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The Role of Blockchain in Green Marketing: Evidence from Agriculture and Consumer Perceptions in India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Modern agriculture is a dynamic and innovative sector that integrates advanced technologies and sustainable farming practices to enhance productivity while minimizing the use of natural resources. To meet the growing global demand for food, biofuels, and fibers, agriculture is increasingly adopting digital solutions. However, India's agricultural sector still lags behind Western nations in adopting such cutting-edge tools. In this context, green marketing has emerged as a strategy to promote eco-friendly practices—such as precision pest and weed control, use of micro-granular fertilizers, and reforestation initiatives. While green marketing has gained traction in parts of Asia, its integration with emerging technologies remains limited globally. This study explores how block chain technology can strengthen green marketing in agriculture by ensuring supply chain transparency, enhancing consumer trust, and promoting sustainability. A mixed-method approach was adopted, combining secondary data analysis and stakeholder interviews to assess current

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adoption levels and identify barriers. Findings indicate that block chain-enabled traceability systems can authenticate eco-friendly practices, provide verifiable data on resource use, and support government incentive schemes. The study concludes that integrating block chain with green marketing can accelerate the transition to sustainable agriculture, especially in developing economies like India.

Keywords: Circular economy; green entrepreneurship; sustainable business practices.

1. INTRODUCTION

Green marketing, a concept that emerged in the late 1980s, refers to the promotion of products that have environmental benefits or characteristics (American Marketing Association, n.d.) (Keller, 1993). These products, often termed "green products," are designed to have less environmental impact, whether through their production, consumption, or disposal. As awareness of environmental issues has grown, green marketing has evolved into a significant field of study and a popular trend in the marketplace. At its core, green marketing involves promoting products based on their environmental sustainability (Ottman, 2011). This includes eco-friendly products, which are developed and advertised to highlight their positive environmental impact. However, the term also encompasses the broader practice of environmental marketing or eco-marketing—efforts that help companies showcase their environmental responsibility (Dembkowski & Hanmer-Lloyd, 1994). In this context, organizations market their products while also emphasizing the need to protect the environment (Keller, 2001). While green marketing can boost a company's image and attract environmentally conscious consumers, it can be subject to criticism if the claims made are not backed by substantial changes in production or operational processes. This phenomenon, known as *greenwashing*, occurs when a company uses misleading or exaggerated claims about its products' environmental benefits to capitalize on the growing green consumer market (Dahl, 2010). Studies indicate that consumers are increasingly concerned about the environmental effects of their purchases, and this concern has shifted their attitudes toward a greener lifestyle (Surya, Dr. M Hajamohideen, 2018). As a result, companies are seeking to capitalize on this trend by offering products that align with these values (Giovanni, 2021). For businesses, green marketing presents a new competitive advantage. Consumers now look for products that are genuinely environmentally friendly, and buying such products gives them a sense of contributing to environmental protection.

Despite the growing demand for green products, many consumers are still not adequately exposed to green marketing messages. This indicates a need for more effective marketing strategies that can raise awareness and promote eco-friendly products more widely (Dr. Shruti P Maheswari, 2014). In India, for instance, the market for green products remains largely untapped, with consumer groups holding pro-environmental values but limited access to sustainable product options.Overall, as consumers become more environmentally conscious, the shift toward purchasing "green" products is evident. However, companies must ensure their green claims are genuine and not merely a marketing tool to attract eco-conscious buyers. With growing global concerns over climate change, resource depletion, and environmental degradation, businesses are facing increasing pressure to adopt sustainable models (Dangkeng et al., 2023; Fausiah et al., 2023; Keller, 1987). Governments, consumers, and international organizations are calling for eco-friendly production, responsible consumption, and sustainable supply chains. In response, green entrepreneurs are leading the charge with innovative solutions that minimize environmental impact while ensuring financial viability. Industries such as renewable energy, sustainable agriculture, eco-friendly manufacturing, and waste management are at the forefront of this transition, utilizing circular economy strategies to enhance both competitiveness and environmental responsibility. Green marketing is a crucial element of the broader movement toward socially and environmentally conscious business practices. Today’s consumers increasingly expect companies to not only improve their operations but also meet a range of environmental, social, and governance (ESG) criteria. In response, many businesses are proactively sharing their social impact reports, periodically updating stakeholders on their progress toward sustainability goals. While green marketing focuses on environmental initiatives, these are often framed within the wider context of social and governance policies, highlighting a company's holistic approach to sustainability.

The concept of sustainability has gained significant traction in the corporate world over the last two decades, reflecting a shift in consumer attitudes towards environmental responsibility. More than just a buzzword, sustainability emphasizes how businesses can reduce the negative impact of human activity on the environment. Green marketing has evolved within this context, with companies advertising products using terms like "100% natural," "eco-friendly," and "green product." These labels are part of a broader effort to align product offerings with growing consumer concerns for the planet. The idea of sustainability began to take shape in the 1980s when various organizations started discussing the issue more actively. The term *sustainable development* was first introduced in 1987 by Norway's then Prime Minister Gro Harlem Brundtland during a United Nations conference. She defined it as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." In business, the practice of promoting environmentally responsible products and services—commonly known as green marketing—has become a key strategy for companies that wish to address consumer concerns about environmental conservation and protection (Keller, 1987).

An in-depth analysis of green finance highlights its pivotal role in addressing climate variability, particularly by emphasizing the importance of investing in renewable energy infrastructure. In this context, blockchain technology stands out as a crucial enabler, facilitating secure and efficient financial transactions. The integration of blockchain is key to enhancing investments in renewable energy projects, which, in turn, plays a significant role in reducing carbon emissions and advancing efforts to combat the effects of climate change (Ciotti, 2013). Objective: Investigating the Impact of Green Products on Consumers.

The primary objective of this investigation is to analyze how green products influence customer behavior, particularly their intention to purchase such products. The study also focuses on consumer satisfaction levels post-purchase and whether this satisfaction leads to loyalty towards green companies. Additionally, the research identifies which customers are most likely to purchase eco-friendly products and explores their environmental consciousness. It also examines how these customers perceive the companies' intentions in adopting green marketing strategies, providing deeper insight into consumer attitudes toward sustainability. Thus, the model for this investigation was developed with consideration of the framework established by Menck and Oliveira (2014).

2. METHODOLOGY

2.1 Research Design

This study employed a mixed-method design, integrating both quantitative survey data and qualitative literature synthesis to examine the role of blockchain in enhancing green marketing practices within agriculture. The approach allowed for triangulation of insights to improve the validity and depth of findings.

2.2 Sampling Procedure

A purposive sampling technique was used to target individuals working in or closely associated with agriculture, agri-tech, supply chain management, and marketing roles. An online structured questionnaire was distributed through professional agricultural networks, academic forums, and social media platforms.

Out of the 300 responses received, 250 valid responses were retained for analysis after data cleaning and removal of incomplete entries.

Demographic profile of respondents:

- **Educational level:** High School (14%), Bachelor's (45.2%), Postgraduate Diploma (9.2%), Master's (28.8%), PhD (0.4%), Others (2.4%)
- **Age groups:** 31–35 years (4%), 36–40 years (6%), 41–45 years (2.4%), 46–50 years (3.2%), above 50 years (11.2%).
- **Gender:** Female (55.2%), Male (44.8%).

This diverse sample provided perspectives from varied educational and professional backgrounds, strengthening the generalizability of results.

3. RESULTS AND DISCUSSION

3.1 Results

The model initially focuses on various features of green products, such as the use of the color green in product logos or packaging. It also examines the availability of alternatives after the product's use (post-use fate) and the overall

quality of eco-products. These factors play a significant role in shaping customers' buying decisions, as their evaluation and perception of these elements contribute to defining a product as "green." In reviewing the literature, Williamson and Zeng (2009) argue that consumers are constantly seeking products or services with distinctive features.

Table 1. Gender distribution of respondents

Gender	Frequency	Percent
Female	138	55.20
Male	112	44.80
Total	250	100.0

3.2 Gender Groups

The majority of the population are women which represent 55.2% of the sample and men are 44.80%.

3.3 Age Groups

As shown in the exhibit, the majority of the sample—70%—consists of young adults aged 21 to 30. Participants over the age of 50 make up 11.2% of the sample. The remaining participants are spread across the other age groups.

3.4 Educational Background

The largest group of participants holds a bachelor's degree, accounting for 42.2% of the sample. The second-largest group consists of individuals with a master's degree, representing 28.8% of the population. Additionally, 14% of participants have a high school diploma. The remaining 11.6% of respondents hold either a postgraduate diploma, a PhD, or another type of degree.

Table 2. Participants' distribution by age groups

Age group	Frequency	Percent
31-35	10	4.0
36-40	15	6.0
41-45	6	2.4
46-50	8	3.2
50>	28	11.2
Total	250	100.0

3.5 Participants' Perception on Company's Intentions

I think companies are adopting green approaches due to (choose one from the following).

In the sample of 250 respondents, the final question focused on participants' perceptions of companies' motivations for engaging in green marketing practices. The majority, 43.2%, believe that companies adopt green marketing mainly for reputation reasons. 18.8% of participants each attribute these practices to seeking government benefits and increasing profits. Additionally, 15.2% of respondents think companies engage in green marketing due to awareness of their environmental impact.

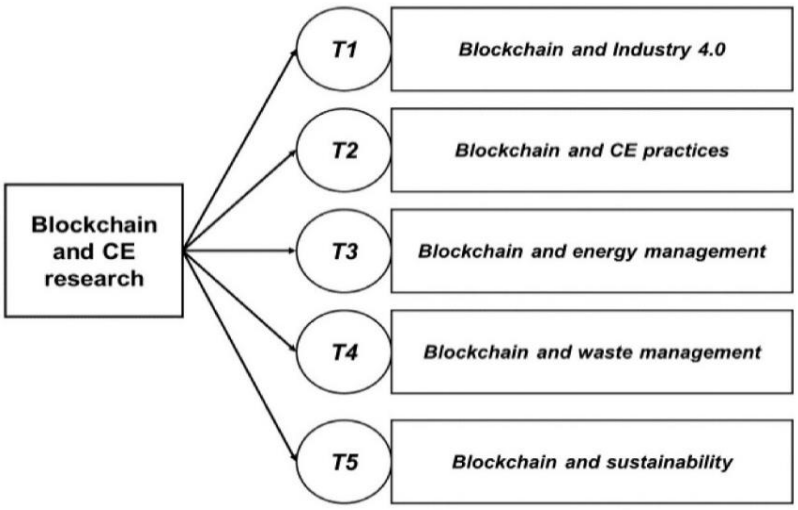

Fig 1. Research themes at the intersection of the blockchain and the CE

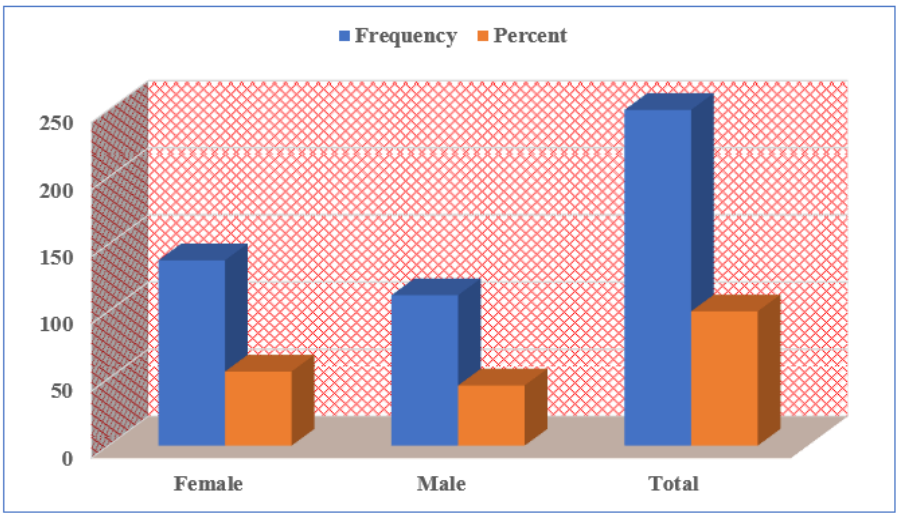

Fig. 2. Gender-based representation of respondents

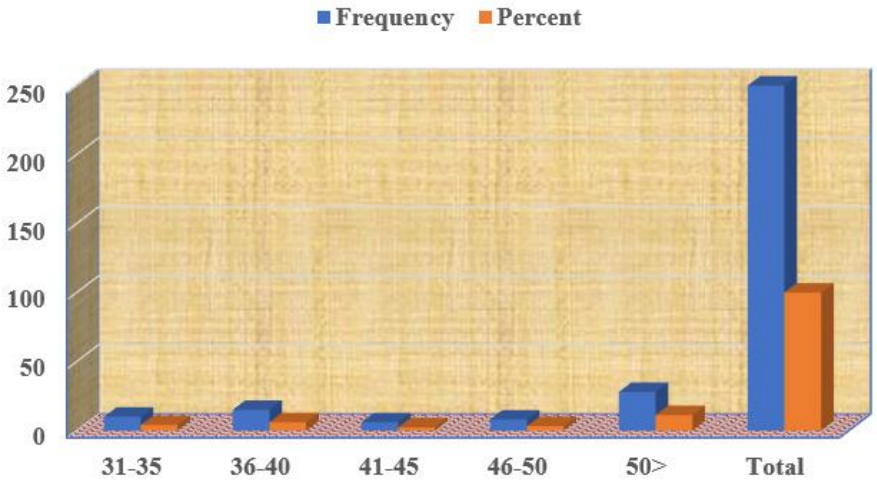

Fig. 3. Participants' distribution by age groups

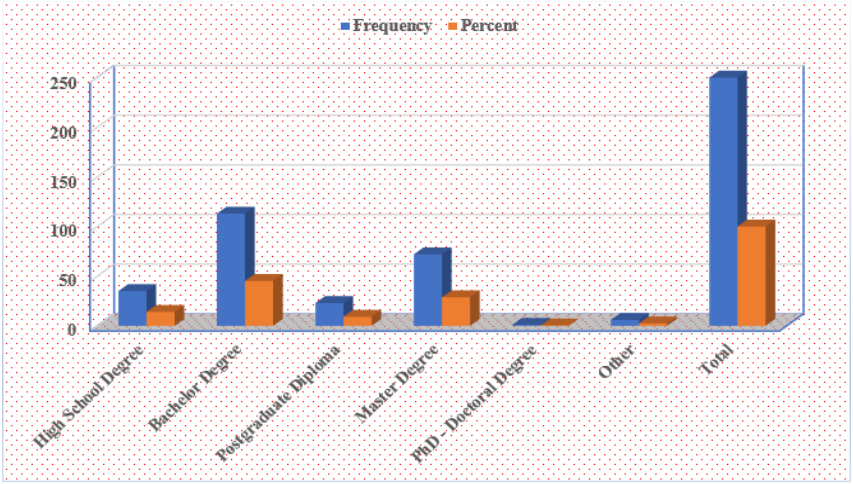

Fig. 4 Participants' distribution by educational level background

Table 3. Interdependent relationship between questions and literature review

Main variable independent	Variable dependents	Hypotheses	Questions	Literature review
Product Color, Product Post- use Fate	Customer response	H1; H2	# 1, 2, 3, 8	Moser (2003), Schmitt and Simonson (1997), Baker (2003)
Product Quality	Customer response (purchasing consciousness)	H3; H6	# 5, 6, 11, 12, 13	Levitt (1960), Baker (2003), Porter and Kramer (2006), Schwartz (1977)
Green Products	Customer response and customer preference (level of satisfaction)	H4	# 10	Rust and Oliver (1994), Kotler and Keller (2009)
Green Products	Customer response (level of arousal and proximity)	H5	# 2, 8, 9	Anderson (1994), Asgharian and Saleki (2012), Kotler and Keller (2009)
Green Products	Consumer and hedonic response	H7	# 15	Porter and Kramer (2006)

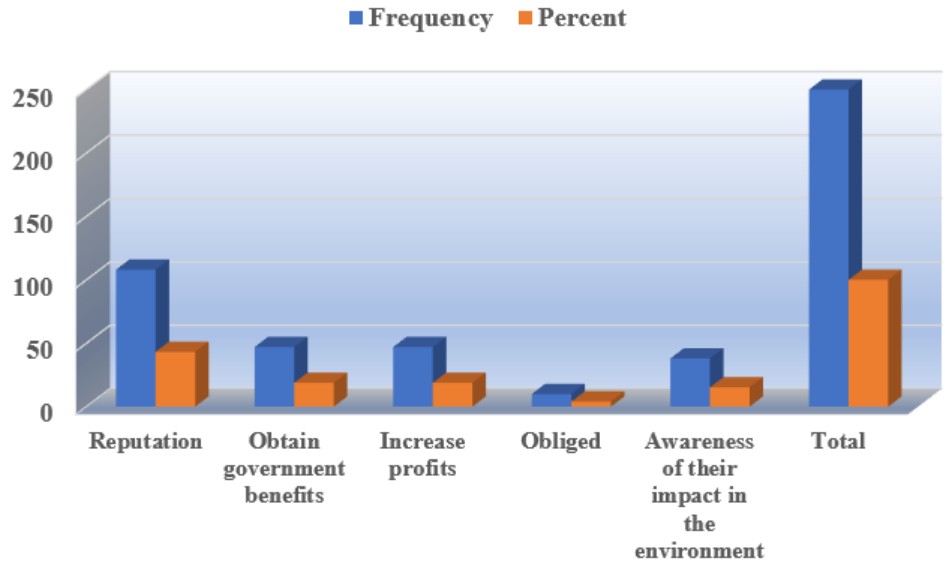

Fig. 5. Participants' choice of companies' intentions of using green marketing

The bivariate analysis reveals differences in perceptions across age groups. Among participants aged 21-25, the majority (50.08%, or 60 respondents) believe that companies engage in green marketing primarily for reputation, while 13.6% of this group (16 respondents) associate it with environmental awareness. In contrast, participants over 50 years old are more likely to view green marketing as a reflection of companies' environmental consciousness, with 28.6% of this group selecting this option. Additionally, 25% and 21.4% of older participants attribute these practices to profit increases and government benefits, respectively. Overall, participants do not view legal obligation as a significant factor driving companies to adopt green marketing practices.

Table 4. Participants' distribution by educational level background

Educational level	Frequency	Percent
High School Degree	35	14.0
Bachelor Degree	113	45.2
Postgraduate Diploma	23	9.2
Master Degree	72	28.8
PhD - Doctoral Degree	1	.4
Other	6	2.4
Total	250	100.0

Regarding educational background, participants with a master's degree or a postgraduate diploma predominantly associate green marketing with reputation—62.5% and 47.8% within each group, respectively. In these groups, 5.6% and 13% attribute it to environmental consciousness. On the other hand, participants with a high school diploma consider environmental awareness the primary reason for companies adopting green marketing, with 37.1% selecting this option. Reputation and profit increase follow as the next most common reasons (31.4% and 8.6%, respectively).

Table 5. Participants' choice of companies' intentions of using green marketing

Green marketing	Frequency	Percent
Reputation	108	43.2
Obtain government benefits	47	18.8
Increase profits	47	18.8
Obliged	10	4.0
Awareness of their impact in the environment	38	15.2
Total	250	100.0

Regarding the findings, the results indicate that participants with higher levels of education are more likely to view companies' green marketing efforts as driven by a desire to enhance their reputation, rather than by genuine social awareness of their environmental actions.

The primary objective of this dissertation is to develop a conceptual model that integrates and measures the effects of green products on consumers. Specifically, the model aims to understand how these products appeal to customers, particularly those who are environmentally conscious. The model's ultimate goal is to gather data and draw conclusions from it.

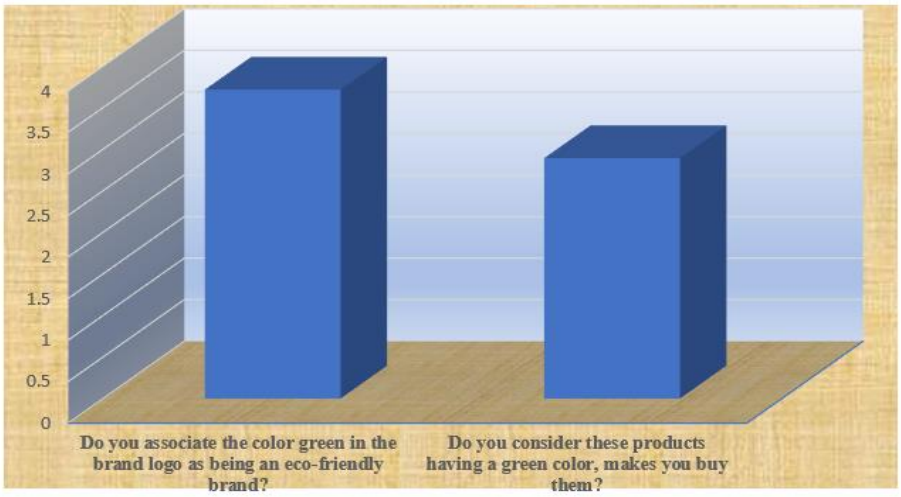

Fig. 6. Participants' perception of companies' intentions of being green marketing

Table 6. Participants' perception of companies' intentions of being green marketing

Green marketing	N	Minimum	Maximum	Mean	Std. Deviation
Do you associate the color green in the brand logo as being an eco-friendly brand?	250	1.00	5.00	3.7160	.98347
Do you consider these products having a green color, makes you buy them?	250	1.00	5.00	2.8920	.96543

To collect relevant information about customer behavior and perceptions, a questionnaire based on Likert scale questions was used. This allowed for a deeper analysis of how customers respond to green products and provided insights into existing theories on how green marketing practices influence consumer actions.

4. DISCUSSION OF FINDINGS

The findings of this study highlight that the color green holds powerful symbolic value as an indicator of environmental responsibility, significantly influencing consumer perceptions of eco-friendly brands. As Chang and Lin (2010) note, green as a visual cue fosters emotional associations with sustainability, guiding customers' initial product preferences based on immediate visual appeal**.** Companies deliberately employ green in their branding to position themselves as environmentally responsible (Williams, 2007; Ciotti, 2013), thereby shaping consumer behavior and increasing market appeal.The strategic use of green serves not only to capture attention but also to embed environmental symbolism within a brand's identity, fostering an instant connection between the brand and ecological values in consumers' minds.

However, the results also reveal a critical insight: while green cues successfully enhance brand perception and attract attention, customers do not necessarily associate green products with superior quality compared to conventional alternatives. As Kotler and Keller (2009) suggest, product quality often underpins customer satisfaction, but this study shows that customers prioritize sustainability features—such as recyclability, reusability, and post-use environmental benefits—over traditional quality indicators when choosing green products. This indicates a shift in consumer decision-making, where the long-term ecological impact of products outweighs perceived product quality. Customers are increasingly motivated by the potential contribution of their purchases to environmental well-being, rather than solely by immediate product performance or durability.Integrating blockchain technology into this context can significantly strengthen the effectiveness of green marketing by addressing growing consumer demands for authenticity and transparency. One of blockchain's core values—traceability—enables companies to offer verifiable data about the sourcing, production, and lifecycle of green products. By recording each stage of the supply chain on an immutable ledger, blockchain can reassure consumers that products marketed as "eco-friendly" genuinely adhere to sustainable practices. This transparency directly supports the emotional trust created through green color cues, transforming symbolic perception into verifiable fact (Baker & Sinkula, 2005). When consumers can trace the journey of a product from origin to end-of-life, their confidence in its environmental claims is enhanced, thereby reinforcing positive brand perception.

Decentralization, another fundamental feature of blockchain, further enhances this trust by reducing dependence on centralized authorities and preventing greenwashing. Since data on decentralized ledgers cannot be manipulated by a single party, consumers gain confidence that sustainability claims are validated by a network of independent stakeholders. This aligns closely with the shift observed in this study, where consumers value evidence of environmental responsibility more than traditional quality signals. Decentralized verification ensures that sustainability claims are not merely marketing strategies but are supported by authentic, tamper-proof records.

Additionally, smart contracts can automate and enforce sustainability commitments, ensuring that companies meet predefined environmental standards before products are certified as green. Such contracts can trigger certifications, carbon credits, or eco-labels only when verified

conditions are met. This mechanism builds consumer trust by ensuring that green branding is not symbolic alone but backed by measurable, enforced practices.

In sum, the strategic use of the color green shapes positive environmental perceptions, while blockchain technologies can convert these perceptions into verified trust, thereby amplifying the credibility and effectiveness of green marketing.

5. SUMMARY AND CONCLUSION

The study underscores that customers' attitudes are strongly influenced by the specific characteristics and distinct features they associate with green products, which shape their preferences, purchase intentions, and commitment to environmental protection. In this context, the research advances the study of green marketing by offering deeper insights into customer perceptions and highlighting the evolving strategic role of green marketing in contemporary markets. It emphasizes the need for marketers to recognize the potential of green marketing not only in shaping consumer behavior but also in identifying emerging trends and enhancing the perceived value of products and services to influence purchasing decisions. Strengthening brand–customer relationships emerges as a key priority, as brands must adapt to meet the expectations of increasingly responsible and eco-conscious consumers. To increase the appeal of green products, marketers should highlight sustainability-oriented features that distinguish them from conventional alternatives and reinforce their eco-friendly credentials. Equally, retailers must work on enhancing the positive associations linked to the color green by positioning it as a symbol of environmental responsibility, thereby cultivating a strong brand image aligned with ecological values. Companies are also encouraged to invest consistently in environmentally responsible practices to build credibility, expand market share, and engage proactively with environmentally conscious consumers who actively contribute to sustainability efforts. Importantly, organizations should avoid superficial or compliance-driven green initiatives, as greenwashing can damage credibility and erode consumer trust; authenticity is essential to sustaining long-term loyalty. Finally, the model proposed in this study offers global applicability, as sustainability concerns transcend geographical boundaries and resonate with diverse markets, reinforcing its relevance across cultures and customer segments.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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