710. https://doi.org/10.1016/j.rser.2021.111710
[43] Gupta, H., Kumar, A., & Wasan, P. (2021). Industry 4.0, cleaner production and circular economy: An integrative framework for evaluating ethical and sustainable business performance of manufacturing organizations. *Journal of Cleaner Production, 295*, 126253. https://doi.org/10.1016/j.jclepro.2021.126253
[44] Colapinto, C., Jayaraman, R., Ben Abdelaziz, F., & La Torre, D. (2020). Environmental sustainability and multifaceted development: Multi-criteria decision models with applications. *Annals of Operations Research, 293*(2), 405–432. https://doi.org/10.1007/s10479-019-03403-y
[45] Chaube, S., Pant, S., Kumar, A., Uniyal, S., Singh, M. K., Kotecha, K., & Kumar, A. (2024). An overview of multi-criteria decision analysis and the applications of AHP and TOPSIS methods. *International Journal of Mathematical, Engineering and Management Sciences, 9*(3), 581–605. https://doi.org/10.33889/IJMEMS.2024.9.3.030
[46] Štilić, A., & Puška, A. (2023). Integrating multi-criteria decision-making methods with sustainable engineering: A comprehensive review of current practices. *Eng, 4*(2), 1536–1549. https://doi.org/10.3390/eng4020088
[47] Schramm, V. B., Cabral, L. P. B., & Schramm, F. (2020). Approaches for supporting sustainable supplier selection-A literature review. *Journal of Cleaner Production, 273*, 123089. https://doi.org/10.1016/j.jclepro.2020.123089
[48] Ayub, Y., Moktadir, M. A., & Ren, J. (2024). Sustainable waste valorization process selection through AHP and advanced Interval Valued Fermatean Fuzzy with integrated CODAS. *Process Safety and Environmental Protection, 185*, 408–422. https://doi.org/10.1016/j.psep.2024.03.019
[49] Imamguluyev, R., Abbasov, I., Sadigov, R., Imanova, T., Sharifli, I., Bagirov, G., & Musayev, J. (2024). Smart decision-making in the green economy: A fuzzy logic approach. In *International conference on computing and machine learning* (pp. 153–164). Springer. https://doi.org/10.1007/978-981-97-7571-2_13
[50] Anagnostos, D., Schmidt, T., Cavadias, S., Soudris, D., Poortmans, J., & Catthoor, F. (2019). A method for detailed, short-term energy yield forecasting of photovoltaic installations. *Renewable Energy, 130*, 122–129. https://doi.org/10.1016/j.renene.2018.06.058
[51] Wu, X., Zhao, W., Li, H., Liu, B., Zhang, Z., & Wang, X. (2021). Multi-stage stochastic programming based offering strategy for hydrogen fueling station in joint energy, reserve markets. *Renewable Energy, 180*, 605–615. https://doi.org/10.1016/j.renene.2021.08.076
[52] Taylan, O., Alamoudi, R., Kabli, M., AlJifri, A., Ramzi, F., & Herrera-Viedma, E. (2020). Assessment of energy systems using extended fuzzy AHP, fuzzy VIKOR, and TOPSIS approaches to manage non-cooperative opinions. *Sustainability, 12*(7), 2745. https://doi.org/10.3390/su12072745
[53] Depczyński, R. (2024). Assessing raw material efficiency and waste management for sustainable development: A VIKOR and TOPSIS multi-criteria decision analysis. *Production Engineering Archives, 30*(2), 198–213. https://doi.org/10.30657/pea.2024.30.50
[54] Igodo, A., Shamsuzzoha, A., Ndzibah, E., & Shamsuzzaman, M. (2023). Optimal maintenance for a waste-to-energy plant using DEMATEL: A case study. *Clean Technologies and Environmental Policy, 25*(7), 2305–2333. https://doi.org/10.1007/s10098-023-02506-2
[55] Wang, M., Sweetapple, C., Fu, G., Farmani, R., & Butler, D. (2017). A framework to support decision making in the selection of sustainable drainage system design alternatives. *Journal of Environmental Management, 201*, 145–152. https://doi.org/10.1016/j.jenvman.2017.06.034
[56] Ziemba, P. (2021). Selection of electric vehicles for the needs of sustainable transport under conditions of uncertainty—A comparative study on fuzzy MCDA methods. *Energies, 14*(22), 7786. https://doi.org/10.3390/en14227786
[57] Zhang, Y., Gu, L., & Guo, X. (2020). Carbon audit evaluation system and its application in the iron and steel enterprises in China. *Journal of Cleaner Production, 248*, 119204. https://doi.org/10.1016/j.jclepro.2019.119204