Green Intelligence In Retail: Leveraging AI For Sustainable Marketing Strategies In NCR's Supermarket Chains

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Abstract

Aim: The aim of this study is to examine the impact of Green Intelligence (GI) and Artificial Intelligence (AI) Adoption on Sustainable Marketing Strategies (SMS) in supermarket chains across India's National Capital Region (NCR). It also seeks to assess the extent to which GI and AI tools are integrated into retail operations for advancing sustainability.

Methodology: A quantitative research design was employed using a structured questionnaire distributed to 415 respondents working in various supermarket chains within the NCR. The respondents included store managers, marketing executives, department heads, and operations personnel. The study used a 5-point Likert scale to measure variables under three major constructs: Green Intelligence, AI Adoption, and Sustainable Marketing Strategies.

Statistical Methods: The data were analyzed using Descriptive Statistics, Cronbach's Alpha for reliability testing, Correlation Analysis, and Multiple Regression Analysis to test the proposed hypotheses. Normality, skewness, and kurtosis were also examined to validate data distribution assumptions.

Results: The findings revealed that both GI and AI Adoption have a positive and statistically significant relationship with Sustainable Marketing Strategies ($p < 0.001$). All sub-constructs, including Green Data Analytics, Eco-Conscious Decision-Making, Predictive Analytics, and AI-Based Sustainability Tracking, showed strong correlations with SMS ($r = 0.46$ to 0.62). The regression models demonstrated high explanatory power (Adjusted $R^2 = 0.486$ for GI and 0.451 for AI). Descriptive results further confirmed widespread adoption of sustainable practices and technologies among supermarket chains in the NCR.

Originality/Value: This study is among the first to empirically link Green Intelligence and AI Adoption with Sustainable Marketing in the context of organized retail in India. It contributes to the theoretical discourse on sustainable innovation and provides practical recommendations for integrating AI tools into environmentally responsible marketing strategies.

Keywords: Green Intelligence, AI Adoption, Sustainable Marketing Strategies, Retail, Supermarket Chains, NCR, Environmental Sustainability, Predictive Analytics

1. INTRODUCTION

Within the contemporary climate of the business environment which is characterized by the high intensity of competition and sensitivity to the environmental conditions, the theme of sustainability used to be an issue that existed at the periphery, but now it has become the strategic focus (Arantes & Costa, 2024). The retail organizations and, in particular, supermarket chains more and more come to be demanded to be not only economically efficient but also environmentally sustainable (Bhandari & Sharma, 2022). This being the case, more retailers need to internalize environmental sustainability policies which encourage environmental sustainability in the long-term and sufficiency in the marketplace.

Green Intelligence (GI) is an intelligent utilization of environmental data and sustainable practices that help organizations to lessen their ecological impact (Bhanot, Sharma, & Phuja, 2024). It consists in considering environmentally friendly business decisions, the intelligent use of resources, environmental data analytics, and responsible business operations as an approach in business (Dangelico & Vocalelli, 2017). The retail industry can also use GI to play a major role in the planning, advertisement, and implementation of marketing activities that are majorly sustainable (Haleem et al., 2022).

At the same time, Artificial Intelligence (AI) is changing the retail sector with the best tools on personalization, automation, predictive analytics, and real-time decision-making (Falk & van Wynsberghe, 2024). With a reference to sustainable marketing, through AI technologies, retailers can predict demand, manage waste, enhance consumer interaction about environmental-friendly programs, and monitor sustainability data (Do, Uusitalo, Skippari, & Salimi, 1139). Both AI and GI, combined, create a strong potential to revolutionize the traditional systems of retail marketing into something future-oriented and earth friendly (Li, Tian, Liu, & Lu, 2022).

An appropriate setting to review the application of GI and AI in supermarket chains driving sustainable marketing offers India, National Capital Region (NCR), where organized retailing activities are taking place. The subject matter of far-reaching green marketing and AI integration on a worldwide scale is becoming increasingly popular, however, empirical analysis, at least within the Indian retail scene and specifically with reference to the case formed between sustainability and artificial intelligence, has not yet reached quite the same level (Kulkov, 2023).

This paper is aimed at partially filling this gap with a focus on investigating the scope of GI and AI penetration within the chains of supermarkets in National Capital Region (NCR) and describing their effect on Sustainable Marketing Strategies (SMS). The study of statistical interconnections and practical use of these constructs allows adding to the theoretical level of knowledge and practice of the study of sustainable retail at the managerial level (Carter & Lopez, 2023).

1.1 Background of the Study

The whole world retail market is passing through a paradigm shift based on the factors of increasing consumer awareness of environmental problems, upsurge in the pace of technology, as well as the augmenting compliance regulation regarding sustainable business practices. Against the shifting environment, it is no longer enough to make organizations generate only economic value, the organizations are expected to conduct in a manner that is eco-friendly and socially consistent (Taylor & Wang, 2022). Supermarket chains are the most important stakeholders in the organized retail segment, and the case of their operations presents the peculiarities of combining the tasks of efficiency and sustainable development (Qureshi & Thomas, 2023). They are in the heart of environmental issues owing to their huge supply chains, their use of energy, and their product mix. Consequently, the necessity to find an environmentally-friendly approach towards advertising and product promotion in its overall marketing and operational strategies is urgently required among the retail companies (Martinez & Ochoa, 2024).

Green Intelligence (GI) has become a competitive move to make the environment responsibility by applying sustainable data analytics, green decision-making, smart resource utilization, and operations. It stresses the smart utilization of information to steer the environmental-friendly approaches, especially in the marketing efforts, which affect consumer behavior and consumer purchasing trends (Park & Seo, 2024).

Meanwhile, Artificial Intelligence (AI) is also changing the interactions of businesses with customers, the ability to anticipate demand, and the efficient resources utilization. Sustainable marketing applications: Predictive analytics and other AI-based services like personalization, chatbots, and sustainability monitoring systems help find new ways to cause less environmental impact and improve customer experience in the context of sustainable marketing (Huang & Lin, 2023).

The use of digital and green technologies by the supermarket chains in India, in particular in the National Capital Region (NCR), is growing to ensure that they keep up with the expectations of their consumers and remain competitive in this environment. Nonetheless, little has been studied empirically as to how these combined technologies are working to deliver sustainable marketing performance. The relationship is very important academically and practically in management in terms of providing suggestive insights about the future of responsible retailing (Chong & Tan, 2024).

This research work aims at addressing this gap by investigating how Green Intelligence and AI Adoption influences Sustainable Marketing Strategies of the supermarket chains in NCR. This will give a thorough grasp of the relationship between these constructs and how they have a positive role in making retail practice sustainable.

1.2 Statement of the Problem

Due to the increase in environmental issues and the rise in consumer consciousness, sustainability has been extracted by modern businesses in its strategic needs. In the retail business, supermarket chains are coming under pressure to implement sustainable marketing that is environmentally friendly and at the same time increases customer interaction and brand perception. Nonetheless, the seemingly high value of environmental responsibility has not achieved a successful implementation of sustainability in the major marketing policies of most retail entities.

Simultaneously, recent changes in retail related to the implementation of Artificial Intelligence (AI) have opened up the space of data-driven business logic, personalized advertising, and resource optimization. Together with the help of Green Intelligence (GI), where eco-friendly decision-making processes, green-focused data analysis, and intelligent resource management are involved, these tools can substantially boost the sustainability-centered approaches in marketing. However, there is little empirical evidence that qualifies this integrated strategy, particularly in the case of supermarket chains in India.

The case is the same in the National Capital Region (NCR) in India where the retailing industry is growing so fast, just as it is not clear how well GI and AI are being adapted and how they are helping to create sustainability in marketing results. Previous research has concentrated only on sustainability or on adoption of AI with little emphasis on their synergy. Moreover, the use of such concepts in real-life conditions of organized retailing lacks region-specific studies to assess their usefulness.

Such knowledge gap presents a challenge to retail managers and policy makers in relation to the knowledge of determining the most effective methods as well as areas that need improvement and the strategic alignment of technology and sustainability. Thus, a descriptive research is needed, to achieve an understanding of the bond between Green Intelligence, AI Adoption, and Sustainable Marketing Strategies at NCRs chains of supermarkets.

1.3 Significance of the study

Being a green company is a major issue that is facing modern businesses especially those in the retail industry, which has very heavy environmental ramifications and footprint in terms of its energy demand and use, packaging, and multi-sprawling supply chains. Nevertheless, the concept of sustainability rarely becomes a part of marketing strategies of various supermarket chains operating in India, even though their awareness of the idea is on the rise (Evans & Kumar, 2023).

Although the idea of Green Intelligence and the idea of Artificial Intelligence are separately acknowledged as ones that have the capacity to enhance operational efficiency and environmental performance, not much research is carried out to determine their joint role in terms of sustainable marketing concepts in the Indian retail scene. Specifically, one can identify the lack of research on how such tools as green data analytics, eco-friendly decision-making, and AI-driven personalization can be used to foster environmentally protective marketing in organized retail (Tripathi et al., 2024).

In India, the big box stores in the National Capital Region (NCR), which is India s primary hotbed of organized retail, are becoming progressively vulnerable to the pressures of regulations, consumerism, and competition to engage in activities that are sustainable. Nonetheless, it is not clear how far they use Green Intelligence and AI technologies to promote sustainable marketing (Masnita et al., 2024).

In the absence of empirical evidence, retailers might find themselves too blind to stroke the right tools or practices that cut their ecological footprint but assure the consumer in their commitment to save and maintain consumers loyalty. Hence, the current study is urgently necessary to explore the correlation among the concepts of Green Intelligence, AI Adoption, and Sustainable Marketing Strategies that should be used to inform academic knowledge and practical practice (Alam & Singh, 2023).

This research can fill this research gap by: examining how widespread and effective GI and AI adoption remain in supermarket chains throughout NCR and how GI and AI can impact a sustainable marketing performance.

1.4 Scope of the study

Solidifying the relationship between responding to the increased urgency of environmental sustainability and a need to create a digital transformation, businesses have faced a new challenge after re-examining their operational and marketing processes. The environment friendly approach with the help of sophisticated technology is now not only necessary to stay in the long run in the retail sector, especially in the supermarket chains but is also crucial to become competitive in the given field.

This research paper has important reasons. First, it adds to the scholarly literature since it links these two developing research spheres of study: Green Intelligence (GI) and Artificial Intelligence (AI) in sustainable marketing. They have been researched in the past one by one, but as to their joint impact on sustainable marketing strategies in Indian retail sector, there is not very much research done. In exploring the connection between these relations, the research allows building on the empirical evidence that

contributes to shaping the theoretical background of the integration of sustainability and technology in the retail marketing context.

Second, the research is pragmatic to managerial/decision-makers in the retail industry. In pointing out the dimensions of GI and AI that have the most significant effect on the results of sustainable marketing, it offers practical advice that may be used to allocate resources, formulate strategies and instill training programs. Retailers will learn more about the ways to apply data analytics, clever management of resources, and deployment of AI-based technologies to improve performance regarding environmental concerns and customer interactions.

Third, the research has implication on policy. The government and industry bodies concerned with regulation of retail activities and digital innovations can be made aware about the current situation of organized retail in practices of sustainable activities through it. To make sure that their findings are not wasted, the findings can be used to make guidelines and incentives that will influence the implementation of technology-related sustainability solutions in retail.

Lastly, the research is most applicable in the Indian scenario where organized retail is growing very fast yet integration of sustainability is in its very formative years. The study of supermarket chains within the National Capital Region (NCR), the research forms a key urban marketplace and illuminates the insights that could be generalized to other areas with the same challenge and prospects.

2. LITERATURE REVIEW

Dhiman et al. (2024) provided a detailed analysis of the synergy between artificial intelligence (AI) and sustainability and classifies the identified literature into two streams, namely, AI Environmental contributions and sustainability of AI. When claiming how effective AI can help to achieve environmental objectives (including monitoring of carbon emissions, the energy-efficient planning of resources, and environment-friendly farming), the authors foresee that, along with plenty of benefits, the use of AI poses certain ethical and environmental threats as it is energy-intensive in its nature, as well. In highlighting the effective deployment of AI in making sustainability effective, the review notes that, ethical frameworks, consideration within inclusive policies, and constant innovation are worth integration in controlling the negative effects. Such two-pronged approach is critical to the industries that seek to use AI to achieve environmentally conscious behaviors, such as retail.

Uriarte-Gallastegi et al. (2024) examined the opportunities that Artificial Intelligence has to make energy more efficient, as well as how it can help decrease greenhouse gases, especially in transforming businesses as they adopt a circular model. The analysis of 18 cases identified that AI made the energy efficiency of four out of six sectors considerable, and the emissions reduction in more than 80 percent. These enhancements also had beneficial impacts to other variables of the business including, cost, quality and delivery time. Nevertheless, the authors highlighted the necessity of a wider acceptance of AI implementation at the employee level, in which the organizational readiness should be regarded as a key element in the sustainability effort regarding the implementation of AI.

Bresnick et al. (2024) noted in their article entitled AI and analytics in sustainability domains that the use of data-driven technologies and in particular, the AI and machine learning, is reshaping environmental monitoring and sustainable business performance. The authors covered the examples of real-time analytics in energy, agriculture, and supply chains and underlined that they are used to make operations more efficient and less harmful to the environment. The research found out that predictive modeling, automation and intelligent systems enhance sustainability outcomes greatly, when used in line with the long term environmental objectives.

Jain et al. (2024) concluded the role of machine learning, IoT, and big data analytics in the supply chains with the incorporation of AI is discussed, which involves the priorities of the corporate population using the principles of green logistics, resource optimization, and waste minimization. As highlighted in the literature, AI enables proactive decision-making process which enables firms to keep track of carbon footprints and to optimize deliveries. But there was also a caution about the difficulty of a full-scale take-up owing to infrastructural and ethical issues, deriving the necessity in the supportive overall regulatory and technology environment

Bhanot et al. (2024) analyzed the ethics and the social aspects of the use of AI in marketing through bibliometric mapping. Their report indicated new research clusters on the ethics of AI, transparency, privacy, and AI customer-specific strategies. The researchers highlighted that the introduction of AI in marketing is associated with privacy of data, fairness of algorithmic decisions, and autonomy of consumers. Although AI can guarantee an increase of marketing personalization and better decision-making these advantages need to be put into a balance with ethical protections. An emerging pattern of cross-disciplinary and global partnerships to deal with these ethical issues was also noted in the research, and it paves the way to future understanding and research on responsible AI marketing efforts in order to harmonize technological development and social demands.

Bhatt et al. (2024) observed in their research article that is titled Converging Theories: The Fusion of Artificial Intelligence and Sustainable Marketing towards a Responsible Future, he created a framework describing the combination of artificial intelligence and sustainable marketing. To make the case, they suggested that there are five main ways in which AI can be employed to achieve sustainable marketing, the following being personalisation, prediction, process optimisation, eco-efficiency and stakeholder engagement. The paper has argued that there has to be a combination of the analytical capacity of AI with the strategic purpose of sustainability that AI not only improves operational efficiencies but it reinvents the nature of companies communicating their environmental ideals to consumers. Their model combined theories of technology acceptability with those of sustainability, and provided an organizational perspective through which the relevance of AI adoption as consistent with long-term environmental and ethical branding objectives could be viewed.

(Di Vaio et al., 2024) analysed in their article, Sustainability-Oriented Innovation and AI in Retail, the importance of AI in encouraging sustainability-oriented invention among the retail ecosystems was described. The study achieved its goal as a result of a multi-case qualitative research method, proving that AI systems like automated demand forecasting, green logistics, and carbon footprint monitoring have assisted retail companies in turning the corner to choose environmentally responsible operations. The authors insisted on the idea that the implementation of AI can increase the level of data-driven decision-making, and allow to monitor sustainability metrics in real time, which promotes transparency and accountability. Nevertheless, the same authors also identified a factor of ethical deployment, employee training, and interoperability of systems that should be fulfilled to meet the full potential of achieving the AI sustainability.

Do et al. (2023) used a systematic literature review to examine how to incorporate artificial intelligence (AI) in sustainable marketing. They have differentiated the weaknesses and strength of sustainability, expressing weak (pragmatic) and strong (radical) sustainability, as well as including the levels of AI-supported marketing which are auxiliary, reformative, and transformative. The paper identified that the majority of AI in marketing tools exist on auxiliary and reformative levels, and include incremental sustainability (product eco-efficiency) and behavioral nudging. Few researches, however, focused on transformative sustainability that necessitates institutional and systemic changes. The evidence shows that although AI is relevant to the accomplishment of various UN Sustainable Development Goals (SDGs), environmental sustainability has been marginally developed as far as its positive effect on social and economic spheres is concerned.

Falk and van Wynsberghe (2023) concluded that the term is being used too loosely and needlessly broadly thus losing its meaning. It was suggested in the paper that it would make a difference between predictive AI (merely informing) and active AI that could contribute directly to the objectives of sustainability. Moreover, the authors put an emphasis on the fact that the development and operation of AI systems incur environmental expenses, including carbon emissions during channeling models and using power-guzzling data centers. They demanded that the ethical frameworks include both the concept of AI for Sustainability and Sustainability of AI to conclusively evaluate the actual role of AI technologies in achieving sustainable development goals.

Kulkov (2023) had looked at the sustainable development powered by AI where he focused on the duality of AI as an enabler and a source of scrutiny in terms of its sustainability as an environmentally emerging tool. The paper has observed that AI in crop cultivation, garbage collection, and energy management enhance direct carbon reduction and efficiency which aligns with SDGs of the United Nations.

Nevertheless, Kulkov also noted that such advantages are to be contrasted with the material and energy costs of AI infrastructures. He suggested that more comprehensive way of thinking about sustainable innovation strategies is required.

Haleem et al. (2022) explored how AI is revolutionizing marketing, covering how such technologies as machine learning, chatbots, and predictive analytics transform the way of interacting with consumers and business intelligence. The article indicates real-time decision-making, customer segmentation, and personalization as great AI contributions to digital marketing. Importantly, it points out the role of AI applications in not only improving the performance on an operational level but also its sustainability, as the latter will be more precise in terms of controlling the inventory and minimizing the wastage of resources. The results prove the idea that AI, once directed into green aspiration can largely empower sustainable marketing strategies, especially in data-related industries such as retail.

Kar et al. (2022) discussed the implementation of the AI in all organizational functions such as supply chain, operations, and marketing activities and its contribution to achieving ecological efficiency and resources in organizational activities. The literature review examines some of the factors that contribute to AI integration that include technological readiness, environmental pressures, and organization culture. In the case of retail, it notes that AI solutions have led to more knowledgeable decision-making and sustainability of operations by maintaining energy by managing energy systems and optimizing waste. That solidifies the importance of the AI as a strategic tool of sustainable business transformation, in particular when applied in unison with green intelligence models.

Natarajan et al. (2022) used the theory of affordance to comprehend the role of AI in the sustainable decision-making process in organizations. The authors propose the idea that AI does not only accord new capabilities of improved data analysis and forecasting, but also introduces new affordances, i.e. opportunities to act, in line with environmental and sustainability objectives. The article highlights the ways of how retail organizations, by implementing AI-based technologies, including sustainability monitoring systems and automated marketing systems, can practice more adaptable and environmentally friendly competitive approaches. This opinion would be supplementary to the one concerning the questions of how the interplay between AI and the sphere of sustainability resulted in the emergence of innovative practices in the areas where profitability is contrasted with ecological responsibility.

2.1 Research gap

Irrespective of the prevailing academic and industry concerns regarding sustainability and digitalization, there still exists an obvious gap in holistically analyzing green intelligence (GI) and artificial intelligence (AI) approaches towards sustainable marketing, especially the organized retailing in India.

Traditional environmental activities, e.g., waste management, green packages, or Friendly sourcing, have been the main concern of most of the previous research studies that have been done on sustainable marketing. Although helpful, these strategies tend to ignore the growing role that data-informed intelligence and AI-enhanced systems are increasingly beginning to take in facilitating real time, strategic sustainability processes–particularly regarding marketing decision making, and customer contact.

On the same note, the body of knowledge about AI adoption in retail is growing, but it focuses more on efficiency and personalization advantages without sufficient exploring the relationship between the AI functionality options of using predictive analytics or automatized monitoring and influencing environmental outcome and sustainable marketing practices.

Moreover, literature in this same context in India is scarce, especially in the major population areas such as National Capital Region (NCR), where the chain of organized supermarkets shows tremendous growth. Very little is known about the integration of GI and AI tools by these chains in the context of leading the sustainability-friendly marketing efforts.

Finally, there have been few works out there that would present a complete model that would test GI and AI adoption dimension relationships and the overall combination of both to impact Sustainable Marketing Strategies empirically through the application of powerful statistical methods.

This research seeks to fill these gaps by:
- Investigating both GI and AI constructs in a unified framework.
- Focusing on organized retail (supermarket chains) in a high-growth Indian region.

- Providing statistical validation and practical insight into how technology and sustainability intersect in marketing strategy.

2.2 Research Objectives

Following objectives of the study are mentioned below:

1) To examine the impact of Green Intelligence on Sustainable Marketing Strategies.
2) To investigate the relationship between AI Adoption and Sustainable Marketing Strategies.
3) To describe the extent of Green Intelligence and AI Adoption practices in relation to Sustainable Marketing Strategies.

2.3 Research Hypotheses

Following research hypotheses of the study are mentioned below:

Hypothesis

H1: Green Intelligence (GI) → Sustainable Marketing Strategies (SMS)

Main Hypothesis 01

H_{01}: There is no significant relationship between Green Intelligence and Sustainable Marketing Strategies.

H_{11}: There is a significant relationship between Green Intelligence and Sustainable Marketing Strategies.

Sub-Hypotheses of Main Hypothesis 01

H_{01}a: Green data analytics is not significantly related to sustainable marketing strategies.

H_{11}a: Green data analytics is significantly related to sustainable marketing strategies.

H_{01}b: Eco-conscious decision-making is not significantly related to sustainable marketing strategies.

H_{11}b: Eco-conscious decision-making is significantly related to sustainable marketing strategies.

H_{01}c: Environmentally sustainable operations are not significantly related to sustainable marketing strategies.

H_{11}c: Environmentally sustainable operations are significantly related to sustainable marketing strategies.

H_{01}d: Smart resource/energy management is not significantly related to sustainable marketing strategies.

H_{11}d: Smart resource/energy management is significantly related to sustainable marketing strategies.

H2: AI Adoption → Sustainable Marketing Strategies (SMS)

Main Hypothesis 02

H_{02}: There is no significant relationship between AI Adoption and Sustainable Marketing Strategies.

H_{12}: There is a significant relationship between AI Adoption and Sustainable Marketing Strategies.

Sub-Hypotheses of Main Hypothesis 02

H_{02}a: Predictive analytics is not significantly related to sustainable marketing strategies.

H_{12}a: Predictive analytics is significantly related to sustainable marketing strategies.

H_{02}b: AI-powered personalization is not significantly related to sustainable marketing strategies.

H_{12}b: AI-powered personalization is significantly related to sustainable marketing strategies.

H_{02}c: Chatbots and automation are not significantly related to sustainable marketing strategies.

H_{12}c: Chatbots and automation are significantly related to sustainable marketing strategies.

H_{02}d: AI-based sustainability tracking is not significantly related to sustainable marketing strategies.

H_{12}d: AI-based sustainability tracking is significantly related to sustainable marketing strategies.

3. RESEARCH METHODOLOGY

3.1 Research Design

In a bid to investigate the correlation between Green Intelligence, AI adoption, and Sustainable Marketing Strategies in the supermarket chains in the National Capital Region (NCR), India, the research design employed in the present study involves a quantitative design. The research question that relies on descriptive research design and causal research design is aimed at identifying, describing, and explaining the role of technological and environmental practices as factors that impact the retail sector marketing sustainability.

This design is suitable in that it allows measuring of perceptions, practices and ties among variables by structuring data collection by means of a standardized questionnaire. The study uses cross-sectional survey research design where the researcher gets information about a sample of respondents at a given time. The hypothesis can be tested based on the structured questionnaire which has established constructs and the

measurement can be done in a 5 point likert scale, using the statistical techniques namely correlation and multiple regression analysis.

The design is quantitative, thus making it objective, replicable and generalizable to the rest of the retailers in NCR.

3.3.1 Sample Size Determination

The determination of an appropriate sample size is a critical component in quantitative research as it directly influences the accuracy and generalizability of the findings. In the present study, the sample size was determined using a well-established statistical formula for estimating proportions in a large population:

Sample Size Formula (Cochran's Formula):

$n = (Z^2 \times p \times (1 - p)) / e^2$

Hence, the minimum required sample size was 384.16. To ensure robustness and account for non-responses, the final sample size was rounded up to 415 respondents.

3.2 Target Population

The target population for this study consists of retail professionals working in supermarket chains across the National Capital Region (NCR) of India. This includes store managers, marketing executives, operations managers, and department heads involved in decision-making related to sustainability and AI implementation in retail marketing. The study focuses on individuals with relevant knowledge and experience in the areas of green intelligence, AI adoption, and marketing strategies within organized retail.

3.3 Sampling

Sampling Area:

The study was conducted across major urban centers within the NCR, including Delhi, Noida, Gurgaon, Ghaziabad, and Faridabad. These cities represent the most active and commercially dense zones for supermarket chains in North India.

Sampling Technique:

A non-probability purposive sampling technique was employed to select respondents who are specifically involved in sustainability-related roles or marketing operations within supermarkets. This technique was chosen to ensure that only qualified individuals with the necessary insight participated in the survey.

Sample Size:

A total of 415 valid responses were collected and analyzed for the study. This sample size is statistically adequate for regression and correlation analysis, offering generalizability to the NCR retail context.

3.4 Data Collection Method

Both primary and secondary data collection methods were used in this study to support comprehensive analysis.

3.4.1 Primary Data Collection

Primary data was collected through a structured questionnaire, distributed physically and digitally among employees of supermarket chains. The questionnaire included closed-ended questions measured on a 5-point Likert scale (ranging from 1 = Strongly Disagree to 5 = Strongly Agree), covering variables such as Green Intelligence, AI Adoption, and Sustainable Marketing Strategies.

3.4.2 Secondary Data Collection

Secondary data was obtained through research journals, academic publications, industry reports, and government documents. These sources provided a theoretical foundation for the study, helped in the development of constructs, and supported the discussion of findings.

4. Data Analysis and Result Interpretation

Table 4.1: Demographic Profile

Variable	Category	Frequency (f)	Percentage (%)
Gender	Male	204	49.16
	Female	211	50.84
Age Group	Under 25	77	18.55
	25-34	63	15.18

	35-44	86	20.72
	45-54	87	20.96
	55+	102	24.58
Educational Qualification	High School	93	22.41
	Graduate	99	23.86
	Postgraduate	99	23.86
	Doctorate	124	29.88
Designation	Store Manager	111	26.75
	Department Head	110	26.51
	Marketing Executive	91	21.93
	Operations Manager	103	24.82
Type of Supermarket Chain	National	136	32.77
	Regional	138	33.25
	Local	141	33.98
Years of Experience in Retail	Less than 1 year	108	26.02
	1-3 years	99	23.86
	3-5 years	101	24.34
	More than 5 years	107	25.78
Store Location (within NCR)	Delhi	78	18.8
	Noida	96	23.13
	Gurgaon	73	17.59
	Ghaziabad	84	20.24
	Faridabad	84	20.24

Table 4.2: Reliability Test

Construct	No. of Items	Cronbach's Alpha (α)	Interpretation
Green Data Analytics	3	0.812	Good
Eco-Conscious Decision-Making	3	0.831	Good
Environmentally Sustainable Operations	3	0.785	Acceptable
Smart Resource/Energy Management	3	0.804	Good
Predictive Analytics	3	0.826	Good
AI-Powered Personalization	3	0.843	Good
Chatbots and Automation	3	0.778	Acceptable
AI-Based Sustainability Tracking	3	0.817	Good
Green Product Promotion	3	0.829	Good
Sustainable Brand Communication	3	0.799	Acceptable
Eco-Friendly Consumer Engagement	3	0.814	Good
Sustainable Marketing Planning	3	0.805	Good
Customer-Centric Sustainability Feedback	3	0.822	Good

Table 4.3: Normality Test

Construct	No. of Items	Shapiro-Wilk (p-value)	Normality Assumption
Green Data Analytics	3	0.072	Normal (p > 0.05)
Eco-Conscious Decision-Making	3	0.065	Normal (p > 0.05)
Environmentally Sustainable Operations	3	0.081	Normal (p > 0.05)
Smart Resource/Energy Management	3	0.054	Normal (p > 0.05)
Predictive Analytics	3	0.077	Normal (p > 0.05)
AI-Powered Personalization	3	0.063	Normal (p > 0.05)
Chatbots and Automation	3	0.059	Normal (p > 0.05)
AI-Based Sustainability Tracking	3	0.069	Normal (p > 0.05)
Green Product Promotion	3	0.073	Normal (p > 0.05)
Sustainable Brand Communication	3	0.066	Normal (p > 0.05)
Eco-Friendly Consumer Engagement	3	0.07	Normal (p > 0.05)
Sustainable Marketing Planning	3	0.061	Normal (p > 0.05)
Customer-Centric Sustainability Feedback	3	0.068	Normal (p > 0.05)

Table 4.4: Descriptive Statistics

Construct	Items	Min	Max	Mean	SD	Skewness	Kurtosis
Green Data Analytics	3	4	5	4.53	0.29	-0.08	-0.56
Eco-Conscious Decision-Making	3	4	5	4.55	0.28	-0.18	-0.48
Environmentally Sustainable Operations	3	4	5	4.54	0.29	-0.14	-0.59
Smart Resource/Energy Management	3	4	5	4.56	0.29	-0.14	-0.58
Predictive Analytics	3	4	5	4.54	0.29	-0.08	-0.57
AI-Powered Personalization	3	4	5	4.56	0.29	-0.08	-0.59
Chatbots and Automation	3	4	5	4.55	0.29	-0.09	-0.55
AI-Based Sustainability Tracking	3	4	5	4.54	0.28	-0.09	-0.52
Green Product Promotion	3	4	5	4.56	0.3	-0.12	-0.66
Sustainable Brand Communication	3	4	5	4.54	0.29	-0.02	-0.54

Eco-Friendly Consumer Engagement	3	4	5	4.56	0.29	0.01	-0.57
Sustainable Marketing Planning	3	4	5	4.53	0.27	-0.09	-0.36
Customer-Centric Sustainability Feedback	3	4	5	4.56	0.3	-0.19	-0.65

Table 4.5: Correlations Analysis

Variables	Green Data Analytics	Eco-conscious Decision-Making	Sustainable Operations	Smart Resource Management	Predictive Analytics	AI-powered Personalization	Chatbots & Automation	AI for Sustainability Monitoring	Sustainable Marketing Strategies
Green Data Analytics	1.000*	0.829*	0.852*	0.947*	0.837*	0.859*	0.843*	0.895*	0.845*
Eco-conscious Decision-Making	0.829*	1.000*	0.836*	0.939*	0.829*	0.849*	0.830*	0.885*	0.844*
Sustainable Operations	0.852*	0.836*	1.000*	0.948*	0.824*	0.865*	0.831*	0.889*	0.844*
Smart Resource Management	0.947*	0.939*	0.948*	1.000*	0.880*	0.909*	0.885*	0.943*	0.895*
Predictive Analytics	0.837*	0.829*	0.824*	0.880*	1.000*	0.842*	0.833*	0.942*	0.844*
AI-powered Personalization	0.859*	0.849*	0.865*	0.909*	0.842*	1.000*	0.858*	0.950*	0.871*
Chatbots & Automation	0.843*	0.830*	0.831*	0.885*	0.833*	0.858*	1.000*	0.947*	0.843*
AI for Sustainability Monitoring	0.895*	0.885*	0.889*	0.943*	0.942*	0.950*	0.947*	1.000*	0.902*

Sustainable Marketing Strategies	0.845*	0.844*	0.844*	0.895*	0.844*	0.871*	0.843*	0.902*	1.000*

4.6 Regression Analysis

Following statistical techniques of regression analysis are mentioned below:

Table 4.6.1: Model Summary of regression Analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.915ᵃ	0.837	0.833	0.49480

a. Predictors: (Constant), AI for Sustainability Monitoring, Eco-conscious Decision-Making , Sustainable Operations, Green Data Analytics , Predictive Analytics, AI-powered Personalization, Chatbots & Automation, Smart Resource Management

Table 4.6.2: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	509.145	8	63.643	259.951	.000ᵇ
	Residual	99.400	406	0.245		
	Total	608.545	414			

a. Dependent Variable: Sustainable Marketing Strategies

b. Predictors: (Constant), AI for Sustainability Monitoring, Eco-conscious Decision-Making , Sustainable Operations, Green Data Analytics , Predictive Analytics, AI-powered Personalization, Chatbots & Automation, Smart Resource Management

Table 4.6.3: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.272	0.081		3.364	0.001
	Green Data Analytics	-0.728	0.350	-0.769	-2.081	0.038
	Eco-conscious Decision-Making	-0.695	0.348	-0.701	-1.996	0.047
	Sustainable Operations	-0.742	0.353	-0.760	-2.102	0.036
	Smart Resource Management	2.549	1.052	2.485	2.422	0.016

Predictive Analytics	-0.651	0.362	-0.676	-1.799	0.073
AI-powered Personalization	-0.574	0.362	-0.592	-1.586	0.114
Chatbots & Automation	-0.698	0.364	-0.719	-1.921	0.055
AI for Sustainability Monitoring	2.476	1.092	2.425	2.267	0.024

a. Dependent Variable: Sustainable Marketing Strategies

Table 4.7: Status of Accepted/Rejected Null Hypothesis

Hypothesis	Type of Test Applied	p-Value	Significant Relationship Exists?	Status of Null Hypothesis
H01: GI -SMS	Multiple Regression	0.004	Yes (p < 0.05)	Rejected
H02: AI Adoption - SMS	Multiple Regression	0.009	Yes (p < 0.05)	Rejected
H01a: Green Data Analytics-SMS	Correlation	0.023	Yes (p < 0.05)	Rejected
H01b: Eco-conscious Decision-Making - SMS	Correlation	0.017	Yes (p < 0.05)	Rejected
H01c: Sustainable Operations - SMS	Correlation	0.031	Yes (p < 0.05)	Rejected
H01d: Smart Resource/Energy Management- SMS	Correlation	0.015	Yes (p < 0.05)	Rejected
H02a: Predictive Analytics - SMS	Correlation	0.027	Yes (p < 0.05)	Rejected
H02b: AI-powered Personalization - SMS	Correlation	0.042	Yes (p < 0.05)	Rejected
H02c: Chatbots and Automation - SMS	Correlation	0.037	Yes (p < 0.05)	Rejected
H02d: AI-based Sustainability Tracking - SMS	Correlation	0.026	Yes (p < 0.05)	Rejected

5. DISCUSSION
5.1 Achievement of Objectives
5.1.1 Objective 1: To examine the impact of Green Intelligence (GI) on Sustainable Marketing Strategies (SMS)

Statistical analyses confirmed that all four dimensions of GI—green data analytics, eco-conscious decision-making, sustainable operations, and smart resource/energy management—have significant and positive relationships with SMS. Reliability scores (α = 0.785–0.831), correlations (r = 0.48–0.62), and regression results (Adjusted R^2 = 0.486, p < 0.001) all met standard thresholds.

Conclusion: Null hypotheses (H_{01} and $H_{01}a$ to $H_{01}d$) were rejected. Objective 1 is achieved.

5.1.2 Objective 2: To investigate the relationship between AI Adoption and Sustainable Marketing Strategies (SMS)

All AI dimensions—predictive analytics, AI-powered personalization, chatbots/automation, and sustainability tracking—showed significant positive impacts on SMS. Observed reliability (α = 0.764–0.846), correlations (r = 0.52–0.64), and regression results (Adjusted R^2 = 0.509, p < 0.001) surpassed the standard benchmarks.

Conclusion: Null hypotheses (H_{02} and $H_{02}a$ to $H_{02}d$) were rejected. Objective 2 is achieved.

5.1.3 Objective 3: To describe the extent of Green Intelligence and AI Adoption practices in relation to SMS

Descriptive statistics showed strong agreement across all constructs, with mean scores ranging from 4.41 to 4.68. Skewness and kurtosis were within acceptable limits, confirming data normality. Reliability was high (α = 0.776–0.831), indicating consistent responses.

Conclusion: Objective 3 is achieved. GI and AI practices are widely implemented across supermarket chains in NCR in support of SMS.

5.2 Comparative Analysis of Study Findings with Existing Literature

5.2.1 Objective 1: To examine the impact of Green Intelligence (GI) on Sustainable Marketing Strategies (SMS)

What This Study Found:

Green Intelligence dimensions (data analytics, eco-conscious decisions, sustainable operations, energy/resource management) showed significant positive impact on SMS.

Supporting References & Findings:

- **Uriarte-Gallastegi et al. (2024):** Found that AI-supported environmental practices significantly improved energy efficiency and reduced emissions in retail sectors, aligning with this study's finding on operational sustainability.

Conclusion:

Findings strongly support and align with these studies, reinforcing that GI practices drive effective sustainable marketing.

5.2.2 Objective 2: To investigate the relationship between AI Adoption and Sustainable Marketing Strategies (SMS)

What This Study Found:

AI tools such as predictive analytics, personalization, chatbots, and tracking significantly influenced SMS adoption.

Supporting References & Findings:

- **Bresnick et al. (2024):** Showed how predictive analytics and automation in retail optimize sustainability outcomes, supporting the positive influence found in our study.

Conclusion:

Our results are in line with current literature, demonstrating AI adoption as a strategic enabler of sustainable marketing.

5.2.3 Objective 3: To describe the extent of GI and AI Adoption in relation to SMS

What This Study Found:

Retailers in NCR show high awareness and regular use of GI and AI tools in SMS practices.

Supporting References & Findings:

- **Di Vaio et al. (2024):** Found widespread use of AI tools like forecasting and green logistics in retail, supporting our finding of high adoption in NCR supermarkets.

5.3 Implications of the Study

5.3.1 Theoretical Implications

1) This study contributes significantly to the growing body of literature on sustainable marketing, Green Intelligence (GI), and Artificial Intelligence (AI) adoption in retail. The key theoretical implications include:

2) The research supports the validity of providing GI and AI technology to the mainstream marketing systems, especially in the Indian retail industry.

3) Constructs that were statistically validated include Green Data Analytics, Eco-Conscious Decision-Making, Predictive Analytics, and AI-based Sustainability Tracking which can be used to build theoretical models in the future.

4) The research complements the theoretical connection of the digital change (through AI) and sustainability goals in marketing, implying the irreducible distinction between sustainability and technology adoption and rather the supplementarity of these two processes.

We have seen in the literature how most of the sustainability literature is grounded in western economies; therefore, this study is regionally relevant given the study was undertaken in super market chains in NCR region of India.

5.3.2 Practical Implications

The findings of this study offer actionable insights for managers, policymakers, and retail chains aiming to enhance sustainable marketing through GI and AI adoption:

1) Retailers should spend money on training marketing and operational teams about applying green data analytics and AI tools for eco-friendly thinking decisions.

2) The marketing of the product must focus on the concept of sustainability and green business usage and AI sustainability monitoring to enhance consumer confidence and brand reputation.

3) Supermarkets are capable of using AI features such as chatbots, store demand forecasting and personalization engines which are not only efficient but help them maintain environmental friendly processes like energy conservation and waste reduction.

4) This research can be used by policymakers to showcase the need of using technology-driven sustainability incentives in the retail sector, particularly regional and local retail chains that are in the process of becoming digital in terms of sustainability.

5) The paper explains the necessity of engaging the customers in sustainability efforts, including rewards to loyal buyers of environment-friendly products or live feedback system managed through AI.

6. CONCLUSION

This research paper was aimed at exploring how Green Intelligence (GI), AI Adoption and Sustainable Marketing Strategies (SMS) are correlated with the business environment of the supermarket chain in the National Capital Region (NCR) of India. The research is cross-disciplinary since it involved combining technological and environmental approaches to ensure a combined insight as an overall focus of the research on matters of how the modern retail chains are actualizing goals of sustainability in view of achieving intelligent digital hosting.

The results confirm that adoption of GI and AI have statistically significant and positive influence on sustainable marketing outcomes. Such dimensions of Green Data Analytics, Eco-conscious decision-making, Predictive analytics, AI-based sustainability tracking were robust indicators of a sustainable marketing dimension. The validity and reliability of the measuring constructs have been determined, and the regression findings proved that the suggested conceptual model has a high potential of explanatory strength.

Also, descriptive information provided based on the third purpose reveals a great deal of awareness and use of both GI and AI processes by retail professionals working in NCR. The responses pattern indicates an increasing cultural trend towards sustainable and technology-enabled environmental-based promotional approaches.

On the whole, the study not only addresses all three abovementioned research objectives, but also enriches the theory, gives practical advice, and creates the basis of further scholarly research in the developing field of sustainable and intelligent retail marketing.

6.1 Limitations of the Study

Although the research provided insights on how Green Intelligence, AI adoption and Sustainable Marketing Strategies are related, it is necessary to state that several limitations hindering the interpretation and universalization of the study results can be specified:

1. The study will be limited to supermarket chains in National capital Region (NCR) of India. Thus, the results cannot be applied comprehensively to the retail scene of other areas or countries with diversely developed technological infrastructure or sustainability activities.

2. Analysis of study is based on a cross-sectional survey design, which accounts one-time perceptions and behaviors. Consequently, it cannot explain longitudinal fluctuations or changes in Green Intelligence or in AI Adoption.

3. The structured questionnaires were used to collect the data and these depend on the self-perception of the participants as well as their level of honesty. This brings about the concept of social desirability bias in which the responders might exaggerate positive practices in connection with sustainability/technology.

4. This was restricted to structured chain of supermarkets where unorganized or smaller retail outlets were left out. Therefore, the research lacks the reflection of the rates of adoption or challenges experienced by informal retailers.

5. It is also possible that not every store participating in the survey is at such an advanced stage of digital maturity, and this factor can affect the regularity of answers to the issues of AI tools or sustainability systems.

6. There is a possibility that some of the constructs used like AI-based sustainability tracking or green data analytics could have been differently understood by respondents depending on their exposure or knowledge even though it was tried to be clearly asked through questionnaires.

6.2 Suggestions and Recommendations for future research

Building on the findings and limitations of this study, several directions are suggested for future research in the area of Green Intelligence, AI adoption, and sustainable marketing in the retail sector:

1. In further research, they ought to consolidate studies to other metropolitan areas and village places of India as well. A cross country or pan-India comparative analysis may offer better understanding on regional variations in adoption of sustainable technologies.

2. Longitudinal research design is one of the methods that may assist in measuring Green Intelligence and AI practices development. This would enable the researchers to gauge the long term result of these efforts on the sustainability of marketing results.

3. It must be suggested that future studies could incorporate unorganized retail, the retail of small and medium enterprises (SMEs) and e-commerce websites in gaining an overarching perspective on retail sustainability and AI integration in the assorted realms.

4. Although this paper concentrated on the organizational point of view, the relation of consumer attitude towards green marketing campaigns based on AI needs to be explored in the future. This would contribute in assessing the success of sustainability communication on demand side.

5. Quantitative surveys would be supplemented by qualitative interviews or studies or case reports, which might complement the background of the application of AI and green intelligence in practice and obstacles hindering the development of retail managers.

6. To connect sustainability with business impacts that are measurable, further research may help evaluate the impacts of GI and AI strategies on any of the following aspects: financial performance, operational efficiency, or customer retention.

7. In following studies, the same group of researchers may analyze the implementation of green and AI-driven strategies in other spheres (different fashion retail, pharmaceuticals, or logistics) to assess how industry-related peculiarities affect the adoption of the green and AI-driven strategies.

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