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Digital Transformation, Green Innovation, and Green Brand Equity: Evidence From Organic Agricultural Products in Vietnam

Do Thi Man[1], Tran Van Hung[2],*, Ngo Viet Huong[3]

[1]Hong Duc University, Faculty of Economics and Business Administration, Thanh Hoa Province, Vietnam.

[2]Thanh Hoa Department of Health, Thanh Hoa Province, Vietnam.

(Corresponding Author)

[3]Hong Duc University, Faculty of Economics and Business Administration, Thanh Hoa Province, Vietnam.

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Abstract

This study examines the impact of digital transformation on green brand equity through the mediating role of green innovation, adopting a consumer-based perspective in the context of organic agricultural products in Thanh Hoa Province, Vietnam. Data were collected from a survey of 359 consumers and analyzed using partial least squares structural equation modeling (PLS-SEM). The results indicate that digital transformation has a positive effect on green innovation, while green innovation exerts a strong influence on green brand equity. Moreover, green innovation serves as a significant mediating mechanism in the relationship between digital transformation and green brand equity. This study contributes to the literature on sustainable marketing and digital transformation by elucidating the underlying mechanism through which digital transformation shapes consumer-based green brand equity in the organic agriculture sector. From a practical perspective, the findings offer important implications for organic agricultural enterprises and policymakers, highlighting the need to align digitalization initiatives with green innovation strategies to enhance green brand equity and foster sustainable agricultural development in emerging markets.

Keywords: Consumer behavior, digital transformation, green brand equity, green innovation, organic agriculture products.

1. Introduction

In recent decades, sustainable development has emerged as a central strategic priority for governments and businesses in response to escalating environmental challenges, including climate change, resource depletion, and ecological degradation. Within this context, organic agriculture has been widely recognized as a viable pathway to promote cleaner production, protect ecosystems, and meet the growing consumer demand for safe and environmentally friendly food products. Despite its environmental and health benefits, organic agribusinesses

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continue to face significant challenges in differentiating their products and building strong green brand value in increasingly competitive markets (Mie et al., 2017).

Concurrently, digital transformation is fundamentally reshaping how firms create value, organize supply chains, and engage with consumers. Beyond the mere adoption of digital technologies, digital transformation represents a holistic organizational change encompassing strategy, business models, and capabilities aimed at enhancing operational efficiency and adaptability (Vial, 2021). In the agri-food sector, digital technologies facilitate traceability, transparency, and information sharing, thereby improving production and distribution efficiency while supporting sustainable consumption and production goals (Wang et al., 2025). However, recent studies suggest that the impact of digital transformation on sustainability-related outcomes is often indirect rather than immediate. Instead, digital transformation tends to exert its influence through intermediary mechanisms, among which green innovation plays a pivotal role (Huang & Lau, 2024). Green innovation refers to the development of environmentally friendly products, processes, and managerial practices that reduce ecological harm while improving resource efficiency (Chen et al., 2006). In organic agriculture, green innovation may manifest through eco-friendly farming technologies, biodegradable packaging, digital certification and traceability systems, and green logistics solutions (Srivastav & Das, 2025).

From a market perspective, green innovation not only contributes to environmental performance but also serves as a strategic driver of green brand equity. According to Chen (2010), green brand equity reflects the incremental value of a brand derived from consumers' perceptions of a firm's environmental commitments and practices. Organic food products are typically characterized as credence goods, as consumers cannot often directly verify product quality or environmental attributes. Consequently, consumers rely heavily on brand-related cues and green signals when forming purchase decisions. In this regard, green innovation functions as a credible signal that strengthens consumer trust and enhances green brand equity (Dao et al., 2025).

Although prior research has examined the relationships between digital transformation and green innovation, as well as the performance outcomes of green innovation (Baeshen et al., 2021; Tariq et al., 2019), empirical studies that integrate digital transformation, green innovation, and green brand equity within a unified framework remain limited. Moreover, most existing studies adopt a firm-centric perspective, focusing primarily on financial or environmental performance indicators, while paying insufficient attention to how consumers perceive and interpret firms' digital and green initiatives through brand value. This gap is particularly salient in the context of organic agriculture, where consumer trust and perceived authenticity are critical determinants of market success. In addition, the extant literature is heavily skewed toward evidence from developed economies, whereas emerging economies, where agriculture remains a vital economic sector, have received comparatively less scholarly attention.

In Vietnam, digital transformation and sustainable agriculture have been identified as key pillars of national socio-economic development. Thanh Hoa province represents a relevant empirical setting due to its growing organic agricultural sector and increasing adoption of digital

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technologies across production, certification, and distribution stages. Investigating this context allows for a more nuanced understanding of how digital transformation and green innovation interact to shape consumer-based green brand equity in emerging markets.

Against this backdrop, the present study aims to examine the effect of digital transformation on green brand equity through the mediating role of green innovation, adopting a consumer-oriented perspective in the context of organic agricultural products in Thanh Hoa, Vietnam. By addressing this objective, the study contributes to the literature on green marketing and sustainable innovation, while offering practical insights for managers and policymakers seeking to foster sustainable brand development in organic agriculture under digital transformation.

2. Literature Review and Research Model

2.1 Theoretical Foundations

This study is grounded in three key theoretical perspectives - signaling theory, the resource-based view (RBV), and green consumer behavior theory - to develop an analytical framework that explains the mechanism through which green brand equity is formed in the context of digital transformation. From the RBV perspective, digital transformation is conceptualized as a strategic resource that enables firms to develop new capabilities related to technology integration, data analytics, and continuous innovation, thereby fostering green innovation and generating sustainable competitive advantage (Barney, 1991; Vial, 2021). However, in markets characterized by high information asymmetry, such as organic agriculture, green innovation efforts can only create value when they are effectively communicated to consumers through credible signals (Connelly et al., 2011). Green innovation activities, supported by digital technologies such as traceability systems and information transparency tools, serve as critical signals that help strengthen consumer trust, enhance brand image, and shape favorable perceptions of green brands (Chen, 2010).

From the perspective of green consumer behavior, when consumers clearly and consistently perceive firms' environmental commitments, they are more likely to form positive brand evaluations, thereby increasing green brand equity in their minds (Peattie, 2010). Accordingly, green innovation is regarded as a crucial mediating mechanism that transforms digital capabilities into market outcomes, specifically green brand equity.

2.2 Research constructs and hypotheses

2.2.1 Green Brand Equity

Brand equity can be examined from either a financial or a consumer-based perspective. When approached from the consumer perspective, it is referred to as consumer-based brand equity (Christodoulides & De Chernatony, 2010). Under this approach, brand equity is defined as the differential effect of brand knowledge on consumers' responses to brand marketing activities (Keller, 1993; Singh & Crisafulli, 2022). It reflects the differences in consumers' choices between branded and unbranded products.

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Green brand equity (GBE) refers to consumers' perceptions, beliefs, and knowledge regarding a brand's environmental sustainability and eco-friendliness (Chen, 2010). GBE encompasses a set of consumer perceptions and behavioral responses toward a brand's environmental responsibility commitments, which enhance the overall value of the brand (Li et al., 2019). Similar to conventional brand equity, GBE denotes the added value a brand provides. Consumers are generally more inclined to prefer products with higher brand equity over alternatives with similar functional attributes. In the context of green products, this added value is associated with product attributes that satisfy consumers' environmental protection needs.

2.2.2 Green Innovation

Green innovation (GI) refers to the development of new products, processes, and managerial practices aimed at reducing negative environmental impacts and improving resource efficiency (Chen et al., 2006). From a consumer perspective, green innovation is manifested through environmentally friendly product features, biodegradable packaging, cleaner production processes, as well as credible certifications and eco-labels. These elements enable consumers to more clearly perceive firms' environmental commitments and provide a foundation for the formation of positive brand attitudes (Del Río et al., 2016).

From a consumer-oriented viewpoint, green innovation can be defined as the extent to which consumers perceive, evaluate, and trust that a product's environmental improvements, through eco-friendly features, processes, or services, genuinely reflect environmental sustainability and reduced ecological impact. This definition emphasizes consumer perception as a central factor in determining whether green innovations create market value and influence attitudes and behaviors, as even technically sustainable innovations translate into consumer value only when they are recognized and positively evaluated (Yang & Roh, 2019).

2.2.3 Digital Transformation

Digital transformation (DT) is defined as the process of integrating digital technologies into an organization's strategy, business model, and operations to create new value and enhance organizational adaptability (Vial, 2021). From a consumer perspective, digital transformation is reflected through factors such as product traceability, information transparency, digital experiences, online interaction, and service personalization. Particularly in the organic agriculture sector, digital technologies, including blockchain, QR codes, e-commerce platforms, and digital communication tools, enable consumers to more easily access information regarding production processes, organic certifications, and the environmental impacts of products (UNEP, 2021).

Recent studies suggest that consumers tend to evaluate brands more favorably when they employ digital technologies to enhance transparency and environmental responsibility (Pei et al., 2025). However, digital transformation alone does not necessarily lead to higher green brand equity if digital technologies are not translated into substantive environmental improvements. This indicates that digital transformation primarily functions as a foundational capability that

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facilitates the effective implementation of green innovation activities, rather than directly generating green brand value by itself (Pei et al., 2025).

2.2.4 The Relationship between Digital Transformation and Green Innovation

Drawing on dynamic capability theory, digital transformation can be conceptualized as a strategic capability that enables firms to sense, seize, and reconfigure resources in pursuit of sustainability objectives (Wu et al., 2013). Digital technologies allow firms to collect and analyze environmental data, optimize production processes, and enhance collaboration across the value chain, thereby creating favorable conditions for the development of green innovation (Huang & Lau, 2024).

Recent empirical studies provide strong evidence of a positive relationship between digital transformation and green innovation. Feng et al. (2022) demonstrate that digital transformation reduces the costs of green research and development while improving the quality of green innovation. Similarly, Huang and Lau (2024) confirm that digital transformation exerts a positive effect on the quality of green innovation, particularly in emerging economies.

From a consumer perspective, digital transformation initiatives enable firms to more effectively communicate their green innovation efforts, thereby enhancing consumers' ability to recognize and evaluate environmental improvements (Fan et al., 2024). Accordingly, this study proposes the following hypothesis:

H1: Digital transformation has a positive effect on green innovation.

2.2.5 The relationship between green innovation and green brand equity

According to signaling theory, green innovation activities function as credible signals that enable consumers to assess the extent of a firm's environmental commitment (Connelly et al., 2011). When consumers clearly perceive green improvements in products and production processes, they are more likely to develop a favorable brand image, leading to higher levels of satisfaction and trust toward the brand (Chen, 2010).

A substantial body of research has confirmed the positive relationship between green innovation and green brand equity. Chen (2010) demonstrates that green innovation significantly influences green brand equity through its effects on brand image and customer satisfaction. In the context of organic agriculture, green innovations such as environmentally friendly packaging, organic certifications, and transparent product information exert a strong influence on consumers' perceptions and purchase behavior (Kautish & Sharma, 2019).

Moreover, green innovation serves as a powerful signal that enhances consumer trust and satisfaction, thereby strengthening green brand equity (Chen, 2010). In organic agriculture, where the green attributes of products are difficult to verify through direct experience, green innovation becomes particularly important in reinforcing trust and reducing consumers'

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perceived risk (Srivastav & Das, 2025). Based on these arguments, this study proposes the following hypothesis:

H2: Green innovation has a positive effect on green brand equity.

2.2.6 The Mediating Role of Green Innovation

Although digital transformation may enhance consumer experience and trust, its impact on green brand equity is often indirect rather than direct. Digital technologies need to be translated into tangible green innovations that consumers can recognize and evaluate. Accordingly, green innovation is regarded as a critical mediating mechanism that links digital transformation to green brand equity (Ha, 2020).

Recent studies have highlighted the mediating role of green innovation in the relationship between technological capabilities and sustainability outcomes (Yao et al., 2021). In the context of organic agriculture, digital transformation contributes to the enhancement of green brand equity only when it enables firms to implement observable and consumer-recognized green innovations. On this basis, the following hypothesis is proposed:

H3: Green innovation mediates the relationship between digital transformation and green brand equity.

2.3 Proposed Research Model

Based on the theoretical foundations and hypotheses developed above, this study proposes a research model that explains how digital transformation influences green brand equity through green innovation, from a consumer-based perspective in the context of organic agricultural products in Thanh Hoa Province, Vietnam.

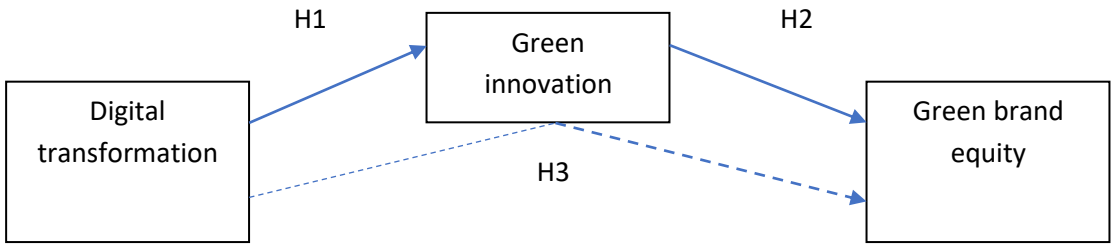

Figure 1. Proposed research model

3. Research methodology and measurement scales

This study employs a quantitative research approach to examine the impact of digital transformation on green brand equity through green innovation, from a consumer-based perspective in the context of organic agricultural products in Thanh Hoa Province, Vietnam.

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Data were collected through a structured questionnaire administered directly to consumers aged 18 and above who had purchased or used organic agricultural products in Thanh Hoa in the recent period.

A non-probability sampling method was adopted, combining convenience sampling and purposive sampling, due to limitations in identifying a comprehensive sampling frame and to ensure effective access to the target population. The sample size was determined based on established guidelines for PLS-SEM, with the "10-times rule," the minimum sample size should be at least ten times the maximum number of structural paths directed at any endogenous construct in the model (Hair et al., 2017). In the proposed research model, green brand equity has a maximum of two incoming paths, indicating a minimum required sample size of 20 observations.

However, to enhance statistical reliability and the generalizability of the findings, this study follows the more recent recommendations of Hair et al. (2021), which suggest that a sample size of 200 or more is appropriate for PLS-SEM models of moderate complexity. Accordingly, 400 questionnaires were distributed, and after data screening, 359 valid responses were retained and used for quantitative analysis to examine the hypothesized relationships in the model.

The survey data were processed and analyzed using SmartPLS 4.0 software. The PLS-SEM analysis was conducted in two main stages. First, the measurement model was evaluated to assess indicator reliability and construct validity using criteria such as composite reliability (CR ≥ 0.70) (Hair et al., 2021), average variance extracted (AVE ≥ 0.50) (Fornell & Larcker, 1981), and discriminant validity assessed via the Fornell–Larcker criterion (Henseler et al., 2015). Second, the structural model was assessed by examining path coefficients and conducting bootstrapping with 5,000 resamples to determine the statistical significance of the hypothesized relationships (Laguía et al., 2019).

Based on prior studies, this research adapts measurement scales for the three constructs in the model, as summarized in Table 1. All observed variables were measured using a five-point Likert scale, ranging from 1 = *strongly disagree* to 5 = *strongly agree*.

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Table 1. Measurement scales for variables in the research model

Item	Definition	Source
DT	*Digital Transformation*	
DT1	Businesses use digital platforms to provide information about the origin and green characteristics of products.	Vial (2021)
DT2	You can easily retrieve organic product information via QR code or a digital platform.	Wang et al. (2025)
DT3	Digital technologies enable you to clearly understand the production process and organic standards of the product.	Huang & Lau (2024).
DT4	Digital technologies provide transparent information about the product's production process and organic standards.	Wang et al. (2025)
DT5	Digital strategies enhance the transparency and credibility of organic brands in your perception.	Feng et al. (2022)
GI	*Green Innovation*	
GI1	The business develops organic products designed to minimize environmental impact.	Srivastav & Das (2025)
GI2	The production process of organic products is designed to improve energy and resource efficiency.	
GI3	Organic product packaging and labeling are designed to be environmentally friendly.	Baeshen et al. (2021)
GI4	Green innovation initiatives make this brand stand out from other brands.	Srivastav & Das (2025)
GI5	The product clearly displays recognized technological certifications or green standards.	Yao et al. (2021)
GBE	*Green Brand Equity*	
GBE1	Compared to other brands, this brand is perceived as more environmentally friendly.	Li et al. (2019)
GBE2	You have confidence in this brand's green claims regarding its organic products.	
GBE3	You are willing to pay a higher price for this brand's products due to its green values	Dao et al. (2025)
GBE4	This brand leaves a positive impression on you due to its green commitments and initiatives.	
GBE5	You are willing to recommend this brand to others due to its sustainability values.	Ha (2020)

Source: Compiled from the authors

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4. Empirical results

4.1 The social characteristics of participants

After data collection, a total of 359 valid responses were retained for analysis. The sample exhibited a nearly balanced gender distribution, with 46.52% male and 53.48% female respondents. The results further indicate that 73.26% of participants were aged between 35 and 55, a group typically characterized by heightened awareness of food safety in daily consumption and environmental responsibility. Regarding income, the largest proportion of respondents (46.24%) reported a monthly income of VND 10-20 million, followed by those earning VND 5-10 million. This distribution broadly reflects the average income structure in Vietnam. Detailed demographic characteristics are presented in Table 2.

Table 2. The social characteristics of participants

Item	Category	Frequency	Percentage (%)
Gender	Male	167	46.52
	Female	192	53.48
Age	18-34 years	55	15.32
	35- 45 years	153	42.62
	45-55 years	110	30.64
	Above 55	41	11.42
Income	Under 5 million	32	8.92
	5-10 million	94	26.18
	10-20 million	166	46.24
	Above 20 million	67	18.66

*Source: Compiled from the author*s

4.2 Measurement model assessment

The analysis shows that all indicator outer loadings exceed the recommended threshold of 0.70, indicating satisfactory indicator reliability and supporting their inclusion for further analysis. The reliability assessment reveals that both Cronbach's alpha and Composite Reliability (CR) values for all constructs are greater than 0.70, confirming adequate internal consistency and scale reliability.

Furthermore, the Average Variance Extracted (AVE) values of 0.628 for Digital Transformation (DT), 0.606 for Green Innovation (GI), and 0.816 for Green Brand Equity (GBE) exceed the minimum threshold of 0.50, thereby demonstrating sufficient convergent validity (Hair et al., 2021). Overall, the measurement model exhibits strong reliability and validity, confirming that the constructs are appropriate for subsequent structural model analysis.

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Table 3. Construct reliability and validity for measurement models

Latent variables	Item Code	Item loadings	CR	Cronbach's Alpha	AVE
Digital Transformation (DT)	DT1	0.741	0.893	0.851	0.628
	DT2	0.816			
	DT3	0.829			
	DT4	0.844			
	DT5	0.815			
Green Innovation (GI)	GI1	0.735	0.844	0.834	0.606
	GI2	0.718			
	GI3	0.857			
	GI4	0.830			
	GI5	0.827			
Green Brand Equity (GBE)	GBE1	0.886	0.957	0.944	0.816
	GBE2	0.897			
	GBE3	0.887			
	GBE4	0.912			
	GBE5	0.933			

Source: authors' data analysis results

The table evaluates the discriminant validity of the latent variables using the Fornell-Larcker Criterion and the Heterotrait-Monotrait Ratio (HTMT). According to the Fornell-Larcker Criterion, the square root of the AVE is 0.793 for digital transformation, which is greater than the correlation between the variables (0.47 and 0.45). It is 0.904 for green brand equity, which is greater than the correlation between the variables (0.626). This indicates clear discriminant validity, as each variable is more strongly associated with its indicators than with any other variable. Overall, the results demonstrate strong discriminant validity, ensuring that digital transformation, green innovation, and green brand equity are independent concepts within the model and appropriately measured as separate constructs.

Table 4. Discriminant Validity (Fornell-Larcker Criterion)

	Digital Transformation	Green Brand Equity	Green Innovation
Digital Transformation	0.793		
Green Brand Equity	0.470	0.904	
Green Innovation	0.450	0.626	0.778

Source: authors' data analysis results

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4.3 Structural equation model

Table 5 presents the results of the structural equation model, examining the direct relationships among digital transformation (DT), green innovation (GI), and green brand equity (GBE). The results indicate that all hypothesized paths are statistically significant at the 0.001 level, providing strong empirical support for the proposed research model.

The results indicate that DT has a positive and statistically significant effect on GI (β = 0.450, p <0.001). This finding aligns with the argument of Huang & Lau (2024), who emphasized that digital transformation constitutes a crucial component of the digital economy and represents a microcosmic manifestation, playing a vital role in advancing enterprise sustainable development from the perspective of green innovation quality. Another study by Feng et al. (2022) cũng đã khẳng định digital transformation can significantly promote the high-quality green innovation of enterprises and also plays a more significant role in promoting the green innovation of high-tech enterprises and state-owned enterprises. The magnitude of the coefficient observed in this study is comparable to those reported in emerging-economy contexts, suggesting that digital transformation plays a similarly important role in supporting green innovation within organic agricultural systems.

Table 5. The results of the structural equation

Hypothesis	Path	Original Sample (O)	Sample Mean (M)	t	p
	Direct effect				
H1	DT →GI	0.450	0.455	9.682	0.000
H2	GI→ GBE	0.626	0.629	17.004	0.000
	Indirect effect				
H3	DT →GI→ GBE	0.282	0.286	7.754	0.000

Note: DT: Digital Transformation, GI: Green Innovation, GBE: Green Brand Equity
Source: authors' data analysis results

Regarding hypothesis H2, the relationship between green innovation and green brand equity is strong and highly significant (β = 0.626, p < 0.001). This result aligns closely with the findings of Chen (2010), who argued that green innovation is a key antecedent of green brand equity through its effects on green brand image, trust, and satisfaction. Similar evidence has been reported by Srivastav & Das (2025), who found that consumers' perceptions of green product innovation substantially enhance brand-related value and loyalty. Compared with previous studies conducted in non-agricultural or developed-market settings, the relatively high coefficient observed here suggests that green innovation may play an even more critical role in shaping brand equity for organic agricultural products, where product quality and environmental attributes are difficult for consumers to verify directly.

The mediating role of green innovation was examined using the bootstrapping approach. The results indicate that the indirect effect of digital transformation on green brand equity (H3) is

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positive and statistically significant ($\beta = 0.282$, $p < 0.001$). This finding is consistent with prior studies highlighting the role of digitalization in enhancing brand reputation and consumer trust through increased transparency and interactive communication (Ha, 2020; Yao et al., 2021). However, the relatively weaker magnitude of this indirect effect compared to the direct relationship between green innovation and green brand equity suggests that digital transformation alone is insufficient to substantially strengthen green brand equity unless it is effectively translated into tangible green innovations that are recognizable by consumers.

5. Discussion

This study provides empirical evidence on the relationships among digital transformation, green innovation, and green brand equity from the consumer perspective in the context of organic agricultural products in Thanh Hoa province, Vietnam. The findings not only enrich the theoretical literature on green branding and sustainable innovation but also reflect the specific characteristics of organic agriculture markets in developing regions.

First, the results demonstrate that digital transformation has a strong and positive effect on green innovation, highlighting the role of digital technologies as strategic resources that foster sustainable innovation. This finding is consistent with the Resource-Based View (RBV), which conceptualizes digital capabilities as valuable and difficult-to-imitate resources that enhance firms' innovation capacity and environmental adaptability (Barney, 1991; Feng et al., 2022; Wang et al., 2025). It also aligns with prior studies indicating that digital transformation improves supply chain monitoring, traceability, and the optimization of green production processes (Chen, 2010; Huang & Lau, 2024).

In the context of Thanh Hoa, where most organic agricultural firms and cooperatives are small and medium-sized enterprises, digital transformation is primarily manifested through QR-code traceability systems, e-commerce platforms, social media, and information technologies in production management. These tools not only enhance operational efficiency but also facilitate the implementation of green innovation practices, such as resource efficiency, logistics optimization, and environmental information transparency, factors that are particularly valued by organic consumers.

Second, the findings confirm a significant and positive relationship between green innovation and green brand equity. This result reinforces Signaling Theory, which posits that green innovation functions as a credible signal enabling consumers to assess a firm's environmental commitment (Connelly et al., 2011). When organic brands adopt environmentally friendly technologies, improve production processes, and develop green products, consumers tend to form more favorable perceptions of brand quality, credibility, and overall value.

This result is consistent with previous research in sustainable marketing, which shows that green innovation enhances green brand awareness, perceived quality, and consumer loyalty (Chen, 2010; Li et al., 2019; Dao, 2025). In Thanh Hoa, Vietnam, where consumer trust in organic

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products is often challenged by concerns over greenwashing, substantive and verifiable green innovations play a particularly critical role in strengthening green brand equity.

Third, the analysis reveals that green innovation mediates the relationship between digital transformation and green brand equity. This suggests that digital transformation contributes to sustainable brand value only when it is effectively translated into concrete green innovation activities. This finding advances existing theory by clarifying the mechanism through which digital capabilities influence green brand equity, extending prior studies that have predominantly focused on direct effects.

From a consumer perspective, the results indicate that organic consumers in Thanh Hoa value not merely the digitalization of marketing communication, but more importantly, the extent to which digital technologies are used to support substantive green innovation. This reflects the growing environmental consciousness of consumers, who increasingly demand transparency, accountability, and genuine sustainability from organic brands.

From a contextual perspective, these findings are particularly relevant for emerging economies such as Vietnam, where organic agriculture is still at an early stage of development, and consumer skepticism toward green claims remains prevalent. Compared to evidence from developed markets, the stronger reliance on green innovation as a branding signal underscores the importance of tangible and verifiable green practices in building green brand equity in such contexts.

6. Implications

6.1 Theoretical implications

This study offers several important theoretical contributions to the literature on sustainable marketing, innovation management, and digital transformation, particularly in the context of organic agriculture in emerging economies.

First, the study extends consumer-based green brand equity theory by integrating digital transformation as a critical strategic antecedent. While prior research has largely emphasized the roles of green communication and corporate social responsibility in building green brand equity, this study provides empirical evidence that digital capabilities also constitute a key resource shaping consumers' perceptions and evaluations of green brands. In doing so, it enriches the theoretical framework of green branding in the digital transformation era.

Second, the findings reinforce and extend the resource-based view by elucidating the mechanism through which digital transformation, as a strategic organizational capability, drives green innovation and subsequently generates sustainable competitive advantage through brand value. By identifying green innovation as a mediating construct, the study clarifies how digital resources are translated into tangible market outcomes from a consumer perspective, an aspect that remains underexplored in prior research.

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Third, the study contributes to Signaling Theory by demonstrating that green innovation functions as a credible signal that reduces information asymmetry in organic product markets. Given consumers' limited ability to directly verify environmental attributes, digitally enabled green innovations enhance transparency and strengthen trust in green brands. This provides additional empirical support for the mediating role of green innovation signals between firm capabilities and consumer perceptions.

Finally, the study enriches the literature on green consumer behavior in developing economies, where institutional conditions, levels of digitalization, and environmental awareness differ substantially from those in developed markets. By focusing on a local context (Thanh Hoa province), the findings suggest that while universal theoretical models remain relevant, their explanatory power depends on contextual adaptation to specific socio-economic conditions.

6.2 Managerial and policy implications

From a practical perspective, the findings provide several important implications for organic agricultural enterprises, cooperatives, and policymakers.

For firms and managers, the results indicate that digital transformation should not be treated as an end in itself, but rather as a strategically guided process aimed at fostering green innovation. Organic agricultural enterprises in Thanh Hoa province should prioritize investments in digital solutions that enhance environmental sustainability, such as digital traceability systems, green supply chain management platforms, and data analytics tools to optimize resource utilization. These initiatives not only improve operational efficiency but also directly strengthen green brand equity in consumers' perceptions.

In addition, managers should place greater emphasis on green digital communication strategies that highlight substantive green innovations rather than symbolic or superficial "green" messages. Leveraging digital channels such as social media and e-commerce platforms to provide transparent, consistent, and verifiable information about green practices can significantly enhance consumer trust and brand loyalty toward organic brands.

From a policy perspective, the findings suggest that digital transformation support programs in agriculture should be explicitly aligned with green innovation and sustainability objectives. Local authorities should promote the development of digital infrastructure, provide financial incentives, and offer digital skills training for organic agricultural enterprises and cooperatives, particularly small- and medium-sized entities. Furthermore, the establishment of digital standards and certification systems for organic products would enhance market transparency and help safeguard green brand equity.

Finally, the results indicate that encouraging consumer participation on digital platforms through reviews, feedback mechanisms, and online interactions can strengthen firm-consumer relationships and contribute to the development of more sustainable green brand equity in the long term.

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7. Future research directions

Future studies should expand the geographical scope to other provinces, regions, or countries to compare differences in green consumer behavior and to test the generalizability of the proposed research model across diverse institutional and cultural contexts. In addition, the model could be extended by incorporating additional mediating or moderating variables, such as green trust, perceived risk, individual environmental consciousness, or consumer engagement on digital platforms, to further elucidate the psychological mechanisms underlying green brand equity formation.

Finally, future research may adopt firm-level or supply chain perspectives and integrate secondary or operational data to provide a more comprehensive understanding of how digital transformation and green innovation jointly contribute to sustainable development in organic agriculture.

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