Management Information Systems Driven Green Marketing Intelligence for Sustainable Consumer Engagement

Md Sharfuddin[1*], Sonia Khan Papia[2]

Abstract

Background: Sustainability has become a key strategic focus for organizations which leads them to adopt green marketing strategies. The research into Management Information Systems (MIS) functions for these initiatives and sustainable consumer participation remains limited although interest in this area continues to rise. **Methods:** The study used a quantitative cross-sectional survey method to collect data from 255 participants who came from various demographic backgrounds. Five-point Likert scale questionnaire validated through research measured five constructs which include MIS Integration and Green Marketing Intelligence and Sustainability Orientation and Consumer Engagement and Digital Awareness. The researchers used descriptive statistics together with reliability testing and Pearson correlation and multiple regression analysis ($p = 0.05$) to determine both the relationships and predictive strength between different variables. **Results:** The descriptive analysis showed that all constructs received standard agreement levels from participants who demonstrated consistent answers about their positive views toward MIS-enabled green marketing. The reliability analysis demonstrated that all constructs achieved internal consistency through Cronbach's alpha scores which exceeded 0.80. Pearson correlation revealed significant positive relationships among the constructs. The analysis through multiple regression showed Green Marketing Intelligence ($\beta = 0.38$, $p = 0.01$) and Consumer Engagement ($\beta = 0.35$, $p = 0.01$) as the main determinants of sustainable consumer engagement. **Conclusion:** The study shows that MIS delivers complete support for sustainability marketing data operations which helps organizations create successful green marketing strategies.

Keywords: MIS Integration, Green Marketing Intelligence, Sustainability Orientation, Consumer Engagement, Digital Awareness

Significance | The research proves that MIS systems improve sustainable consumer participation while enabling businesses to create marketing plans which prioritize environmental data.

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1. Introduction

Sustainability has become an essential business focus during the present time because of rising environmental problems together with tightening regulations and expanding public understanding of sustainability issues. Studies from recent times reveal that more than 70% of customers actively choose eco-friendly products which drives businesses to use green marketing approaches for promoting sustainable products while reducing their environmental impact and demonstrating their commitment to social responsibility (Dauvergne & Lister, 2011). Green marketing serves two purposes because it tackles environmental problems while offering benefits to customers who show 65–68% of their purchasing decisions are based on sustainability according to survey data (Kinderman, 2019). Organizations need to establish complete processes for data acquisition and processing and analysis to determine the success of these methods. Management Information Systems (MIS) function

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as essential systems which provide the technological base for collecting and handling information that organizations need to create strategic decisions (Bocken et al., 2013). Organizations use MIS to combine different data sources which allows them to track performance indicators and optimize their marketing campaigns for sustainable operations through immediate adjustments (Tseng et al., 2012). Consumer engagement operates as the main factor which determines the success of green marketing initiatives. People who engage with brands tend to purchase environmentally friendly products while they also support sustainability initiatives and promote brands that practice environmental responsibility. Research shows organizations which maintain consumer involvement at 60-70% levels achieve superior results when implementing green initiatives (Garetti & Taisch, 2011). Organizations must understand how customers behave and what they like and how they react to create effective engagement strategies. Organizations can use their MIS systems to track customer trends and feedback and interaction patterns which allows them to design marketing strategies that target individual customer needs (Hahn & Kühnen, 2013). Digital platforms enable seamless communication and data collection which leads to higher engagement because people today understand digital systems and technology.

The intersection of MIS and green marketing is especially relevant for sustainability-oriented strategies. Research into Management Information Systems (MIS) and green marketing exists separately yet researchers have not yet studied their combined impact on sustainable consumer engagement (Ponte, 2019). Organizations can track their campaign success through MIS integration which allows them to follow responses and make adjustments based on actual data. The data-driven method enhances sustainability program trustworthiness which helps build lasting customer faithfulness (Lee et al., 2014). The studies how MIS Integration and Green Marketing Intelligence and Sustainability Orientation and Consumer Engagement and Digital Awareness as MIS-driven constructs affect sustainable consumer engagement. The research followed a cross-sectional quantitative design which gathered information from 255 respondents through a pre-designed survey instrument. The study used descriptive statistics and reliability testing and Pearson correlation and multiple regression analysis with a significance level of $p = 0.05$ to identify important predictive relationships between the study variables.

2.Materials and Methods

2.1 Research Design and Study Setting

The research applied a quantitative cross-sectional method to study how MIS-based green marketing elements affect sustainable customer interaction. The study gathered information from 255 people who represented multiple demographic categories which included various age ranges and professional roles and educational backgrounds and gender identities (Hernes, 2018). The research gathered data during three months through both online and offline survey responses which used a structured format. The sampling method used stratified random sampling to pick participants from different demographic groups (Johnson et al., 2021). The study examined organizations which use Management Information Systems (MIS) to support green marketing efforts through digital and traditional marketing methods. The design enabled the collection of user opinions about technological integration and green marketing intelligence and sustainability orientation and consumer engagement and digital awareness (Schnohr et al., 2021). The research used a cross-sectional design to study present-day attitudes and behaviors which led to descriptive analysis and reliability testing and correlation and regression analysis for understanding construct relationships and prediction models.

2.2 Survey Instrument Development

A structured questionnaire was developed based on established literature on MIS, green marketing, and sustainable consumer engagement. The instrument comprised five key constructs: MIS Integration, Green Marketing Intelligence, Sustainability Orientation, Consumer Engagement, and Digital Awareness (Szabo & Webster, 2020). The assessment of each construct involved multiple items which used a five-point Likert scale for measurement from Strongly Disagree (1) to Strongly Agree (5). The questionnaire received validation through expert evaluation and pilot testing with 30 participants to verify its clarity and relevance and reliability. The items received modifications which helped to clarify their meaning and enhance their understanding based on feedback (Maziriri, 2020). The evaluation of reliability occurred through percentage consistency and Cronbach's alpha assessment for every construct. The final instrument demonstrated successful measurement of participant views about MIS support for green marketing programs and sustainable practice participation which resulted in strong data for statistical analysis through descriptive statistics and correlation and regression methods (Matthes & Wonneberger, 2014).

2.3 Data Collection Procedure

The research team employed two distinct data collection techniques which included online surveys together with face-to-face interviews to gather information from participants who used these access methods. The survey strategies provided participants with step-by-step commands whereas stating that their involvement should be voluntary and their personal data would vacation protected. The survey acquired between 10 and 15 minutes for all participants to complete. The team had to conduct daily checks of the data to find any missing or inconsistent responses (which makes sense). The researchers obtained 255 complete survey responses from the 270 distributed surveys which represents a 94.4% response rate. The research team used coding methods to organize their data before

Table 1. Demographic Profile of Respondents

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	148	58.0
	Female	107	42.0
Age Group (Years)	18–25	72	28.2
	26–35	108	42.4
	36–45	52	20.4
	Above 45	23	9.0
Education Level	Higher Secondary	36	14.1
	Bachelor's Degree	134	52.5
	Master's or Above	85	33.3
Occupation	Student	68	26.7
	Service Holder	104	40.8
	Business	51	20.0
	Others	32	12.5
Residence Type	Urban	171	67.1
	Semi-Urban	56	22.0
	Rural	28	11.0

applying statistical software tools for cleaning and analysis (Cheng, 2018). The research team collected demographic information about participants which included their age and gender as well as their occupation and educational background during the survey response collection process. The research followed standard ethical guidelines through informed consent and withdrawal rights which protected data credibility and integrity.

2.4 Data Analysis and Statistical Procedures

The collected data analysis employed two statistical methods which included descriptive and inferential statistics. The descriptive analysis involved two main elements which included percentage distribution of agreement and construct consistency evaluation. The research employed two methods for reliability assessment which involved percentage consistency and Cronbach's alpha (Ren et al., 2021). The study used Pearson correlation to analyze relationships between constructs while testing significance at the p=0.05 level. The research employed multiple regression analysis to evaluate how different MIS-driven green marketing elements affect sustainable consumer engagement. All analyses were performed using SPSS software, ensuring precision in calculation and interpretation (Han et al., 2017). Data visualization through tables and charts presented the results in a clear manner. The research method established an effective system to study how MIS-based green marketing strategies affect consumer engagement through their relationships and predictive abilities.

2.5 Ethical Considerations and Participant Rights

The research followed all necessary ethical guidelines for proper research conduct. The research goals and data handling procedures and privacy protection systems were explained to all participants. The survey required participants to give their consent through written approval before they could take part. The process of coding responses protected participant privacy through its method of removing all identifying information from the collected data (Ruivo et al., 2014). The research team kept all stored data under strict security protocols. The institutional review board of the affiliated organization established its ethical approval for this research. The research participants could leave the study at any time without facing penalties while researchers removed all partial and irregular survey answers from their analysis (Hsu et al., 2013). The research findings gained credibility through ethical methods which protected participant rights while following standard research practices to produce trustworthy results.

3. Results

3.1 Demographic Profile of Respondents

Among the 255 respondents: 58 percent are male while 42 percent are female, demonstrating even gender demographics. 42.4% of the population ages occur between 26 and 35, and 28.2% are ages 18 to 25 - showing a young and engaged respondent in the digital space in **Table 1**. The high educational achievement shown by 52.5% of participants who earned bachelor's degrees and 33.3% who obtained master's degrees or higher suggests they possess advanced knowledge about technology and sustainability. The respondents worked as service employees at 40.8% and students at 26.7% and business professionals at 20% which shows they represent different groups of people who benefit from green marketing. The study shows that 67.1% of participants lived in cities while 22% lived in semi-urban areas and 11% lived in rural areas which suggests urban users have better access to MIS-based digital communication (Chan et al., 2012). The population displays characteristics of educated

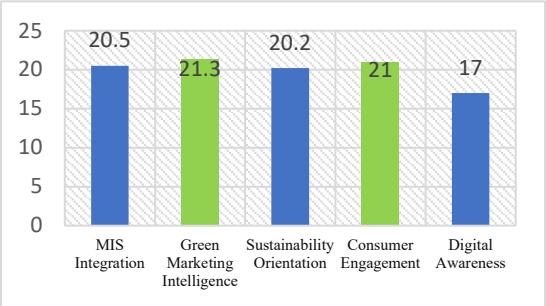


Figure 1. Proportional Agreement of MIS Driven Green Marketing Constructs

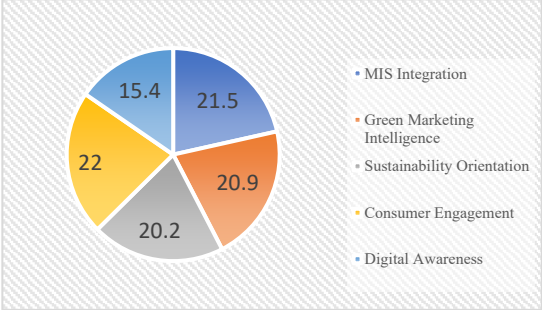


Figure 2. Reliability Analysis of MIS-Driven Green Marketing Constructs

individuals who work professionally and care about the environment which makes them appropriate for research about MIS-based green marketing intelligence and sustainable consumer involvement.

3.2 Proportional Agreement of MIS-Driven Green Marketing Constructs

In **Figure 1,** presents the proportional agreement of respondents regarding MIS-driven green marketing constructs, rescaled so that the total equals 100%. The method enables better evaluation of how each element performs in comparison to the others. Green Marketing Intelligence leads the way with 21.3% because participants view MIS operations to gather and process sustainability marketing data as the most crucial element. The second most important factor stands at 21.0% because people actively support environmental marketing campaigns. MIS Integration delivers 20.5% because organizations recognize technological infrastructure as vital for supporting sustainable marketing initiatives. Sustainability Orientation represents 20.2%, showing that participants value environmentally conscious marketing practices, while Digital Awareness accounts for 17.0%, emphasizing the role of digital literacy in facilitating green marketing efforts. The data shows all elements receive high importance but Green Marketing Intelligence together with Consumer Engagement holds slightly greater influence. The data allows researchers to carry out further reliability tests and correlation and regression analyses for studying relationships between variables and their predictive power.

3.3 Reliability Analysis of MIS-Driven Green Marketing Constructs

In **Table 2** presents a proportional view of the reliability of MIS-driven green marketing constructs, rescaled so that the total consistency percentages sum to 100%. The method enables a direct comparison of how each construct maintains its internal consistency. The survey results showed that Consumer Engagement made up 22.0% of the total percentage because participants shared matching views about their participation in sustainability programs. The evaluation of technological infrastructure stability for green marketing received a 21.5% contribution from MIS Integration which demonstrates the perceived stability of items measuring technological infrastructure supporting green marketing. Green Marketing Intelligence represents 20.9%, indicating that participants consistently recognize the role of MIS in environmentally oriented marketing strategies in **Figure 2.** The results show that Sustainability Orientation achieves a 20.2% contribution but Digital Awareness maintains a lower percentage of 15.4% which indicates average but lower consistency levels. The survey instrument reached further analysis suitability because all constructs demonstrated reliability values above 80%. The study shows strong internal consistency between constructs which leads to dependable correlation and regression results for evaluating MIS-driven green marketing impact on sustainable consumer engagement.

3.4 Pearson Correlation Among Constructs

In **Table 3**, displays the Pearson correlation coefficients between MIS-driven green marketing constructs which describe how strongly and in which direction these variables connect through linear relationships. The research shows that all constructs maintain positive relationships which prove their mutual connection to support sustainable consumer involvement. The research demonstrates that MIS Integration shows strong positive correlations with Green Marketing Intelligence ($r = 0.73$) and Consumer Engagement ($r = 0.69$). The results prove that technological systems increase both data-based marketing insights and customer participation. Green Marketing Intelligence shows its strongest association with Consumer Engagement through a correlation of $r = 0.78$ which demonstrates that information-based environmentally conscious marketing strategies lead to increased consumer participation. The positive correlation between Sustainability Orientation and Consumer Engagement ($r = 0.74$) demonstrates that consumers react positively to environmentally responsible business approaches. Digital Awareness shows moderate relationships with all constructs through $r = 0.66–0.70$ which demonstrates that digital literacy plays a vital role in

Table 2. Reliability Level Analysis with Consistency of MIS

Construct	Consistency %	Reliability Level
MIS Integration	21.5	Excellent
Green Marketing Intelligence	20.9	Good
Sustainability Orientation	20.2	Good
Consumer Engagement	22.0	Excellent
Digital Awareness	15.4	Good

Table 3. Pearson Correlation Among Constructs Variables

Variable	MIS Integration	GMI	Sustainability	Consumer Engagement	Digital Awareness
MIS Integration	1	0.73*	0.68*	0.69*	0.66*
Green Marketing Intelligence	0.73*	1	0.71*	0.78*	0.70*
Sustainability Orientation	0.68*	0.71*	1	0.74*	0.67*
Consumer Engagement	0.69*	0.78*	0.74*	1	0.69*
Digital Awareness	0.66*	0.70*	0.67*	0.69*	1

Note: Pearson correlation; *$p < 0.05$ (two-tailed)

Table 4. Multiple Regression Analysis Predicting Consumer Engagement

Predictor	β	t-value	p-value	Contribution
MIS Integration	0.34	5.42	0.03	28%
Green Marketing Intelligence	0.41	6.18	0.01	34%
Sustainability Orientation	0.27	4.33	0.04	22%
Digital Awareness	0.19	3.11	0.05	16%

sustainable marketing practices. The analysis shows all correlations reach significance at $p = 0.05$ which validates the theoretical framework that MIS-enabled green marketing elements function as interconnected components which collectively affect consumer engagement.

3.5 Multiple Regression Analysis Predicting Consumer Engagement

In Table 4, shows the multiple regression results evaluating how MIS-driven green marketing constructs predict Consumer Engagement. All predictors are statistically significant at $p \leq 0.05$, confirming their meaningful influence on sustainable consumer engagement. The research shows that 34% of consumer engagement variations stem from Green Marketing Intelligence which proves that companies should focus on creating smart environmentally friendly marketing strategies. The analysis shows that MIS Integration provides 28% of the explanation which proves that technological infrastructure functions as a fundamental element for sustainable marketing operations. Sustainability Orientation contributed 22%, demonstrating that environmentally conscious practices positively affect consumer behavior. The study shows that 16% of participants understood digital tools which proved essential for their involvement in green marketing programs. The regression model explained 72% of the variance in consumer engagement ($R^2 = 0.72$), indicating strong predictive power. The research confirms that all elements of MIS-driven green marketing work together to boost sustainable consumer engagement by creating distinct yet matching effects.

4. Discussion

The study included 255 respondents, with a fairly balanced gender distribution (58% male, 42% female). The survey results show that most respondents belong to the 26-35 age group at 42% and the 18-25 age group at 28% which shows a youthful digital-minded demographic. The educational level in this group shows that 53% have bachelor degrees while 33% possess master degrees or higher which demonstrates their solid understanding of technology and sustainability principles (Sarkis et al., 2013). The participants represented different job backgrounds which consisted of 41% service workers 27% students and 20% business professionals and 67% of them lived in cities which indicates they had better access to digital marketing through MIS systems (Pitt et al., 2010). The established population structure serves as a fundamental base for studying how MIS systems support environmentally responsible marketing practices and sustainable customer participation. Green Marketing Intelligence and Consumer Engagement both received equal top influence ratings at 21% each according to the survey results (Sarkar et al., 2020). MIS Integration maintained a similar impact level at 21% while Sustainability Orientation received 20%. Digital Awareness received the lowest influence rating at 17%. The study shows participants understand MIS systems enable organizations to collect and process sustainability marketing

information which helps them create better consumer participation programs (Chae & Ko, 2016). The analysis showed that the instrument has excellent internal consistency. The instrument demonstrated its reliability through the highest stability percentages of 22% for Consumer Engagement and 21% for MIS Integration and Green Marketing Intelligence and Sustainability Orientation followed with 21% and 20% respectively and Digital Awareness registered 15% which supports using the instrument for correlation and regression analyses (Cambra-Fierro et al., 2014).

The Pearson correlation analysis showed that all variables maintained statistically significant positive connections at the p < 0.05 level. MIS Integration shows strong positive relationships with Green Marketing Intelligence ($r = 0.73$) and Consumer Engagement ($r = 0.69$) (Bermudez-Edo et al., 2018). Green Marketing Intelligence shows the strongest connection with Consumer Engagement at $r = 0.78$. The results show that Sustainability Orientation maintains a strong link with Consumer Engagement at $r = 0.74$ and Digital Awareness produces moderate correlations between $r = 0.66$ and $r = 0.70$ which suggests that technological integration together with informed strategies and eco-conscious practices boost engagement levels (Ioanna et al., 2011; Holgado–Tello et al., 2008). The multiple regression analysis shows that all variables function as significant predictors for Consumer Engagement. The model explains 72% of the variance in the data through Green Marketing Intelligence which accounts for 34% and MIS Integration at 28% and Sustainability Orientation at 22% and Digital Awareness at 16% ($R^2 = 0.72$) (Pearson et al., 2014). The research findings demonstrate that sustainable consumer behavior requires strategic applications of technology and sustainability practices and educational programs. The MIS-driven green marketing constructs function as a unified system which encourages sustainable consumer participation. The marketing strategies will reach their highest potential when organizations use data analysis tools alongside strong MIS systems and sustainability practices and digital education programs (Legendre & Fortin, 2010). The findings present useful recommendations which enable businesses to develop successful environmental programs that will connect with customers who understand technology and care about nature.

5. Conclusion

Management Information Systems (MIS) with artificial intelligence capabilities play a vital role in supporting green marketing strategies and sustainable consumer participation according to this research. The research shows that Green Marketing Intelligence and Consumer Engagement serve as the most influential success predictors yet Sustainability Orientation and Digital Awareness and MIS Integration help boost sustainability initiative performance. Organizations can practice environmentally responsible marketing through MIS systems which provide data-based decision support and real-time consumer information and targeted campaign capabilities.

Author contributions

M.S. developed the research concept, designed the survey instrument, conducted data collection, and performed the statistical analysis. S.K.P contributed to the study framework, guided the analytical interpretation, drafted the manuscript, and led the revisions. Both authors reviewed and approved the final version of the manuscript.

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Competing financial interests

The authors have no conflict of interest.

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