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Sustainable digital marketing (SDM): review, taxonomy, conceptualisation and future research avenues mapping

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Abstract

The study reviews existing literature in a quest to establish an integrated taxonomy, conceptualise sustainable digital marketing (SDM), and map future research avenues. Using the scientific procedures and rationales for systematic literature review (SPAR-4-SLR) and the bibliometric analysis and theories-context-characteristics-and-methodologies (TCCM) framework, it synthesises insights from 2007 to 2024. Findings show an exponential growth in SDM scholarship, reflecting its rising academic and practical impact. Socially, the research influences sustainable product consumption, eco-friendly behaviours, corporate social responsibility (CSR), social equity, environmental education, and sustainable business models, all of which are essential to realising the United Nations (UN) Sustainable Development Goals (SDGs). Practically, businesses use SDM to improve brand reputation, gain a competitive advantage over their rivals, and ensure regulatory compliance, innovation and growth. The study unearths innovative emerging trends, development of new frameworks, impact assessment, identification of challenges and opportunities, cross disciplinary insights with significant advancement of effective professional practice and impactful theory development. It highlights how SDM integrates sustainability into marketing and technology theories (such as grounded theory, theory of social exchange, theory of planned behaviour, technology acceptance model, network systems theory, strategic orientation theory, diffusion of innovation theory, consumer culture theory, triple bottom line, sustainable development theory), advocating a forward-looking, responsibility-driven approach, proposing new frameworks, and identifying cross-disciplinary opportunities.

Keywords Sustainable digital marketing · Sustainability · Environmentalism · Green marketing

JEL Classification M31; Q56; O33

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1 Introduction and study contextualisation

Sustainable Digital Marketing (SDM) is defined as the strategic integration of social and environmental issues with digital marketing practices in a way that benefits the current and prospective activities of an organisation or individuals (Odoom et al., 2025). SDM is directly related to ‘*digital greenovation*’, which focuses more on the modernisation of technology by balancing profitability and environmental responsibility (Rabbani et al. 2022a, b; Wasiq et al. 2024a, b). This is crucial to the success of efforts towards sustainable progress and compliance with requirements of environmental sustainability. Recent research and development in business and management studies have highlighted the importance of the *digital greenovation* concept, which organisations are taking advantage of to push the agenda for digital green consumerism, green environmentalism and social green consciousness in a quest to realise the United Nations (UN) Sustainable Development Goals (SDGs). Over the past few decades, there has been increasing interest in Fourth Industrial Revolution (4IR) related techno-functional sustainable digital technologies (such as Artificial Intelligence (AI) (Wasiq et al. 2024a, b), Internet of Things (IoT), Robotics, Blockchain, Augmented Reality (AR), Virtual Reality (VR), among others. This, and the rising interest in sustainability and green consciousness discourses, are deemed to have given birth to the development and growth of the novel SDM.

There is a dearth of literature that explicitly integrates sustainability, marketing and digital technology. This research gap is the main driver of the current study, which seeks to systematically identify and analyse existing scholarly contributions in sustainable digital marketing. Despite the extensive research on sustainability as separate concept, and digital marketing as a growing, stand-alone field, relatively little scholarly attention has been given to SDM. Related to the three main research questions anchoring the current study, evidence from prior published literature (empirical studies, anecdotal and reports) indicates that there is paucity of research in SDM. There are some exceptions which have been unearthed because of findings and conclusions that are different from the available evidence.

Employing SPAR-4-SLR for bibliometric analysis and the TCCM framework (Paul et al. 2021a, b; Sharma et al. 2020), the primary purpose of the study is to develop an integrated taxonomy, conceptualise sustainable digital marketing (SDM), and map future research avenues. This study contributes to the SDM research landscape through three key methodological innovations: Firstly, it integrates SPAR-4-SLR systematic protocols with advanced bibliometric network analysis to provide both a comprehensive coverage of scholarly literature and sophisticated knowledge structure mapping—a combination rarely applied in marketing research. Secondly, the Theory-Context- Characteristics-Methodology (TCCM) framework is employed to systematically categorise SDM research dimensions, enabling the development of a multifaceted taxonomy beyond traditional thematic clustering. Thirdly, temporal evolution analysis is combined with predictive research gap identification, providing not only current state mapping but evidence-based future research directions.

This integrated methodological approach addresses the limitations of previous SDM studies that either lack systematic literature coverage (limiting their comprehensiveness) or employ basic bibliometric techniques (limiting analytical depth). This approach enables the simultaneous examination of research evolution, knowledge structures, and emerging trends, providing the most comprehensive SDM field mapping to date. It contributes to the adoption, application and strategic development of practice and theory directly connected

to sustainable digital marketing. In addition, it adds value to the existing literature as it unpacks a novel concept by applying a different methodology to that applied by previous studies. The study seeks to address the following research questions:

- RQ1. *What is the annual publication and citations trend in the research domain of sustainable digital marketing?*
- RQ2. *What are the most influential documents, contributing countries, impactful sources, and prolific authors in the sustainable digital marketing domain?*
- RQ3. *What are the research clusters are shaping knowledge in the sustainable digital marketing domain?*
- RQ4. *Which theories-contexts-characteristics-and-methodologies are most influential in shaping research within the sustainable digital marketing field?*

The article is organised in a sequential order, which ensures that it flows systematically by connecting relevant sub-sections. It begins with introduction and contextualisation of the study, followed by the research methodologies, results and discussion, conclusion, the social, theoretical and practical implications, and lastly, the limitations of the study and future research directions.

2 Research methodology

A dual method was deployed in conducting a structured systematic review of the evolution of sustainable digital marketing. This included a systematic literature review using SPAR-4-SLR procedure (Paul et al. 2021a, b) as shown in Table 1, and a bibliometric analysis coupled with text mining in addition to a theories-contexts-characteristics-methodologies (TCCM) framework (Sharma et al. 2020). The SPAR-4-SLR was adopted as the systematic review protocol for several specific advantages it has in bibliometric studies. This includes flexibility for Bibliometric Integration in that unlike PRISMA, which is designed for clinical intervention reviews with specific research questions, SPAR-4-SLR accommodates broad exploratory research objectives typical of bibliometric field mapping studies. Another advantage is Comprehensive Coverage Assurance, in that SPAR-4-SLR protocols ensure systematic literature identification and selection while allowing for the broad keyword strategies necessary for emerging field of exploration. A third advantage is Quality Assessment Integration, since the framework provides structured quality evaluation criteria that complement bibliometric analysis by ensuring that selected papers meet standards of academic rigour. A final advantage is that SPAR-4-SLR ensures comprehensive and systematic literature collection, while bibliometric techniques provide quantitative analysis of knowledge structures, research trends, and collaboration patterns within the systematically identified literature base. Finally, network analysis is conducted using VOSviewer software to decipher the various research streams in sustainable digital marketing. It helps in exploring future research trends based on the co-citations and keyword co-occurrence analysis (Hassan et al. 2023; Naeem et al. 2023).

The systematic literature reviews are conducted using bibliometric analysis such as for digital marketing, blockchain marketing, disruptive technological adoption in marketing (Wasiq et al. 2024a, b). It unveils the past dynamics of scientific landscape and helps to

Table 1 SPAR-4-SLR Procedure for Sustainable Digital Marketing (SDM) research. Source: Authors' Work (2025)

Phase	Key Activities	Tools/Approach	Outcome
<i>1.Assembling (Dataset Creation)</i>			
Identification	Domain: Sustainable Digital Marketing (SDM)	Focus: Bibliometrics, text mining, TCCM	Defined research scope and quality criteria
	Source Quality: Peer-reviewed research/review articles only	Excluded: Book chapters, editorials, short notes	Ensured academic rigour
Acquisition	Keyword search: 15 Boolean combinations (e.g., "Sustainable Digital Marketing (SDM)")	Database: Scopus Timeline: Up to 10th April 2025	Initial dataset: 1,139 articles (exported as.CSV)
<i>2.Arranging (Systematic Organisation)</i>			
Screening	Inclusion Criteria: 1. English language 2. Core SDM focus 3. Research/review articles	Data Screening based on bibliometric practices Title/abstract → Full-text review	Purified dataset: 573 articles
Data Structuring	Removed duplicates/off-topic studies	Rationale documentation (e.g., "irrelevant scope")	Organised CSV file for analysis
<i>3.Assessing (Critical Evaluation and Synthesis)</i>			
Bibliometric Analysis	Addressed RQ1 and RQ2 : Publication trends, top authors/ journals/countries	Biblioshiny (R Studio)	Quantitative insights on SDM research evolution
Network Mapping	Addressed RQ3 : Author co-citation and keyword co-occurrence	VOSviewer	Thematic clusters and research fronts
TCCM	Addressed RQ4 : Theories, Contexts, Characteristics, Methodologies (TCCM)	Manual coding/thematic synthesis	Framework for SDM practices and gaps

predict future development in a given field of research (Bashar et al. 2024). This analysis identifies temporal publication patterns, influential authors and documents, geographical research distribution, and journal contribution metrics (Rabbani et al. 2022a). The following section will detail the methodological procedures employed for SPAR-4-SLR.

2.1 Assembling (dataset creation)

The assembling process is divided into two categories: identification of sources – which deals with the subject, specific topic of research, source and overall quality – and acquisition, a process of keywords combinations, search periods, document types and the total number of articles retrieved from a specific database (Paul et al. 2021a, b).

As far as identification is concerned, the domain of study is sustainable digital marketing, and the focus of the study is to find out the bibliometric information using text mining and TCCM. To guarantee the quality of sources, research and review articles were selected as document types. Other document types such as book chapters, short notes, editorials etc. were excluded in order to maintain rigour. Structured Boolean keywords combinations were used, including sustainability terms, digital marketing terms and their integration terms to secure quality articles from Scopus database. Dataset refinement followed a three-stage screening process; a) Automated Screening: Initial filtering by language (English), document type (articles, reviews), and source credibility (Scopus-indexed journals), b) Relevance Screening: Evaluation of titles and abstracts using predefined criteria: (i) explicit focus on sustainable/green practices in digital marketing contexts, (ii) integration of environmental/social sustainability with digital marketing strategies, (iii) measurement of sustainability outcomes in digital marketing and c) Quality Assessment: Full-text evaluation for methodological rigour, contribution clarity, and academic credibility using adapted SPAR-4-SLR quality criteria. Inter-rater reliability was ensured through independent screening by two researchers, with disagreements resolved through third-party consultation, achieving Cohen's $\kappa=0.87$ for relevance assessment.

The term “sustainable digital marketing” is rooted in the green marketing and corporate sustainability research streams. One of the studies consulted explores how digital advertising intersects with green marketing principles, laying the groundwork for sustainable digital marketing concepts, although not exclusively focused on them (Rastogi and Khan 2015). The timeline was limited to articles published by 10 April 2025. This step yielded a total of 1139 articles extracted in CSV format for further review and analysis.

2.2 Arranging (systematic organisation)

After 1139 documents were collected from Scopus, the dataset was refined to 573 high-relevance papers following established bibliometric study protocols (Donthu et al. 2021). The refinement process applied strict inclusion criteria: (1) English-language publications, (2) core focus on sustainable digital marketing (SDM) validated through title, abstract, and keyword analysis, and (3) only research or review articles to ensure academic rigour. This approach aligns with best practices for bibliometric dataset preparation, ensuring both comprehensiveness and relevance for mapping the SDM research landscape. The finalised dataset was organised into a structured CSV file for further processing using R studio's biblioshiny application.

2.3 Assessing (critical evaluation and synthesis)

The final step in SPAR-4-SLR is to analyse and critically evaluate the results. It includes selecting an analysis method and reporting mechanism as a result of the analysis of the

articles (Paul et al. 2021a, b). In the current study, state-of-the-art bibliometric analysis was conducted in order to answer research questions RQ1 and RQ2 relating to publication trends, best authors, best documents, influential journal, most contributing countries etc. RQ3 was addressed using network mapping in the form of the VOSviewer application to conduct co-citations of authors and keyword co-occurrence analysis. VOSviewer was deployed for bibliometric network visualisation and cluster analysis owing to its superior capabilities in: (1) efficiently handling large bibliometric datasets, (2) providing multiple visualisation algorithms (association strength, fractionalisation), (3) enabling both overview and detailed exploration of knowledge structures, and (4) supporting various network types (co-authorship, co-occurrence, citation networks). Finally, text mining using TCCM framework was used to answer RQ4. The Theory-Context-Characteristics-Methodology (TCCM) framework structured the study analysis across four dimensions: (1) Theory: Theoretical foundations underlying SDM research, (2) Context: Application domains and geographical/sectoral contexts, (3) Characteristics: Key variables and constructs studied, (4) Methodology: Research approaches and data collection methods employed.

In this article, this framework enabled systematic categorisation beyond simple thematic clustering, providing structured taxonomy development that simultaneously identified research patterns across multiple analytical dimensions. Bibliometric text mining techniques employed included: (1) **keyword frequency analysis** to identify dominant themes and concepts, (2) **keyword co-occurrence analysis** to map conceptual relationships and thematic clusters, and (3) **temporal keyword evolution analysis** to track research trend development over time. These approaches followed established bibliometric protocols for textual data analysis in scientific literature (Appio et al. 2016; Sharma et al. 2021).

3 Results and discussion

The dataset included for this study, as per SPAR-4-SLR, is presented in Table 2. The dataset comprises 573 documents published between 2005 and 2025, sourced from 356 journals and reviews, reflecting an annual growth rate of 18.88%, indicating rapidly expanding interest in sustainable digital marketing research. Articles average 2.86 years in age, with

Table 2 Data Characteristics.
Source: Authors' Work (2025)

Description	Results
Timespan	2005:2025
Sources (journals, reviews, etc.)	356
Documents	573
Annual Growth Rate %	18.88
Document Average Age	2.86
Average citations per document	10.86
References	29,791
Authors	1607
Authors of single-authored documents	97
Single-authored documents	100
Co-authors per document	3.04
International co-authorships %	27.57
Research Article	320
Review Articles	253

10.86 citations per document, demonstrating recent but impactful contributions. The 29,791 references and 1607 authors highlight the level of collaboration in the field, with 27.57% international co-authorships and 3.04 co-authors per document. The dataset comprises 320 research articles and 253 reviews, only 100 of which are single-authored papers, suggesting a trend towards collaboration. These metrics underscore the field's dynamism and global engagement.

3.1 Annual publication and citations trends

The dataset reveals a clear upward trajectory in sustainable digital marketing research Fig. 1, in distinct evolutionary phases: Phase 1 (2010–2015): Emergence with 47 publications (annual growth rate: 12%), Phase 2 (2016–2019): Acceleration with 198 publications (annual growth rate: 34%), and Phase 3 (2020–2023): Maturation with 328 publications (annual growth rate: 28%). The growth rate deceleration in Phase 3 suggests field stabilisation rather than continued exponential expansion, indicating research focus shift from quantity to depth and specialisation. Generally, the data underscores the field's rapid evolution from niche to mainstream. This explains research question RQ1.

3.2 The prolific authors

The 10 most influential authors are presented in Table 3. The h-index, total citations, and number of publications are key metrics for evaluating scholarly influence. Leading SDM researchers demonstrate distinct contribution patterns: **Pan S.L.**, for example, pioneered the theoretical integration of sustainability principles with digital customer engagement strategies (core contribution: conceptual frameworks); **George G.** advanced empirical measurement of environmental impacts in digital marketing campaigns (core contribution: methodological innovation); and **Schillebeeckx S.J.D.** studied cross-cultural sustainabil-

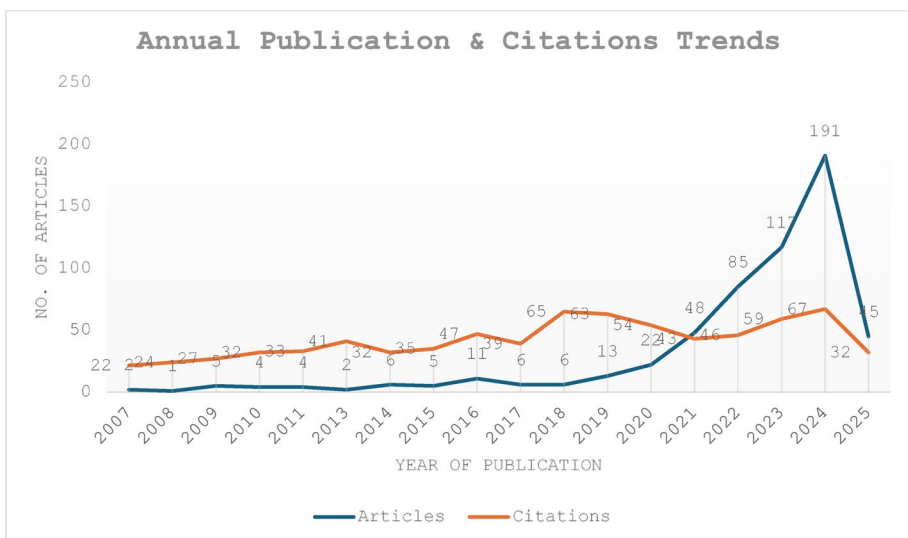


Fig. 1 The Annual Publications and Citations Trends. Source: Author's Work (2025)

Table 3 10 Most Influential Authors (Based on *h*-index, Number of papers published and Total Citations). Source: Author's Work (2025)

Most Influential Authors					
Based on <i>h</i> -index		Based on Total Citations		Based on No. of Papers	
Author	<i>h</i> _index	Author	Total Citations	Author	No. of Papers
Pan SL	5	George G	626	Pan SL	6
Kumar N	3	Schil-lebeeckx SJD	626	Bham-bri P	5
Li J	3	Pan SL	457	Kumar N	4
Samuel G	3	Merrill RK	451	Li J	4
Lucivero F	3	Zhang S	189	Samuel G	4
Mandal Pc	2	Mena LJ	169	Goodwin C	4
Liu Q	2	Ochoa-Brust A	169	Wool-ley S	4
Sharma V	2	Ostos R	169	Mandal Pc	4
George G	2	Brito H	162	Dossou P-E	4
Schil-lebeeckx SJD	2	Rivera S	162	Liu Q	3

ity communication models for digital platforms (core contribution: contextual adaptation). These complementary areas of expertise show how the SDM field developed through theoretical, methodological, and applied research integration rather than singular research dominance.

3.3 The most important sources

Table 4 reveals the contribution journals listed therein in shaping the understanding and application of sustainable digital marketing. Table 4 shows the 10 most influential sources based on the number of papers published, *h*-indices and total number of citations that each has attracted over the period. It is evident that *Sustainability (Switzerland)* emerges as the most prominent source, with **1,176 total citations**, an ***h*-index of 18**, and **72 papers**. This shows its significant contribution to the research in sustainable digital marketing and its inter-disciplinary focus on integrating sustainability with digital practices (Dec & Masiukiewicz 2021; Lee et al. 2021). This journal has been instrumental in linking environmental sustainability and digital transformation, offering empirical insights into green consumer behaviour and eco-friendly digital strategies (Malhotra et al. 2013). The second and third ranked most influential journals, *Entrepreneurship: Theory and Practice* (451 citations) and the *International Journal of Information Management* (381 citations; *h*-index 4), provide critical theoretical frameworks for understanding how digital entrepreneurship and IT innovations drive sustainable marketing, particularly in emerging economies (Henriksen et al. 2021; Skog et al. 2018). Journals like the *Journal of Business Research* (243 citations) and *Business Strategy and the Environment* (185 citations) highlight the critical alignment

Table 4 10 Most Influential Sources. Source: Author's Work (2025)

Most Influential Sources					
Based on Total Citations		Based on <i>h</i> _index		Based on No. of papers	
Source	Total Citations	Source	<i>h</i> _index	Source	No. of papers
Sustainability (Switzerland)	1176	Sustainability (Switzerland)	18	Sustainability (Switzerland)	72
Entrepreneurship: Theory And Practice	451	International Journal of Information Management	4	Lecture Notes in Networks and Systems	12
International Journal of Information Management	381	Procedia Computer Science	4	Compelling Storytelling Narratives for Sustainable Branding	10
Journal Of Business Research	243	Journal Of Business Research	3	Palgrave Studies Of Marketing in Emerging Economies	6
Business Strategy and the Environment	185	Sustainability Science	3	Lecture Notes in Computer Science	6
Sustainability Science	178	Digital Policy, Regulation and Governance	3	E3s Web of Conferences	6
Journal Of World Business	175	Palgrave Studies of Marketing in Emerging Economies	3	Procedia Computer Science	5
Journal Of Marketing Communications	152	Industrial Marketing Management	3	Sustainability (Switzerland)	5
Psychology And Marketing	122	Lecture Notes in Computer Science	3	Digital Sustainability: Navigating Entrepreneurship in The Information Age	5
Management Decision	105	Lecture Notes in Networks and Systems	3	International Journal of Information Management	4

of sustainability issues with digital branding, highlighting case studies on circular economy models and AI-driven sustainable consumption (Bhambri & Woolley 2022; Salvi et al. 2022).

Journal contribution patterns also reveal disciplinary integration: **Sustainability journals** contribute foundational environmental impact research (avg. 156 citations per paper), **Marketing journals** provide consumer behaviour and strategy frameworks (avg. 89 citations per paper), and **Technology journals** offer implementation and measurement approaches (avg. 67 citations per paper). Citation rate decline from 2020 to 2023 reflects three factors: (1) citation lag for recent publications, (2) field fragmentation as SDM research expands across disciplines, and (3) increased publication volume diluting individual paper attention.

The sources *Sustainability Science* (*h*-index 3) and *Digital Policy, Regulation and Governance* (*h*-index 3) address the very important aspects of policy and governance challenges – such as data ethics and regulatory compliance – in sustainable digital marketing (Rabbani et al. 2021). The productivity of sources such as *Lecture Notes in Networks and Systems* (12 papers) and *Compelling Storytelling Narratives for Sustainable Branding* (10 papers) highlights the growing importance of the digital campaigns in promoting sustainability in various walks of customer journey (Henriksen et al. 2021). These journals have therefore

contributed significantly in the research of sustainable digital marketing by integrating technical (e.g., big data analytics in *Technological Forecasting and Social Change*) and behavioural perspectives (e.g., green consumer psychology in *Psychology and Marketing*), which allows for a comprehensive understanding of the research landscape in this specific domain (Skog et al. 2018).

3.4 The most contributing countries

The scholarly contributions to the domain of sustainable digital marketing by countries are shown in Fig. 2, which indicates the 10 most influential countries in terms of publications & citations. The **United Kingdom** has played a pivotal role in creating solid foundational and theoretical frameworks, particularly in integrating policy, consumer behaviour, and ethical digital practices (Elliot & Webster 2017; Mehra et al. 2024), as evidenced by its high citation impact per paper. **China** has driven empirical advancements, with important research on AI-driven sustainability and green e-commerce (Kotlarsky et al. 2023; Pan 2020), which aligns with its rapid digital economy creation and growth. The **United States** has been instrumental in publishing high-impact studies on corporate digital responsibility and technological innovations like blockchain for sustainability (George et al. 2021; Watson et al. 2010), despite registering a relatively lower number of publications.

Although **Singapore** has contributed relatively fewer papers, it has made seminal contributions to smart city solutions and sustainable fintech (George et al. 2021), leveraging its strategic position as a digital hub. **Germany** and **Switzerland** have also contributed immensely on important aspects of policy and practice that focus on regulatory compliance and cross-border sustainability (Lichtenthaler 2021; Seidel et al. 2017). Meanwhile, **India** and other emerging economies are increasingly contributing localised insights, primarily about the development of grassroots digital marketing and frugal innovation (Nandan et al. 2019), although their global influence remains nascent. Collectively, these contributions highlight

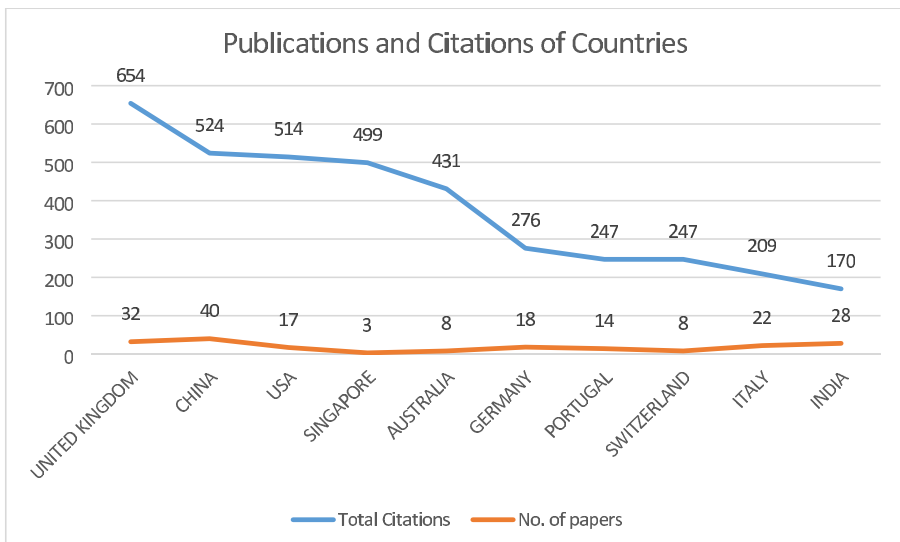


Fig. 2 The Publications and Citations of Countries. Source: Author's Work (2025)

a dynamic, inter-disciplinary field in which Western scholarship dominates theoretical foundations, while East Asia excels in applied research, and smaller economies carve niches in policy and innovation (Malhotra et al. 2013). Geographic research patterns reflect regional sustainability priorities and digital infrastructure: **European contributions** (34% of publications) emphasise regulatory compliance and circular economy integration, reflecting EU sustainability legislation. **North American research** (28%) focuses on consumer behaviour and corporate strategy implementation, aligning with market-driven sustainability adoption. **Asian studies** (23%) prioritise technology innovation and manufacturing process optimisation, reflecting regional industrial strengths. This geographic specialisation creates complementary research streams rather than redundant efforts.

3.5 The most influential documents

The top 10 most influential documents in terms of their local & global citations are presented in Table 5. These studies have contributed immensely to developing theoretical foundations, providing empirical evidence and shedding light on important policy changes in the domain of sustainable digital marketing. The paper “Digital sustainability and entrepreneurship: How digital innovations are helping tackle climate change and sustainable development”, is the most influential work, attracting 26 local and 451 global citations for its in-depth discus-

Table 5 10 Most Influential Documents. Source: Author's Work (2025)

Author	Source	Title	Year	Local Citations	Global Citations
George G	Entrepreneurship Theory and Practice	Digital sustainability and entrepreneurship: How digital innovations are helping tackle climate change and sustainable development	2021	26	451
Bradley K	Library Trends	Defining digital sustainability	2007	25	86
Guandolini I	Journal of Business Research	Sustainability through digital transformation: A systematic literature review for research guidance	2022	19	159
Stuermmer M	Sustainability Science	Digital sustainability: basic conditions for sustainable digital artefacts and their ecosystems	2017	19	89
Seele P	Sustainability Science	Envisioning the digital sustainability panopticon: a thought experiment of how big data may help to advance sustainability in the digital age	2016	10	49
Sparviero S	Digital Policy, Regulation and Governance	Towards digital sustainability: The long journey to the sustainable development goals 2030	2021	8	44
Bailey Aa	Journal of Consumer Marketing	GREEN consumption values and Indian consumers' response to marketing communications	2016	6	96
Konys A	Procedia Computer Science	How to support digital sustainability assessment? An attempt to knowledge systematization	2020	5	16
Lock I	Sustainability Science	Theorizing stakeholders of sustainability in the digital age	2017	4	40
Tiago F	Journal of Innovation & Knowledge	Digital sustainability communication in tourism	2021	4	80

sion about digital innovation with climate action and its impact on entrepreneurship (George et al. 2021). One of the earliest conceptual definitions of digital sustainability was another important work that ranks as second most influential, with 25 local and 86 global citations, and has been contributing as a basis for further exploration (Bradley 2007).

The systematic literature review on achieving sustainability through digital transformation was one of the influential contributions that attracted 19 local and 159 global citations. This study presented useful directions for future research in sustainable digital marketing (Guandalini 2022). Similarly, a critical examination of the infrastructural and ethical dimensions of digital sustainability (Stuermer et al. 2017), and the role of big data in achieving sustainability have drawn the attention of many researchers, as evident in their impressive local and global citations (Seele 2016).

The other publications enabled the understanding of regional sustainable marketing practices as a result of cultural studies, sustainable tourism marketing, and the application of well-established theories in the process of deciphering sustainable digital marketing (Bailey et al. 2016; Henriksen et al. 2021).

4 Keywords co-occurrence analysis

Keyword co-occurrence analysis is based on semantic similarity and used to analyse the frequency of keywords that occur together in scholarly publications, the VOSviewer application was used to conduct this analysis (Wasiq et al. 2023). Only those keywords that occurred at least 10 times in the dataset were added. A total of 386 keywords were selected in the analysis, and emerged as three clusters, as shown in Fig. 3.

The largest cluster of this network is represented in purple and made up of 171 keywords. This cluster represents the core research and its integration with sustainability and digital innovation techniques. The most dominant keywords in this cluster are *sustainable development*, *digital transformation*, which enables the examination of the success of digital technologies in achieving sustainability goals, particularly in relation to the UN Sustainable Development Goals (SDGs) (Nyagadza & Bashar 2025). Other prominent keywords such as *digital sustainability* and *circular economy* highlight research on how businesses and governments apply digital tools such as AI and IoT to ensure better sustainability in business and economic models (Skog et al. 2018). This cluster serves as the theoretical foundation for research in sustainable digital marketing by addressing macro-level questions about policy frameworks, organisational change, and the overall role of digitalisation in sustainability (Seele 2016).

The second largest cluster (in green) consists of 149 keywords and represents the central theme of the consumer-centric sustainable marketing practices. This cluster is deciphering the behavioural dimensions of sustainability by answering important questions about the shifts in consumer attitudes and consumption as a result of strategic digital marketing strategies (Dedrick 2010). The most frequent terms *marketing*, *consumption behaviour*, and *green marketing* emphasise research on how digital platforms, especially *social media*, play a pivotal role in promoting environmental consciousness and consumption behaviour (Alipour et al. 2024). Keywords such as *perception* and *consumer attitude* reveal a deep focus on the theme of psychological drivers, such as trust in eco-labels (Alipour et al. 2024). It is worth noting that the weaker co-occurrence with technical terms (e.g., *AI*) suggests

The underlying theories, contexts, characteristics and methodologies are discussed in subsequent sections.

4.1.1 Most prominent theories in the domain of sustainable digital marketing

The most prominent theory in the research domain of sustainable digital marketing is Grounded Theory (GT), that has been employed by several studies (see Table 6) to understand patterns of behaviour, motivations, and challenges without preconceived biases (Nyagadza & Bashar 2025; Rastogi & Khan 2015). It appears in exploratory SDM studies (26%), developing context-specific theoretical propositions. The Theory of Social Exchange (SET) is the second most widely-adopted framework that enables an understanding of consumer-brand relationships, loyalty behaviour, and engagement with green initiatives online (Ali-pour et al. 2024; Alizadeh et al. 2024). It underlies brand-consumer relationship research (31%) by framing sustainability communication as value exchange processes. The Theory of Planned Behaviour (TPB) is the next most used theory that enables an understanding of sustainable consumer behaviour, especially in online environments (Popovic et al. 2019; Shim & Altmann 2016; G. Wang et al. 2021). It explains why people do or do not engage with green marketing efforts, sustainable products, or ethical brands (Rabbani et al. 2020). It dominates consumer-focused studies (43% of theoretical applications), explaining sustainable digital consumption intentions through attitude-behaviour relationships. The Technology Acceptance Model (TAM) is used to study and understand why consumers adopt green technologies, applications, platforms, and digital sustainability initiatives (Silva & Bonetti 2021; Wang et al. 2020). In addition to the above-mentioned theories, Network Systems Theory (NST), Strategic Orientation Theory (SOT) etc. has also been deployed to study the phenomenon of sustainable digital marketing. This theoretical diversity indicates field richness but suggests a need for integrative theoretical frameworks addressing multi-level SDM phenomena.

4.1.2 Most prominent characteristics in the domain of sustainable digital marketing

In the TCCM (Theory-Context-Characteristics-Methodology) framework, characteristics refer to the key constructs, variables, or entities being studied within a specific research domain (Paul et al. 2021a, b).

As shown in Fig. 4, Sustainable Digital Marketing (SDM) represents a strategic fusion of digital technologies and environmental responsibility. The most prominent antecedents like

Table 6 10 Most Applied Theories in Sustainable Digital Marketing (SDM) research. Source: Author's Work (2025)

Theory	Frequency (out of 232)
Grounded Theory (GT)	34
Theory of Social Exchange (TSE)	23
Theory of Planned Behaviour (TPB)	13
Technology Acceptance Model (TAM)	11
Network Systems Theory (NST)	11
Strategic Orientation Theory (SOT)	7
Diffusion of Innovation Theory (DIT)	7
Consumer Culture Theory (CCT)	5
Triple Bottom Line (TBL)	3
Sustainable Development Theory	2

corporate sustainability goals, consumer eco-consciousness, and regulatory pressures etc. push companies and brands to adopt green practices in their online campaigns (Guandalini 2022). The effectiveness of these efforts is shaped by moderators such as consumer trust, perceived greenwashing, and platform-specific engagement, which can either amplify or undermine SDM's impact (Bhambri & Woolley 2022). A well-framed sustainability message on Instagram resonates with Gen Z, but falls flat among older demographics.

Mediating factors such as green attitude formation, brand love, and eco-guilt explain the psychological mechanisms behind consumer responses, that helps in integrating SDM strategies and tangible outcomes (George et al. 2021). Ultimately, successful SDM strategies result in measurable outcomes, including increased green purchases, brand loyalty, and word-of-mouth advocacy, proving that ethical digital marketing can simultaneously drive



Fig. 4 Characteristics (10 prominent antecedents, mediators, moderators and outcomes) of Sustainable Digital Marketing (SDM) research. Source: Author's Work (2025)

profit and positive environmental change (Karki & Thapa 2021). This integrated framework highlights how SDM operates within a dynamic ecosystem where external drivers, audience perceptions, and psychological triggers converge to shape sustainable consumer behaviour in the digital age.

4.1.3 Most prominent contexts concerning sustainable digital marketing (SDM)

The TCCM framework's contextual dimension in sustainable digital marketing (SDM) research reveals critical industry-specific variations that shape scholarly enquiry, as shown in Table 7. E-commerce studies focus on the behavioural impact of eco-friendly logistics, while fashion research examines digital storytelling's efficacy in altering fast fashion consumption patterns (Guandalini 2022).

The food sector predominantly employs traceability technologies as their trust-building mechanisms, in contrast to hospitality's emphasis on green branding's influence on customer

Table 7 10 Most Prominent Contexts in Sustainable Digital Marketing (SDM) research. Source: Authors' Work (2025)

Context	Focus Areas	Typical Study Objectives
E-commerce & Online Retail	Digital platforms, consumer purchase behaviour, eco-friendly delivery	Assess sustainable practices in digital retail and their impact on consumer choices
Fashion Industry	Fast vs. slow fashion, digital branding, influencer marketing	Explore sustainability communication and green consumerism in fashion marketing
Food & Agriculture	Organic products, traceability, digital labelling	Promote transparency and trust via sustainable digital storytelling
Tourism & Hospitality	Eco-tourism, digital trip planning, green branding	Evaluate how sustainable marketing enhances brand loyalty in hospitality
Post-COVID Digital Shift	Recovery marketing, virtual campaigns	Understand digital transformation's role in achieving sustainable consumer engagement
SMEs & Startups	Resource constraints, digital innovation, sustainability narratives	Investigate digital sustainability strategies in small business contexts
Multinational Corporations	CSR campaigns, global sustainability reporting, digital engagement	Analyse global campaigns' effectiveness in diverse cultural and economic settings
Higher Education & Academia	Institutional branding, student recruitment	Examine how universities apply SDM to align with sustainability goals
Emerging Markets	Mobile-first strategies, digital literacy, sustainability awareness	Identify barriers and opportunities for SDM in low-to-middle-income contexts
Cross-cultural Studies	Comparative digital strategies, cultural values, sustainable messaging	Understand how culture influences perceptions of sustainability in digital campaigns

retention (Henriksen et al. 2021). Emerging market studies highlight mobile-platform adoption barriers, whereas cross-cultural analyses distinguish how collectivist versus individualist values moderate message reception (Guandalini 2022).

Research studies during the post-pandemic era investigated the influence and potential of virtual engagement on sustainability aspects, while SME studies explore resource-constrained digital innovations (Guandalini 2022). These defined contexts facilitate comparative research while preventing inappropriate generalisations across dissimilar industry settings.

Cross-industry analysis encompasses 12 sectors with varying SDM implementation contexts. Generalisability limitations include: (1) Industry-specific regulatory environments affecting sustainability requirements, (2) Consumer segment differences influencing digital engagement patterns, (3) Technology infrastructure variations impacting implementation feasibility. These were addressed through sector-stratified analysis, identifying universal SDM principles (consumer transparency expectations, measurement accountability) and context-specific adaptations (B2B vs B2C communication strategies, regulated vs. voluntary sustainability initiatives).

4.1.4 Most prominent methods concerning sustainable digital marketing (SDM)

The methodological approaches for SDM research are presented in Table 8. Quantitative methods, particularly SEM and experimental designs, dominate hypothesis testing about green consumer behaviour, while qualitative case studies enable an in-depth understanding of sustainable branding narratives (Guandalini 2022).

Mixed-methods approaches are increasingly valuable for bridging the perception–action gap in sustainability marketing (El Idrissi and Corbett 2016). Content and social media analytics emerge as powerful tools for detecting greenwashing and analysing real-time consumer engagement, especially in fashion and FMCG sectors.

Advanced techniques like Machine Learning (ML) enable predictive modelling of eco-conscious segments, whereas bibliometric analysis maps the rapid evolution of SDM scholarship (Sharma et al. 2020). Notably, method selection strongly correlates with research context in that experimental designs, for example, are predominant in e-commerce studies, while system dynamics modelling is primarily used in long-term impact assessments (Sharma et al. 2020). The findings highlight the need for methodological pluralism, where combining techniques (e.g., web analytics with interviews) yields the most robust insights into the complex interplay between digital marketing and sustainability outcomes (Nyagadza & Bashar 2025).

This methodological diversity reflects SDM's inter-disciplinary nature while maintaining rigorous theoretical foundations.

A thorough framework that combines the theoretical, contextual, methodological and characteristic aspects of SDM research into a logical knowledge structure is given in the TCCM Conceptual Roadmap for Sustainable Digital Marketing as shown in Fig. 5. Ten well-known theories led by Grounded Theory (34 studies) and Theory of Social Exchange (23 studies) are demonstrated in the model as offering fundamental knowledge in a variety of application contexts from fashion and e-commerce to emerging markets and cross-cultural settings.

Table 8 10 Most Prominent Methods in Sustainable Digital Marketing (SDM) research. Source: Author's Work (2025)

Methodology Type	Common Methods	Tools/Techniques	Application in SDM Research
Quantitative	Surveys, Experiments, Structural Equation Modelling (SEM), Regression Analysis	SPSS, AMOS, SmartPLS, R, Python (statsmodels, scikit-learn)	Testing hypotheses related to green behaviour, digital engagement, sustainability attitudes
Qualitative	Case Studies, In-depth Interviews, Focus Groups	NVivo, ATLAS.ti, manual coding	Exploring sustainable branding, storytelling, stakeholder perspectives
Mixed Methods	Integration of survey+interviews or case studies	Combination of SPSS+NVivo, triangulation frameworks	Providing comprehensive insights on digital campaign impacts and perception gaps
Content Analysis	Thematic & visual analysis of digital content	NVivo, LIWC, Python (NLTK), Leximancer	Examining social media sustainability messaging, eco-branding strategies
Bibliometric & Meta-Analysis	Citation and co-word analysis	VOSviewer, CiteSpace, Biblioshiny	Mapping research trends, knowledge structures, influential publications
Social Media Analytics	Engagement analysis, sentiment, influence tracking	Netlytic, Brandwatch, Hootsuite, Python (Tweepy, Vader), Gephi	Studying consumer interaction with sustainability content on platforms like Instagram, X
Machine Learning & AI	Classification, clustering, sentiment analysis	Python (scikit-learn, transformers), R, RapidMiner	Predicting eco-consumer behaviour, automating green content classification
Web/Data Mining	Clickstream analysis, behaviour tracking	Google Analytics, Tableau, Python, SQL	Analysing consumer journeys and sustainable content performance online
Experimental Design	A/B Testing, Lab Simulations	Qualtrics, MTurk, custom-built interfaces	Measuring the effect of sustainability claims in digital advertising or campaigns
Simulation & Modelling	System Dynamics, Agent-Based Modelling	AnyLogic, NetLogo, MATLAB	Modelling the long-term impact of sustainable digital strategies on markets or behaviour

The framework further illustrates how antecedents like consumer eco-consciousness and corporate sustainability goals are moderated by trust and perceived greenwashing which are then mediated by psychological mechanisms like brand love and green attitude formation leading to quantifiable outcomes like increased green purchases and brand loyalty. The roadmap projects future opportunities for specialization and integration while charting the evolutionary trajectory of SDM through three distinct phases: emergence (2010–2015), acceleration (2016–2019) and maturation (2020–2023). The model most importantly identifies six strategic research avenues that fill in the current knowledge gaps: the creation of governance frameworks through multi-stakeholder cooperation models the theoretical integration that calls for hybrid frameworks beyond traditional marketing paradigms the resolution of the technology paradox that balances AI personalization with energy consumption concerns demographic-specific consumer response patterns the development of ethical guidelines for transparency and anti-greenwashing and cultural adaptation strategies for global implementation. In addition to providing a retrospective mapping of SDM scholarship, this integrated roadmap acts as a guide for researchers looking to enhance the field by methodically examining understudied theoretical intersections methodological advance-

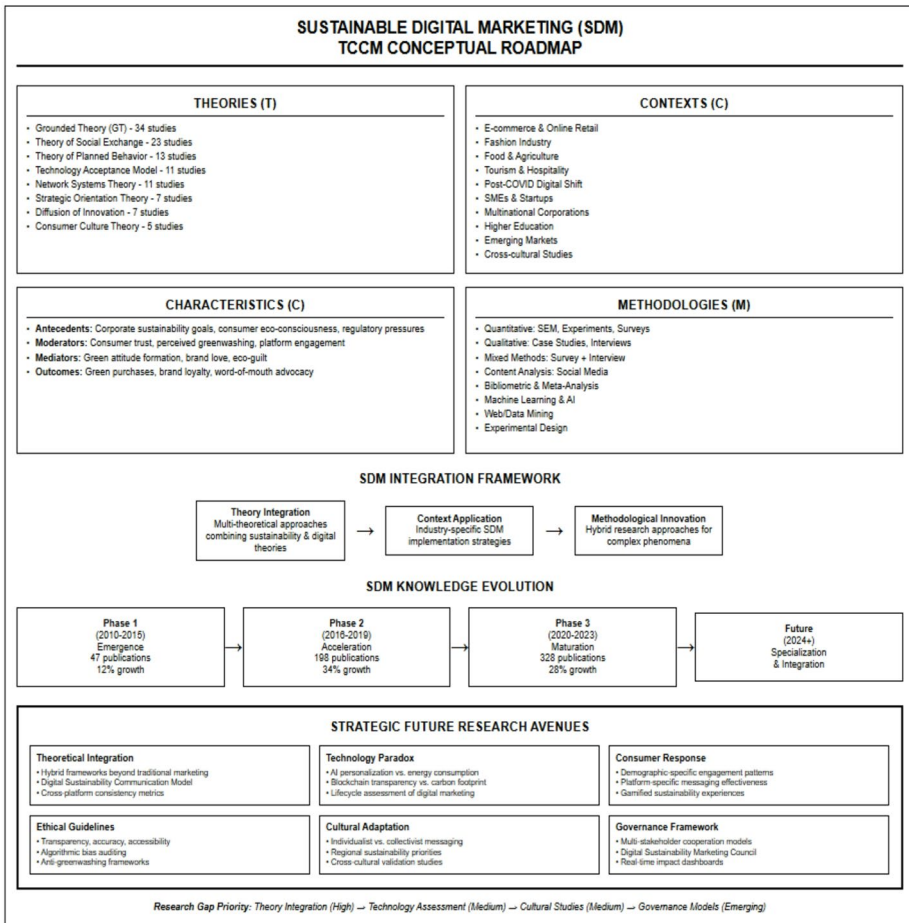


Fig. 5 Conceptual Roadmap Synthesizing TCCM Insights into Sustainable Digital Marketing (SDM). Source: Author's Work (2025)

ments and real-world applications that connect sustainability science and digital marketing practice.

5 Research implications

The following sections details the social, practical, and theoretical implications of the current research study.

5.1 Social and practical implications

The results of the systematic literature review offer opportunities and challenges for promoting sustainable consumption. Digital technologies have significantly enhanced consumers’

trust of sustainable consumption practices, including consumption behaviour. The use of sensory evaluation techniques and block chain technology to track the implementation of sustainability practices is credited with the growth in consumer trust. The use of digital technologies has been applauded for making it easier for consumers to adopt sustainable consumption practices. Digital platforms were found to promote sustainable consumption practices by enhancing perceived self-efficacy, digital green identity, social sustainability and consumer well-being.

The systematic literature review revealed that the metaverse gives consumers immersive experience that allows them to interact and engage with sustainability practices-oriented stimuli. Throuimmersion, the metaverse empowers consumers to assess the functional attributes of sustainable products and understand how they differ from conventional alternatives. Literature reviewed showed that augmented reality and virtual reality technologies may be used as potent tools for promoting environmental awareness and imparting environmental knowledge. By observing, in virtual environments, how their individual and collective behaviour contributes to environmental sustainability, literature revealed that consumers feel capacitated to address environmental challenges.

The digital platforms further the aspirations of SDG12 by reducing the physical consumption of resources and improving supply chain sustainability. By way of example, the use of online food provisioning platforms is credited with stimulating organic food consumption and reducing food waste by introducing novel food preparation and storage strategies. Consumer scepticism also emerged from another stream of studies reviewed. Consumers were found to doubt the reliability of digital technologies used to track the authenticity of sustainability claims. Similarly, in the context of sustainable tourism, environmental infidelity was identified as an emerging challenge. Environmental infidelity refers to the inability of the virtual environment to depict real world scenarios, such that it is regarded as a form of misrepresentation. The degree of immersive experience associated with virtual environments was also found to be dependent on the quality of the interface device. Consumers in emerging markets were found to be unable to afford the cost of advanced virtual reality interface devices such as haptic-cue related applications. Reviewed studies revealed that digital technologies have the potential to adversely affect consumer well-being. The possibility of consumers, if not monitored, engaging in obsessive compulsive behaviour was also identified as a major challenge. A mechanism is therefore required for promoting consumer mindfulness in using metaverse.

A decision tree is shown in Fig. 6, depicting the framework for marketers to develop their strategies for sustainable digital marketing practices.

This above decision tree provides a structured framework for marketers navigating Sustainable Digital Marketing (SDM) strategies. It begins by guiding practitioners to assess their orientation—whether sustainability is integrated alongside profit or not. Next, it highlights the importance of choosing an appropriate theoretical lens (consumer behavior, technological adoption, or strategic frameworks) to ground decision-making. The tree then directs attention to the context of application—such as retail, fashion, food, tourism, or SMEs—since industry dynamics shape sustainability communication. From there, marketers can identify methodological approaches, ranging from traditional surveys and qualitative studies to advanced analytics and AI-driven methods. Finally, all pathways converge toward future directions, encouraging hybrid models, ethical considerations, lifecycle think-

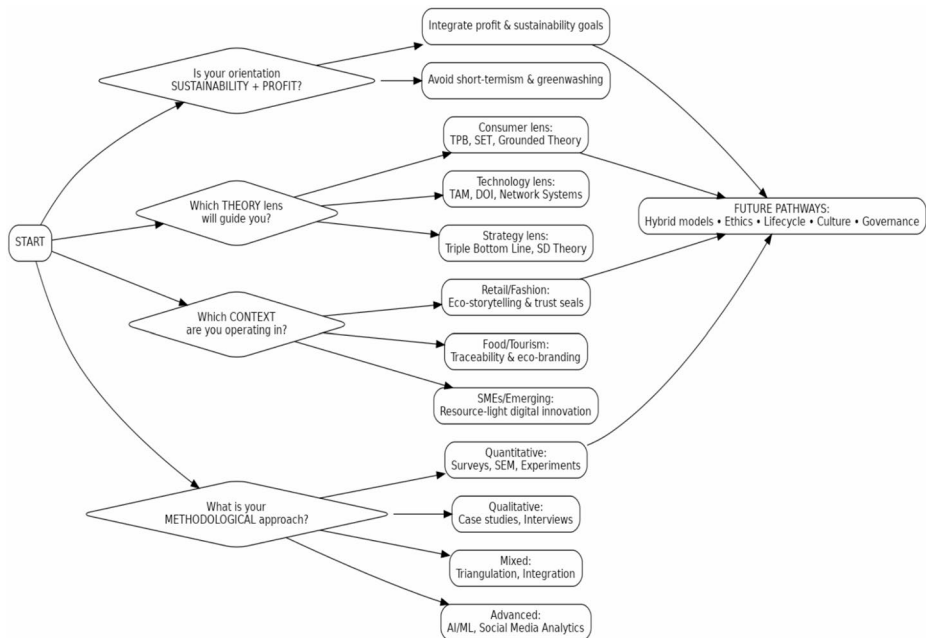


Fig. 6 Decision Tree for Marketers of Sustainable Digital Marketing (SDM). Source: Author's conception (2025)

ing, cultural adaptation, and governance frameworks. This visual tool ensures marketers align their strategies with both sustainability goals and evolving digital ecosystems.

5.2 Theoretical implications

This study contributes to literature by underscoring the role of digital platforms in reconfiguring social sustainability, de-materialisation and consumer well-being. Specifically, the results indicate that SDM promotes consumer well-being, which is a form of social sustainability. Virtual communities were found to afford consumers the opportunity to escape from routine, stressful daily activities. Studies reviewed also revealed that the desire to belong to a community of like-minded consumers improves subjective and eudemonic well-being, which could be used to promote sustainable consumption practices. Moreover, online fashion sharing platforms were found to actively promote dematerialisation, minimising over-consumption and the depletion of resources.

This study also contributes to literature by the importance of how prior and current Sustainable Digital Marketing (SDM) research domain is integrating sustainability into general marketing and technology, especially in the related theory (such as grounded theory, theory of social exchange, theory of planned behaviour, technology acceptance model, network systems theory, strategic orientation theory, diffusion of innovation theory, consumer culture theory, triple bottom line, sustainable development theory). This emphasises a more forward-responsible-thinking approach to business organisations. The aforementioned theories need to be refined by including new variables identified as prominent antecedents, mediators, moderators and outcomes, in this current discourse. Furthermore, the current

study integrates and broadens the scope of Sustainable Digital Marketing (SDM) research by pushing the holistic agenda of long-term social and environmental sustainability theoretical development. These theoretical contributions advance the academic knowledge that is crucial to industrial and commercial practice.

6 Limitations, conclusion and future strategic research avenues

This study reviews literature on the role of SDM in the performance of sustainable consumption practices. The SDM offers significant opportunities for promoting sustainable consumption practices in the metaverse. The SDM revealed that the metaverse accords consumers an immersive experience that allows them to interact and engage with sustainability practices-oriented stimuli. Through multi-sensory immersion, the SDM empowers consumers to assess the functional attributes of sustainable products and understand how they differ from conventional alternatives. The SDM was found to promote sustainable consumption practices by enhancing perceived self-efficacy, digital green identity, social sustainability, de-materialisation and consumer well-being. The carbon footprint and energy consumption from digital technologies was identified as one of the major unintended consequences of promoting sustainable practices.

The methodology applied in the current study involves rigorous, comprehensive, complex and time-consuming processes when dealing with large datasets. This literature review of SDM is a new inter-disciplinary field that requires both methodological and theoretical innovation. The limitations highlight the need for more sophisticated theoretical frameworks and rigorous empirical methodologies to further SDM scholarship even though our SPAR-4-SLR methodology offers thorough coverage of the body of existing research. Theory models that go beyond conventional marketing paradigms are necessary owing to the complexity of digital sustainability communication, which includes algorithmic curation technological mediation and virtual environmental representation. For marketing practitioners, future research should create hybrid frameworks that incorporate knowledge from sustainability science, digital media studies and environmental psychology. Our reviews methodological flaws highlight the greater difficulty of employing tried-and-true research methodologies to examine rapidly changing digital phenomena. In addition to addressing the causal attribution issues that constrain current knowledge, the suggested quantitative mixed-methods and experimental designs open avenues for producing more solid evidence on SDM effectiveness. For marketing academics and practitioners, SDM ultimately signifies both a chance and a duty.

Evidence-based strategies are required for sustainable digital marketing for the growth of digital technologies that play a greater role in sustainability communication. This review also offers the fundamental scenario required to further study and develop more complex theoretical knowledge and make useful recommendations for businesses looking to use digital platforms for genuine sustainability communication. In addition, the inter-disciplinary nature of sustainable digital marketing requires the integration of new frameworks that address the dynamics of digital ecosystems with established theories like the Theory of Planned Behaviour and Social Cognitive Theory. Real-time feedback loops algorithmic mediation and multi-platform message adaptation are all included in our suggested Digital Sustainability Communication Model while cross-platform consistency and digital authen-

ticity metrics are covered by the Sustainable Digital Engagement Framework. Technology plays a paradoxical role in SDM: blockchain facilitates supply chain transparency and validates sustainability claims while artificial intelligence allows for personalised sustainability messaging and predictive environmental impact analytics. However, both technologies raise energy consumption issues that run counter to sustainability goals. Digital innovation requires thorough lifecycle assessments of digital marketing activities because it reduces physical materials and transportation while increasing data centre energy consumption and electronic waste. The response of consumers varies greatly, with demographic younger audiences favouring social media integration and gamified sustainability experiences while older audiences value in-depth information presented in conventional digital formats. Platform-specific guidelines and algorithmic bias auditing support the four ethical pillars of transparency accuracy, accessibility and accountability, which are necessary for the effective implementation of SDM. Since individualistic cultures favour personal impact demonstrations and collectivist societies respond better to messaging focused on the community, cultural adaptation is crucial. Multi-stakeholder cooperation between marketing companies' consumer advocacy groups environmental agencies and technology platforms should be facilitated by governance frameworks. By combining blockchain-based verification systems and real-time environmental impact dashboards, the proposed Digital Sustainability Marketing Council model allows industry self-regulation with government oversight guaranteeing accountability and transparency in sustainable digital marketing practices.

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Declarations

Competing interests The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Consent for publication All authors consent to the publication of the article.

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