

Research Article

A Systematic Literature Review on AI- Driven Sustainable Marketing Optimization

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Abstract: A transitional shift from Industry 4.0, inclusive of rapid growth in Big Data Analytics lead to development of Internet of Things and Artificial Intelligence to Industry 5.0 whose main theme is human centrisim and sustainable wellbeing, has created a major shift in both marketing practices and consumer behaviour. The development in AI over the passage of time has not only driven innovation in marketing segment but has made people think in which directions these advancements are shaping both consumer behaviour and influencing society at large. While Sustainability has become a pressing concern in the current global landscape, marketers have promptly shifted from what was called as basic marketing strategies to a more modern approach which aims to achieve a balance between profits and social and environmental responsibilities. This study analysis the marketer's viewpoint in relation to their evolving marketing strategies to be in coordination with increased emphasis on sustainability by analyzing peer-reviewed papers from Scopus and Google Scholar between the years 2000 and 2024, using keywords like "AI in marketing", "marketing optimization," and "sustainable marketing". The research gap identified reflects the lack of a unified perspective on how AI is operationalized to drive sustainable marketing outcomes. A ballpark view of the current literature available highlights AI - Driven tools such as chatbots, predictive analytics, and conversational marketing are improving personalization and efficiency, they also support the Triple Bottom Line (TBL) approach- balancing profit, social responsibility, and environmental care. As the study progresses further critical concerns like data biases, ethical concerns, uncertain long-term impacts of technology, and privacy issues undermining the efforts toward sustainable marketing are also analyzed to come to a holistic view on AI-led sustainable marketing aspects.

Keywords: Marketing, Artificial Intelligence, Sustainability, Triple Bottom Line, Big Data, Predictive Analytics, Machine Learning.

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INTRODUCTION

Before dwelling into the transitional phase of industry 5.0 and accessing its essence in terms of development in marketing domain, it's imperative to understand that marketing has its roots since ancient civilizations, starting with the basic exchange of goods and services through bartering (Crittenden et al., 2019). As commerce grew, marketplaces became centers for trade and advertisements; with passage of time people witnessed rise of mass media and shifts in consumer preferences causing marketing to evolve into a more organized practice, giving birth to the concept of the 4Ps (Product, Price, Place, Promotion), which formed modern marketing strategies. Over years of Growth-Shift-Development in digital and technological advancements marketing landscape has also shifted gears but the imperative principal remains the same which is managing consumer needs and delivering products (Kumar et al., 2019). For this review, AI has been viewed as "computational agent that acts intelligently" (Poole & Mackworth, 2010, p. 3), drifting away from the traditional concept of understanding AI as machine which acts like a human. Undoubtedly Artificial Intelligence is the most talked about technology as it is a powerful tool to reshape industries, organizations are proactively adopting AI across various business operations as it is seen as game changer to create a more profitable market position (Huang & Rust, 2018). AI seems to have emerged as a critical driver to ensure long-term survival in an environment where hundreds of companies enter the

market on regular basis and thousands exit only due to unmet breakeven points.

Marketing and AI can together be defined as “artificial agents based on their existing knowledge about customers, organization and competition at large” suggest ways to achieve the best marketing results.” (Davenport et al., 2020; Kumar et al., 2019) Strategic view point of AI has become a critical element in marketing, industry players like Google, Spotify, Deloitte have taken an active step to further enhance and optimize their operations by incorporating AI- Driven platforms like Microsoft Cognitive Services, Google Assistant, and IBM Watson in there day to day operations as these platforms suggest ways to improve customer engagement leading to customer retention, automation of key resultant processes to eliminate the scope of human error and predict actual market trends based on the data generated through Big Data Analytics. The results factualize that AI has been seen as a major transformative force in business, where its global market share is expected to grow from \$10.1 billion in 2018 to \$126 billion by 2026 (Tractica, 2020), as per the latest trends of analyzing the impact of AI in marketing functionality it is observed and reported that 65% of businesses use generative AI in at least one of their key functional department, whereas only 5% of generative ai has been fully integrated into production domain. Additionally, 54% of businesses utilize AI agents, and 32% plan to implement semantic segments into their daily tasks and assignments (MIT Technology Review Insights – Redis 2024 Report). This shift reflects a desire to ensure that sustainability must not be compromised despite rising consumption creating a need for formulation of “sustainable marketing” which aims to align business objectives of earning profits with the broader goals of societal and environmental well- being, which is often guided by the triple bottom line (TBL) framework.

PROBLEM STATEMENT

The collaboration of AI-MARKETING-TBL with Sustainability raises a critical issue which needs to be addressed; how to ensure alignment between the data-fuelled AI initiatives and the overarching AI strategies within an organization. As per different peer- reviewed viewpoints, waste minimization, resource optimization, and precise marketing are possible with AI-powered analytics but without constant and careful intervention, AI may create the promotion of overconsumption, exacerbate unsustainable consumer behaviour leading to ethical and environmental risks (Chatterjee et al., 2021; Duan et al., 2019). Ethical concerns like invasion of personal data, lack of transparency also pose a high question concern on the extent of responsibility while integrating AI with marketing (Dwivedi et al., 2021). The existing literature factors in only technological advancement concerning AI capabilities, thereby neglecting its contribution toward sustainable marketing frameworks. With such an explanation, the evolution of AI technologies and concerns of public policies has been addressed. However, the interdisciplinary aspects alongside the environment are yet to be fully redefined.

Objective of Study

The present study aims to examine how AI-driven marketing is contributing to sustainability. To elaborate further, it delves into the concept of “Our Common Future” as outlined by the World Commission on Environment and Development (WCED), which emphasized the need to strike a balance between AI-powered economic growth in coincidence with fulfilment of social and environmental responsibilities. The foundational theoretical models like Technology acceptance model (TAM), Tripple Bottom Line (TBL), Problem Based Learning (PBL) frameworks provide a base in development of Artificial Intelligence which finds its roots in sustainable marketing (Kumar et al., 2021; Elkington, 1997). These theories help create parameters to evaluate the adoption-integration- positioning of AI in marketing domain, which ensures that AI is not viewed as an isolated technological advancement but has its anchors inclusive of ethical responsibility, customer engagement and long-term sustainability. marketing models which could easily adapt to the changing consumer preferences and sustainability demands accordingly (Mikalef et al., 2019; Chatterjee et al., 2023).

RESEARCH METHODOLOGY

This segment is a cumulation of how the existing literature was studied and what are the key observations which could further aid us in justifying the intent of this paper.

Research Design

To develop a comprehensive understanding based on the already established literature SLR based methodology is adopted, which ensures that data is first evaluated based on peer-reviewed studies published between 2018-2024, focusing on articles indexed in Scopus and Web of Science (WOS). The methodology adopted adheres to guidelines outlined by Keele (2007) for systematic review. For transparent and reproducible outcomes PRISMA 2020 framework is used (Page et al., 2021). In reference to the growing convergence Marketing-AI

Sustainability which is directed towards ensuring increased demands for responsible consumption and corporate accountability, this review also factors in evolving research trends, explores unforeseen challenges and proposes a strategic direction for future consumption pattern.

Research Questions

Sustainability in the recent years has evolved from a peripheral concern to a central pillar for marketing strategies. This is

fueled by growing consumer awareness, environmental regulations, and corporate commitments which must be fulfilled due to the UN Sustainable Development Goals (SDGs). However, despite these promising intersections, the literature lacks a unified perspective on how AI is operationalized to drive sustainable marketing outcomes. To address the gap identified this SLR is designed to explore answer of the following research questions

- RQ1: What types of AI technologies and models are being applied in sustainable marketing optimization?
- RQ2: How is the concept of sustainability defined and operationalized in AI-driven marketing literature?
- RQ3: What ethical, environmental, and managerial challenges are identified in the literature?
- RQ4: What are the emerging themes and gaps in research on AI-driven sustainable marketing optimization?

Search Strategy

This section talks about how a unified approach was adopted to explore and find the gap in the existing literature along with a timeframe research observation used.

Databases Used:

For this review only peer-reviewed articles published in well-established journals was used. This includes “SCOPUS” and “Web of Science” databases which contain most comprehensive academic literature in various domains inclusive of AI research and Marketing. These databases are known for their authenticity and creditworthiness in terms of academic credibility. Along with this to get an idea about conference papers and technical reports which aids in factual data “Google Scholar” was used.

Timeframe:

The Articles published from April 2016 to December 2024 are taken for review.

This timeframe captures all the advances and changes various industries have explored in terms of AI driven technologies and sustainable marketing functionalities. This ensures that both the developments as well as challenges are well highlighted.

Data Extraction and Analysis

For review purposes from a total of 120 full-text articles, 90 were studied, they were chosen based on relevance to AI-driven sustainable marketing. Data was extracted using a template capturing fields like: author(s), year of publication, AI technology used, sustainability dimension addressed (environmental, social, economic), marketing application area, research methodology, and key findings.

Thematic Patterns Identified:

From the review, the following themes were noted: Theme 1: Effectiveness and Resource Management – All articles highlighted AI’s capability to optimize the use of resources in digital marketing, minimize redundant campaigns, and enhance operational efficiency. Theme 2: Consumer Participation in Green Activities – Chatbots and sentiment analyzers powered by AI communicate green brand values, assisted with increasing eco-awareness. Theme 3: Transparency and Ethics – Various authors (Cui et al., 2020; Lee et al., 2021) fostered the importance of using models in promoting ethical sustainability narratives. Theme 4: Socio-Environmental Value Alignment – Studies conducted explain how AI systems can be programmed to align brand messaging with consumersustainability values, thereby fostering loyalty and sustainable corporate growth (Kim & Yu, 2020).

Sentiment Analysis and Text Mining

The 4 themes identified above are based on text mining which explains the patterns built on existing literature and to understand the direction as well as the tone of the research, sentiment analysis is taken into consideration. This paper uses both text mining and sentiment analysis as additional instruments for reviewing the literature. While Text mining aided us to methodically find recurring themes and patterns, Sentiment analysis to resulted in finding out how academics felt about these advances in terms of future promising role of AI, Ethical or prejudice issues or the general attitude of consumers towards these continues changes.

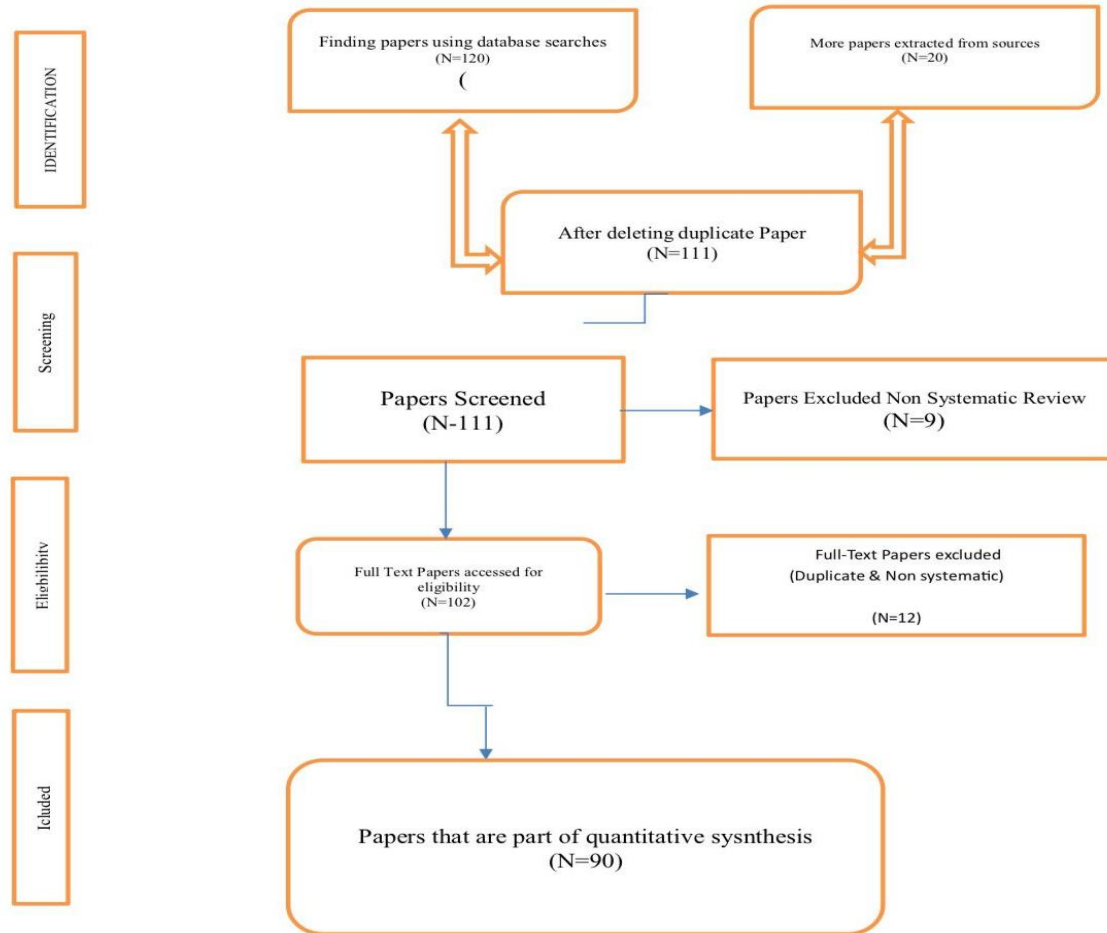


Figure 1: PRISMA Flow Chart

5. Theoretical Framework - To anchor this systematic review paper within a solid research foundation, its important to interpret the emerging trends through well-established theoretical perspectives. Theoretical framework provides foundation for structuring concepts and theories acting like a blueprint which gives explanations in terms of why the study is conducted, exploring relationship between variable and position the new research with existing scholarly discoveries. The use of AI in sustainable commercialization extends beyond technical innovation. It also requires alignment with core principles related to ethical marketing, sustainable consumption, and consumer engagement. This section explores the key theoretical foundation guiding this study.

Foundational Theories – In order to understand whether AI driven technologies are leading to sustainable marketing or creating an unrequired consumption thereby drifting away from environmental concerns this strategic based literature highlights a few theories which lead to offering a structured understanding of the topic taken into consideration.

Sustainable Marketing Theory – Marketing at its core has always ensured creating value for customers which results in a more profit- oriented aspect thereby ignoring other aspects due to which any business is running. This is where Sustainable theory comes into picture which talks about ensuring that at grass root level markets go beyond the traditional profit led strategies to a broader aspect of considering environmental and social wellbeing's as well (Peattie & Belz, 2010; Lim, 2016). This shift requires brands to not only just sell their products but also educate their buyers to make economic-conscious decisions. Today we live in a digitalized landscape where AI has emerged as a center for providing large data sets, uncover consumption patterns and deliver customized content which provides a foundational base for marketers to align their strategies with keeping sustainability into the picture (Kemper & Ballantine, 2019). This supports the theory's proposition that long-term relational value can drive both economic and ecological gain. Collaborating AI and sustainable marketing align well reducing resource waste, creating tailored campaigns for eco-conscious consumers, and working towards circular economy initiatives (Kemper & Ballantine, 2019; Kotler et al., 2022).

Technology Acceptance Model: TAM attempts to explain how people psychologically accept technology. Created in 1989, it has evolved into a robust framework for understanding how users adopt and engage with technologies. While businesses are increasingly adopting Artificial Intelligence (AI) technologies aimed at enhancing

marketing functions, especially in sustainable marketing, TAM still assists in explaining adoption behavior as well as the drivers of effective deployment of AI-powered marketing tools. The more recent changes in TAM regarding its scope to include AI and sustainability incorporated external as social influence, facilitating conditions, and trust that are fundamental components to the adoption of AI in enterprises (Venkatesh & Bala, 2008)

Triple Bottom Line: It is introduced by John Elkington in 1994, is about going beyond the conventional single bottom line “Profit” framework that each organization thrives for and work on a more nuanced framework which includes ecological and social performances and gives equal opportunity to all. It redefines traditional business strategies by targeting the need for firms to focus equally on financial performance (Profit), social responsibility (People), and environmental sustainability (Planet) (Elkington, 1997). TBL has gained momentum specifically after development of Industry 4.0 which talks about digital transformation, be it IOT, Chatbots, or blockchain these changes focus on resource efficiency, transparency, and stakeholder engagement. As per current literature, the MSMEs which had shown resentment in collating profitability with social and environmental segments, have suggested its positive impact in improving the success of organizations. As per a research report in Langsa, Indonesia in 2024 stated that due to incorporation of TBL there seemed a variation in net income of 46% which led to firms experiencing a 27.4% gain in cost effectiveness.

AI and Marketing Integration Models: Artificial Intelligence is transforming industry at a lightning speed where data-driven decisions, customized and tailored campaign, sustainability in consumption are its outcomes. These outcomes have led to traditional Marketing being infused with modern touch thereby providing better marketing condition keeping in consideration that at the end we exchange value for value from consumers. Thus, there are amalgamated models which create a relationship between AI and Marketing.

NOAH Framework: A Breakthrough Marketing-AI model which works on optimizing Email Marketing by creating a model that deals with delays in feedback and large-scale optimization constraints, this is used by LinkedIn where users outreach is optimized, and long-term user engagement algorithms are tailored.

Agentic Multimodal AI Framework: It is a multilingual marketing AI system which had large language models, personalized driven message options to create a hyper-personalized advertisements for both business to business and to customers across diverse cultural domains (Chakraborty et al. (2024). It is highly adaptable and relates to customers by creating tone-based content for customers.

6. AI Application in Marketing

As we dwell deeper, precedence has been established that AI has evolved and its application across various domains be it marketing or finance or for that matter the latest shift towards sustainability has enabled even layman to take smarter decision with the help of Big Data Analytics, or ensure that they get tailored experience.

6.1 Consumer Behavior Prediction- AI creates an environment where marketers can now easily predict and understand human dynamics by analyzing the vast source of data which they generate through sources like purchase order history, social media presence, browsing habits. Segmentation- Targeting-Positioning, which once were any marketers fundamental go to strategy has been redesigned and redeveloped by machine learning models like Random Forest, Gradient Boosting. Going a step further, deep learning tools have led to identifying behavioral patterns, analysis of customer sentiments, and then reinforce the learning models which have become adaptive in nature. AI by analyzing past transactions and search queries of customers help predict purchase intent of the customers, the same was validated by Chatterjee et al. (2021) which stated that AI could predict with up to 86% of accuracy the purchase intent of customers.

6.2 Personalized Marketing Campaign – AI has intervened its functionality in marketing by not only giving explanations for consumer behavior but by also creating tailored customer experiences. AI processes customers patterns and behaviors in real- time and then dynamically personalizes its message, like if a consumer is just thinking about visiting a place and searches the same on his social media handle then ads, emails or pop-ups related to the topic searched gets easily visible with all the offers availed from a vast pool of choices (Chatterjee et al., 2021). Central Platforms like Netflix, Spotify or Amazon use advanced algorithms like collaborative filtering options and deep learning to provide product suggestion on the basis on past behaviours. Mogaji & Nguyen (2022) have stated to ensure more human interaction and study interaction patterns AI predicts both time and communication channels leading to developments in click-through rate systems or understanding conversion rate dynamics accordingly. The below table is a concise statistical brief up as shared by various scholars about AI- Driven Personalized Marketing Matrix.

Table 1: AI Intervention and Contribution

Metric	AI-Driven Improvement	Source
Email open rate	↑ by 29% with personalized subject lines	Chatterjee et al., 2021

Conversion rate	↑ by 34% with AI-generated product suggestions	Davenport et al., 2020
Customer engagement (CTR)	↑ by 41% with sentiment-optimized content	Mogaji C Nguyen, 2022
Customer retention	↑ by 26% due to hyper-personalized offers	Xie et al., 2023

6.3 Chatbot's and Customer Engagement: As top up to analytical consumer dynamics with a hint of personalized campaigns, Chatbots have become the next big thing in our digital driven industry. It plays a vital part in marketing strategies as it has increased real- time conversations 24/7. Technologies like NLP, Machine Learning are used to imitate human-like conversation which makes it easy for customers to interact without even realizing that its an AI-human based interaction taking place. The anthropomorphic design of chatbots leads to creation of human-like features, which improves customer perceptions.

7. Sustainability in Marketing: AI has deep level involvement and contribution towards marketing creating a interlinking bridge between AI-Marketing- Sustainability must be clear with what sustainability is inclusive off.

Environmental dimension: With the ongoing development in all sectors of the economy there has been an increase in carbon footprint as well which will to scarcity of resources in near future, thus this dimension focuses on minimizing ecological footprints through sustainable practices which includes use of renewable energy, exploring solar segment, practicing recyclable packaging all which will lead to reduced emissions thereby reflecting the principle of ecological stewardship. Social dimension: This aspect is all about fair treatment of employees, suppliers, and communities. It includes labour rights, diversity, equity and overall community development initiatives adopted by small to large enterprises. (Martin & Schouten, 2012).

Economic dimension: Caring about environment and society at large is important but if it leads in impact the profitable aspect, then the same needs to be reiterated as organizations can only function or survive if the generate enough revenue from their operations-thus this is what the economic dimension is all about. Therefore, the above three dimensions align with TBL framework as it includes Planet, People, Profit in one domain where this framework supports the concept of measuring success from three aspects namely- Finance, Environment and Society. Thus, Sustainable marketing ensures that the paradigm effectively shifts from short-term optimization to long-term value creation.

Green Marketing Strategies: One of the key elements of sustainable marketing is green marketing. The word green is all about use of products or services which have environmental benefits, the goods which don't take away from the environment but give something to environment. A Study by White et al. (2023) highlighted the influence that eco-labels had on purchasing decisions, the labels served as tool to signify the environmental attributes of the products. With heightened focus on reducing environmental impact firms have started redesigning their deliverables which includes use of recyclable materials, use of solar segment, saying no to plastic and so on. Mehraj et al. (2023) talked about the CSR initiatives, which when effectively communicated, leads to influencing consumer behaviour, specifically younger demographics. Firms have started adjusting to pricing and packaging as well only to ensure effective communication towards greenness, which is the need of the hour so that the new eco- conscious customer segment is also targeted. The impact that AI has on these strategies in terms of analyzing consumers' response will be discussed further.

AI-DRIVEN SUSTAINABLE MARKETING OPTIMIZATION

The amalgamation of AI Sustainable Marketing has changed the direction of business ventures where they have started linking their promotional campaigns with environmental objectives. Intelligent tools like NLP, Big Data have led to increased efficiency, precisions and ethical alignment towards marketing initiatives. As per Jaiswal and Singh (2022), AI applications in sustainable marketing ensures firms to estimate green product demand, leading to decreasing overproduction and waste of resources. Similarly, Gupta et al. (2023) highlighted that AI ensures real-time consumer segmentation based on ecological aspects, which results in highly focused green message.

8.1 Industries adopting AI-Driven Sustainable Marketing Optimization

A new breakthrough has been created due to intersection of AI and sustainable marketing which has created a scope for a more purpose-driven business strategy to become trend setters in this new world of changing taste and preferences. To begin with Unilever was at the forefront to adopt AI-powered sentiment analysis model and aligned the same with environmental innovation, the new eco-conscious product line "Love Beauty and Planet" is all about using recyclable materials and reduce plastic waste by over 15% (Unilever, 2023). In the fashion segment, H&M Group has created a "Circulator" Platform by fusing AI into its sustainability agenda through demand prediction which used machine learning to create garments designed for reuse to promote reduced overproduction and textile waste while promoting circular fashion (H&M Group, 2022). Tech giant Google also contributes through its Environmental Insights Explorer (EIE), which is all

about use of AI and satellite images to measure urban emissions and transportation footprints. They highlighted that firms should harness these imitative for location-based sustainable marketing campaigns which leads in promoting green mobility (Google, 2023). Talking about the food industry, Nestlé has taken an initiative to reduce carbon footprint by developing and investing in AI models which aid to trace supply chain emissions and optimize logistics routes. Nestlé's marketing campaigns now focus on traceability and ethical sourcing, both of which are not focused by real-time AI analytics currently. Another standout example is L'Oréal, which has incorporated AI into its Green Sciences initiative by optimizing ingredient sourcing and eco-packaging. The brand promotes this environmental responsibility across targeted digital platforms, resonating especially with Gen Z and millennials. To monitor water and energy consumption in real time to promote sustainability-driven campaign, PepsiCo developed AI systems for the same through verified operations model, (PepsiCo ESG Summary, 2022). These cases collectively define AI as not a just technological enhancer but a transformative driver of sustainable marketing.

8.2 Metrics for Measuring Sustainability and Optimization

Environmental sustainability metrics work towards assessing the ecological impact of AI- driven marketing practices. The key area of focus is reduction of carbon footprints where AI technologies are developed to ensure that optimistic logistics are used, digital campaigns are more effectively worked out and product lifecycles are redesigned to reduce the emission of greenhouse gas., Google's application 'DeepMind AI', has enhanced data center energy efficiency by 40%, significantly reducing carbon emissions (Google AI Blog, 2023). As per Microsoft's 2022 Sustainability Report, AI-enabled predictive models led to an improvement of 34% in cloud energy efficiency, coinciding with the firm's net-zero objectives. Waste minimization represents another key dimension where brands like H&M have utilized AI-driven demand forecasting tool to reduce overproduction and textile waste by 15%, while maintaining their production stock as well (H&M Sustainability Report, 2022). AI has also contributed to sustainable packaging by analyzing the materials for recyclability and environmental impact, L'Oréal's AI-supported "Green Sciences" initiative explains the enabling efforts of the company to achieve 95% recyclable packaging across its product categories in 2023. AI efficiency metrics focuses on assessing the performance and sustainability of artificial intelligence driven tools within marketing ecosystems. Real-time adaptability is another metric, which reflects AI system's responsiveness to dynamic external factors such as the changing environmental regulations as well as inconsistency in consumer sentiments. Effective data utilization also ensures there is a reduction in computational demand which results in reducing environmental impact from long term perspective.

8.3 Benefits and Limitations of Current Approaches

The 3 metrics as discussed above have positive and negative implications which need to be further explored so that a relevant scenario can be developed which creates a solid foundation in terms of justifying sustainability with AI led marketing. With development in digital technology and data analytics there has been a significant increase in tailoring ways to increase customer reach which is considered critical in boosting awareness of sustainable behaviour. These technologies have led to assisting firms in improving their resource planning by minimizing production, exploring new trends. As per recent observations, tactics which led to individual engagement has significant scope in increasing consumer contact and loyalty, which results in stabilizing demand for sustainable goods and services. AI-Driven tools such as real-time communication interfaces and transparent tracking systems allows firms to meet rising consumer expectations while ensuring transparency and responsible ethical behaviour is also intact. On the other hand, it has negative implications too. Baring the advantages there are few concerns which can't be ignored, one such example is the contemporary digital marketing systems which was created with a foundation of immediate results, such as increasing revenue or user engagements, which jeopardizes long-term sustainability goals. There is a rising concern about over-personalization, which has let to violation of customer privacy and has also resulted in biased targeting. According to Magableh et al. (2024), many organizations at ground level face multiple issues to use AI-tool as individuals have insufficient technical knowledge, limited digital infrastructure and lack of specific implementation methods. There is no denying fact that AI systems are created and trained by humans based on previous behavioural data availed which may contain biases leading to generating no true picture in return. While these tools have great potential for improving sustainable marketing, it is important that defined boundaries, strategic monitoring, and ethical governance aspects as pre-decided and monitored on a regular basis.

CHALLENGES AND RESEARCH GAP

9.1 As we reach the final phase of this SLR based paper, one aspect is clear that inclusive of the increased industry interest in amalgamating AI-Sustainability- Marketing together there are several critical challenges and gaps availed in the existing literature which cannot be ignored. These include ethical delima's, data silos, cost issues, and so on which are pondered up as follow:

Ethical and Privacy Concerns -The risk of customer autonomy, no justified transparency, easy exposure of personal data are some of the primary ethical concerns which are hard to ignore only due to the booming AI segment. AI tools are well equipped to collect all sorts of data be it structured or unstructured leading to potential misuse and privacy violations (Martin & Murphy, 2017; Pasquale, 2015). This gets highlights in sustainability campaigns, where it gets even more problematic as consumers expect authenticity and integrity from eco-conscious products as they tend to pay premium prices

Bias in AI Algorithms -One of the most pragmatic problem AI Application is “Algorithm Bias”. It boils down to the point where these AI systems are trained, during induction phase the systems are trained on incomplete data sets or on self-created data which has scope for biases being present, now these biases can lead in undermining campaigns credibility and cause reinforcement of societal stereotypes as well as mis-representation of consumer preferences (Binns, 2018; Mehrabi et al., 2021). This challenge magnifies to a level of 100 when sustainability is propaganda using automated personalization Scalability and Cost -Development in AI is not only expensive but is time consuming even if it leads in demonstrating the potential to increase small-scale operations to large scale. Their costing is a concern for SME’s who are even if interested in spearheading sustainability options are unable to due to the extreme costing paradigms (Kraus et al., 2021). Along with this, the buzz about real-time AI systems is at a very fragile stage as it is at its early phase of development which again highlights the costing parameters thereby showing only tech goats can take first mover advantage of the same (Lu et al., 2023).

9.2 Gap in existing Literature

Till now we have explored all the developments and scholarly observations done by various scholars, but there still marks several important deficiencies which must be well explored to frame out a solid foundation for AI-Driven Marketing Sustainability. To begin with there is fragmentation and siloed knowledge. According to Dwivedi et al. (2021), sustainability and marketing are often studied in isolation, which limits the scope of cross-disciplinary synthesis. This results in studying all these aspects separately leading to prevention of formation of a holistic framework necessary for effective sustainable marketing strategies that leverage AI technologies. Second, a limited focus on psychological constructs which characterizes much of the AI marketing literature. All the studies till now have given weighed advantage to performance metrics like engagement ratios, click-through rates, or sales conversion, but on the contrary there a few or rather no deeper psychological impact matrices which are specifically designed to measure consumer trust, motivation, or emotional resonance aspects. This is a major aspect which is undermined and requires a lot of research especially in the context of sustainability where it’s the emotional and ethical factors that influences consumer decision-making. Scarcity of research on adaptive and real-time AI models is another gap in the existing literature which has been unexplored and relates to AI models dynamically adjusting themselves based on consumer feedback, environmental shifts, or socio-political changes. (Lu et al., 2023). Fourth, geographical and cultural bias is evident across the entire literature Most of the research done till now is concentrated in Western contexts deliberating their focus on developed countries, thus leading to the underrepresentation of developing regions. This has led to creation of blind spots in analyzing how diverse consumer psychologies, cultural norms, and economic constraints affect the adoption of AI in sustainable marketing. Most of the existing literature is focused on short-term metrics that implies looking at immediate engagements thus ignoring the long run aspects as well. All these gaps in conclusion highlight the need for future research that is transdisciplinary, culturally inclusive, psychologically informed, and morally sound.

FUTURE RESEARCH DIRECTION

The future of AI led sustainability marketing lies in use of more emerging AI-Technologies, specifically Generative AI & Explainable AI(XAI). Generative AI talks about models like GPT-4, DALL-E & Stable Diffusion. This model is all about developing machines to a level that they work on self-automation basis for example creation of human-liked text or images. Research should be focused on exploring the life-cycle assessments of AI models keeping in view the ethical boundaries as well. While generative AI is all about creation, Explainable AI (XAI) addresses the aspect of explainability and blameworthiness in decision-making systems. From sustainable marketing point of view, XAI tools will explain how AI models segment consumers, recommend eco-products, or prioritize certain environmental values over others thereby ensuring transparency which is an essential aspect for both internal (e.g., marketers, sustainability officers) stakeholders and external consumers. Further research should be able to answer the following aspects- How do customers feel about justifications for sustainability suggestions produced by AI? Does XAI increase long-term customer loyalty, satisfaction, and trust in green campaigns? How can XAI be successfully included into marketing platform user interfaces without overwhelming or perplexing users? The circular economy (CE) paradigm -The Paradigm focuses on a closed-loop systems that help in reducing waste, ensures extend product life cycle and encourages regenerative resource usage, thereby having the potential of becoming a strong pillar for sustainable development. Firms can collate marketing tactics with environmental goals, increase operational efficiency and promote consumable sustainable products by integrating AI technologies with the ideas of the circular economy. Artificial Intelligence can also contribute to circular economy practices by ensuring data-driven decision-making, predictive analytics, and real-time analysis throughout the product and marketing lifecycle. AI-powered systems can predict product returns, identify reuse of opportunities, and optimize logistics to minimize carbon emissions.

CONCLUSION

This paper is a consolidated version highlighting the key insights related to intersection of AI and Sustainable Marketing, based on extensive analysis of over 90 peer-reviewed publications. The key findings indicate that AI has considerable

potential to enhance and promote marketing effectiveness with the help of AI tools leading to personalization, predictive modeling and so on but its application towards sustainability remain underdeveloped. If AI is strategically applied it acts as a catalyst for sustainable transformation, example Magableh et al. (2023) through his research supported that AI contributed towards improved customers satisfaction and ensured financial sustainability was stable enough all due to data-driven personalized strategies. Conceptual Frameworks like Triple Bottom Line (TBL) and the Technology Acceptance Model (TAM) offers ways to evaluate the consequences of AI in sustainable marketing initiatives, thereby facilitating a balanced evaluation on how AI strategies can be aligned with environmental, social, and economic objectives. Instead of its advantage the current body of research remains fragmented, with limited integration across disciplines highlighting critical gaps in several areas. There seems lack of research in exploring adaptive, real-time AI systems for understanding from suitability point of view, specifically in developing countries where consumer behaviour and infrastructure have contrasting views significantly.

Reiterating the Relevance of Aligning AI and Sustainability in Marketing

It is imperative to understand that consolidation of AI and sustainability in marketing is considered not only as an opportunity but also a responsibility. With the ongoing environmental concerns and consumer awareness for more responsible business practices, firms must include AI to not only enhance efficiency and profitability but also to drive environmental and social change. When AI systems are designed one must ensure that they are modelled ethically, and the systems are contextually aware about the support they can provide be it ensuring transparency in sustainability or supporting circular consumption models. However, this requires a deliberate alignment of AI technologies with ecological values and human-centric principles; if not aligned as required there are enhanced risks of superficial "green AI" practices which will lead in misleading all its stakeholders.

Call to action for researchers, practitioners, and policymakers

This SLR based paper calls for involving multiple stakeholders to fully iterate AI's potential towards sustainable marketing. It is important to study this cross-disciplinary research to ensure that data science, economy, ethics, societal aspects and environmental well-being are well connected and deliver longitudinal research which not only works with diversified datasets but also provides a framework which could evaluate sustainability effect and performance outcomes. Practitioners can work towards ensuring inclusivity in marketing and invest more in ensuring transparent algorithms that could empower not exploit consumers. Finally, legislators should ensure establishment of more structured legal frameworks which would aid the ethical application of AI, guarantee data accountability, and protect against unethical strategies.

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