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Determinants of agritourism development in green tea farms of the northern mountains of Vietnam: A hybrid approach based on the combination of diffusion of Innovation (DOI) theory and PLS-SEM

Keunjae Lee[a] | **An Thinh Nguyen**[b] | **Nhung P. T. Nguyen**[bc] | **Thuy Hang Nguyen**[b] | **Ngoc Tran**[b] | **Tung Lam Nguyen**[b] | **Van Quy Khuc**[b] | **Thuong Thi Vu**[b]

[a]Department of Economics, Pusan National University, Pusan, Korea.
[b]VNU University Economics and Business, Vietnam National University, Hanoi.
[c]East Asia University of Technology, Hanoi, Vietnam.

Abstract Agritourism is the practice of identifying and capitalizing on rural destinations' diverse on-farm and off-farm attractions. Thai Nguyen, a major green tea farming region belonging to the Northern Mountains of Vietnam, is selected as the study area. This study aims to determine and analyze the factors affecting agritourism development including Green Productivity, Digital Transformation, and Stakeholder Engagement. Five innovative attributes of the Diffusion of Innovation (DOI) theory as Relative Advantage, Compatibility, Complexity, Trialability, and Observability are included. Questionnaires are distributed to 350 farmers inhabited in Thai Nguyen. The Partial Least Squares Structural Equation Modeling (PLS-SEM) is used to analyze at two levels: the determinant and the goal of agritourism development. The study results show that, at the determinant level, innovation attributes of DOI account for 35.8% of farmers' perceptions of Green Productivity (R^2 = 0.358), 30.6% for Stakeholder Engagement (R^2 = 0.306), and 34.6% for Digital Transformation (R^2 = 0.346). At the goal level, Green Productivity, Stakeholder Engagement, and Digital Transformation determinants explain 55.1% of the sustainable development goal of Agritourism (R^2 = 0.551). The study findings reveal that the innovation attributes of DOI are strong predictors of how factors like green productivity, stakeholder engagement, and digital transformation play their roles in the sustainable development of agritourism. These factors are helpful in moving agritourism toward its desired long-term growth. Policy suggestions are also presented for the long-term growth of agritourism on regional and national scales in Vietnam.

Keywords: agritourism, green productivity, stakeholder engagement, digital transformation, PLS-SEM, diffusion of innovation (DOI), green tea farms, northern mountains of Vietnam

1. Introduction

Agritourism is a recognized approach for identifying and leveraging the diverse attractions found in both on-farm and off-farm settings within rural destinations. This form of tourism is closely intertwined with agricultural activities conducted by small-scale farmers, for whom these activities serve as the primary source of income, often carried out on their own premises (Foris et al 2018). Klaze (1994) provided a definition of agritourism as "a wide range of activities, services, and amenities offered by farmers and rural residents to attract tourists to their area, thereby generating additional income for their businesses. Small and medium-sized agricultural producers have increasingly turned to diversifying their income sources as a means to sustain their involvement in agriculture (Neda et al 2011). Agritourism represents a facet of rural tourism where guest accommodations are integrated into agricultural estates, enabling visitors to engage in agricultural activities (Marques 2006). Much like the hospitality industry, agritourism is practiced by agricultural enterprises that maintain close ties to farming activities (Sonnino 2004). It entails the operation of a working farm that is geared towards providing enjoyment for visitors while also generating income for the farm's owner (Federation 2004). Wilson et al (2006) defined agritourism as anything that connects consumers with the heritage, natural resource, or culinary experiences unique to the agricultural industry or a rural area. As a novel agricultural activity, agritourism generates additional income and employment opportunities for producers and the adjacent community (Maruti 2009). Agritourism has emerged due to an opportunity for farmers and ranchers to increase their income diversification and stability (Nickerson et al 2001; George et al 2011), the public's growing concern for supporting local farmers (Govindasamy et al 2002), the encouragement of rural development

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through tourism (Sharpley and Vass 2006), and the desire to use farm household assets and expand employment opportunities for household members (Bernardo et al 2004). Agritourism is an alternative solution to the acute economic depression in rural areas, thereby facilitating the recovery of local economies (Haggblade et al 2010; Tew and Barbieri 2012). As a strategy for the sustainable development of rural communities, agritourism has recently gained prominence among policymakers, researchers, and government officials (Sonnino 2003).

Agritourism provides rural communities with the opportunity for sustainable development (Despotovc et al 2017). The economic, social, and cultural vitality of regions where agritourism is practiced is inextricably linked to the sustainability of agritourism operations. Agritourism stimulates the economy, provides visitors with memorable experiences, and promotes environmental protection and sustainable development (Moraru et al 2016; Zacal et al 2019; Atijon et al 2020). As a result of the synergy between the two industries, unique commercial tourism enterprises have been established on working farms (Mahaliyanaarachch 2016; Karampela et al 2017; Joshi et al 2020). Agritourism networks link communities to create an optimal structure that guarantees the destination's appeal and is a viable option for farmers seeking sustainable means of subsistence. Agritourism can contribute to the sustainable development of local lifestyles and the alleviation of poverty (Marian 2017; Polin et al 2021). In addition to monetary benefits, agritourism creates jobs, increases and restores community pride, and encourages the adoption of innovative working practices (Lane 2009). Agritourism encourages agricultural communities to produce their crops sustainably and conserves farm biodiversity, thereby reducing internal risk factors associated with agriculture, such as disease outbreaks and soil deterioration (Neda et al 2012; Marian 2017). The utilization and protection of natural and cultural resources, as well as the minimal negative impact on the environment, make agritourism a crucial form of sustainable tourism (Neda et al 2012; Marian 2017). Agritourism has emerged as means of agricultural diversification among local communities due to its positive effects on sustainability (Neda et al 2012). Agritourism is an authentic form of rural tourism because it allows visitors to experience a working farm, participate in agricultural operations, connect with animals and nature, and consume food produced and prepared on the farm (Sharon et al 2010).

The sustainable development of agritourism hinges on several critical factors, including the ability to acquire and apply local knowledge, engage in service provision activities, and garner support from the community and local government (Comen and Foster 2006; Veselinovis 2013). Numerous agribusiness owners aspire to attract a greater number of vacationers to access and utilize their services. These interactions can serve as catalysts for visitors to adopt more sustainable dining and living practices. Apart from capitalizing on the inherent advantages of an appealing natural setting and government backing, providers of agritourism services must possess a thorough understanding of customer needs and expectations, adhere to established service delivery standards, acquire and employ social skills, and more. Suppliers must consistently deliver exceptional service quality, maintain adequate capacity, provide a safe and easily accessible environment, foster collaboration with similar organizations to exchange information and experiences, cultivate positive community relations, and adopt flexible business planning and risk management strategies (Chase et al 2007). In the context of a developing nation, government involvement and stakeholder engagement hold pivotal importance for the success of agritourism (Marketa et al 2018). The development of agritourism in rural areas extends beyond simply providing tourists with local products; it necessitates a careful evaluation of local acceptability and suitability (Gopal et al 2008). The progression of agritourism is subject to influence from various stakeholders, each harboring distinct perspectives and objectives regarding the manner in which activities should be developed and carried out. Furthermore, the achievement of successful agritourism development is contingent upon the capacity of local communities to sustain themselves and derive enduring benefits (Pretty 1995).

The major reason farmers started providing agritourism attractions is the money it brought in (Christelle 2021). Figure 1 shows that agritourism is concerned at both demand and supply sides (Valarmathi 2021). This research utilizes a supply side analysis of agritourism since it is concerned with the reasons farmers (suppliers) provide this service. Several academics back this strategy in regards to (i) motivations like income, farm diversification, rural development, and attributes of farm owners like operator age, and farm size (Barbieri 2013; LaPan et al 2013); and (ii) agritourism performance and environmental performances (Pulina et al 2006; Barbieri et al 2008). Farmers that open their properties to visitors for agritourism enjoy several financial and other advantages. Additional income generation, diversification of farming operations, education of tourists and visitors about farming and rural life, and the introduction of a new use for underutilized farmland are just some of the potential advantages. Long-term viability for farms is another way in which agritourism may aid farmers. For small areas, agritourism may lead to new employment prospects, economic development, and diversification.

In this study, the Diffusion of Innovation (DOI) theory is selected because it offers a substantial conceptual framework for the examination and advancement of agritourism, facilitating researchers and stakeholders in comprehending the mechanisms and rationales behind the adoption of innovations inside this particular economic domain. By utilizing DOI, the development of agritourism may be enhanced with more effectiveness, so contributing to economic growth in rural regions and promoting the adoption of sustainable farming methods. According to Rogers (1962, 1995, and 2003), the DOI theory suggests that individuals with a creative inclination are more inclined to embrace new experiences and are better equipped to navigate uncertainty. Since its inception in 1962, the DOI theory has undergone continuous development, with significant refinements emerging from empirical research conducted in 1971, 1983, 1995, and 2003. The DOI theory has been applied in

separate research projects across a wide spectrum of fields, including but not limited to the social sciences, business, economics, and tourism (Rogers 2003; Robinson 2009).

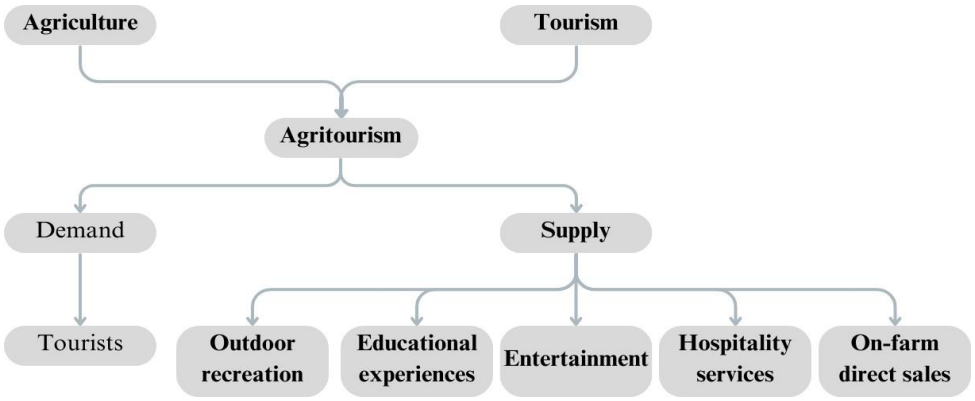

Figure 1 The demand and supply sides of agritourism (Source: adapted from Valarmathi, 2021).

To calculate and show how determinants affect agritourism development, the Partial Least Squares Structural Equation Modeling (PLS-SEM) is conducted. This model employs proxies as input data for ordinary least squares regression. The primary aim of this process is to minimize the variances of the residuals (error terms) associated with endogenous variables (Kline 2010; Sadia et al 2017). In the initial step of the evaluation process, the measurement model is assessed by examining the reliability, convergence value, and discriminant validity of the measurement concepts and structures incorporated within the model. In line with recommendations outlined by Hair et al (2016), the structural model is evaluated through stages that include the examination of multicollinearity and path coefficients, calculation of the squared coefficient of determination, assessment of the coefficient of impact, and evaluation of predictive relevance. These stages of PLS-SEM have been applied in various contexts, such as testing the intention to book travel online (Amaro et al 2015), exploring the impact of diversity on the relationship between auxiliary services and satisfaction, leading to loyalty among domestic visitors (Mohsin 2015), and investigating how human capital interacts with organizational orientations, influencing them to determine performance outcomes (Assaker 2019).

By merging the DOI Theory with PLS-SEM, this study aims to offer a comprehensive understanding of determinants influencing agritourism development in green tea farms in a locality of Vietnam, enabling evidence-based policy formulation, and fostering sustainable development at different levels of Vietnam.

2. Materials and Methods

2.1. DOI Theory

The DOI (Diffusion of Innovations) theory offers an explanation for how innovations are adopted within a population. An innovation can be defined as an idea, behavior, or object perceived as novel by its intended audience (Robinson 2009). The innovation adoption process is an intricate activity that encompasses both the acquisition of information and the assimilation of this knowledge (Rogers 2003). Throughout this process, individuals are motivated to reduce uncertainty regarding the advantages and disadvantages associated with an innovation. The innovation-decision process comprises five distinct stages: knowledge, persuasion, choice, implementation, and confirmation. Typically, each of these stages follows a sequential, time-ordered progression (Rogers 2003). The process of disseminating innovations serves as a means of reducing uncertainty and pertains to the characteristics of innovations that are proposed to help mitigate ambiguity surrounding the innovation itself. There exist five attributes associated with innovations, namely relative advantage, compatibility, complexity, trialability, and observability. The rate at which innovations are adopted can be predicted based on individuals' perceptions of these specific attributes (Rogers 2003).

2.2. PLS-SEM

Through SEM (Structural Equation Modeling), various sophisticated models have been assessed (Richter et al 2014). Since its inception, SEM has emerged as one of the most widely used multidimensional statistical techniques across a plethora of research fields, including psychology, education, sociology, management, physics, political science, public health, and more. In a structural equation, a variable can serve as a dependent variable in one interaction while simultaneously functioning as an independent variable in its relationship with another factor (Hair et al 2010). SEM enables the simultaneous estimation of multiple equations involving both independent and dependent variables, facilitating the computation and graphical representation of the relationships between these variables (Sadia et al 2017). There are two main groups of SEM: structural covariance-based models and PLS-SEM (Partial Least Squares Structural Equation Modeling) (Hair et al 2013).

PLS-SEM employs surrogate variables as input data to perform ordinary least squares regression, aiming to minimize the residual variances (error terms) of endogenous variables for research purposes. Thus, PLS-SEM is primarily utilized in exploratory research to construct theories, with an emphasis on explaining variance (forecasting research variables) (Hair et al 2021). However, PLS-SEM has a limitation in its ability to assess the overall fit of the model, which restricts its use in theory testing and confirmation (Hair et al 2021). In the PLS-SEM model, a single data sample is insufficient to conduct a statistical significance test on the model's characteristic parameters. To address this limitation, the Bootstrap method is employed in PLS-SEM (Nguyen et al 2020).

When applying PLS-SEM, the evaluation of the research model occurs in two steps: the measurement model evaluation and the structural model evaluation (Henseler et al 2010). The measurement model is assessed by examining the reliability, convergence value, and discriminant validity of its measurement concepts/structures. The structural model, on the other hand, is evaluated through several steps, including tests for multicollinearity, path coefficients, coefficient of determination R^2, assessment of the coefficient of impact (F-Square value), and evaluation of predictive relevance (coefficient Q^2) (Hair et al 2016).

2.3. A hybrid approach of DOI & PLS-SEM

The phases of this study are as follows. Knowledge, Persuasion, Decision, Implementation, and Confirmation are the first steps of this research. The agritourism concept is evaluated based on five novel features from DOI theory: green productivity, stakeholder engagement, and digital transformation. The group also proposed research hypotheses, questionnaires, and field surveys, all of which yielded findings and advanced the project to the next stage. Second, the DOI theory provides a hypothesis to be tested using the PLS-SEM. The software SmartPLS 3.0 is used for data processing and hypothesis testing (figure 2).

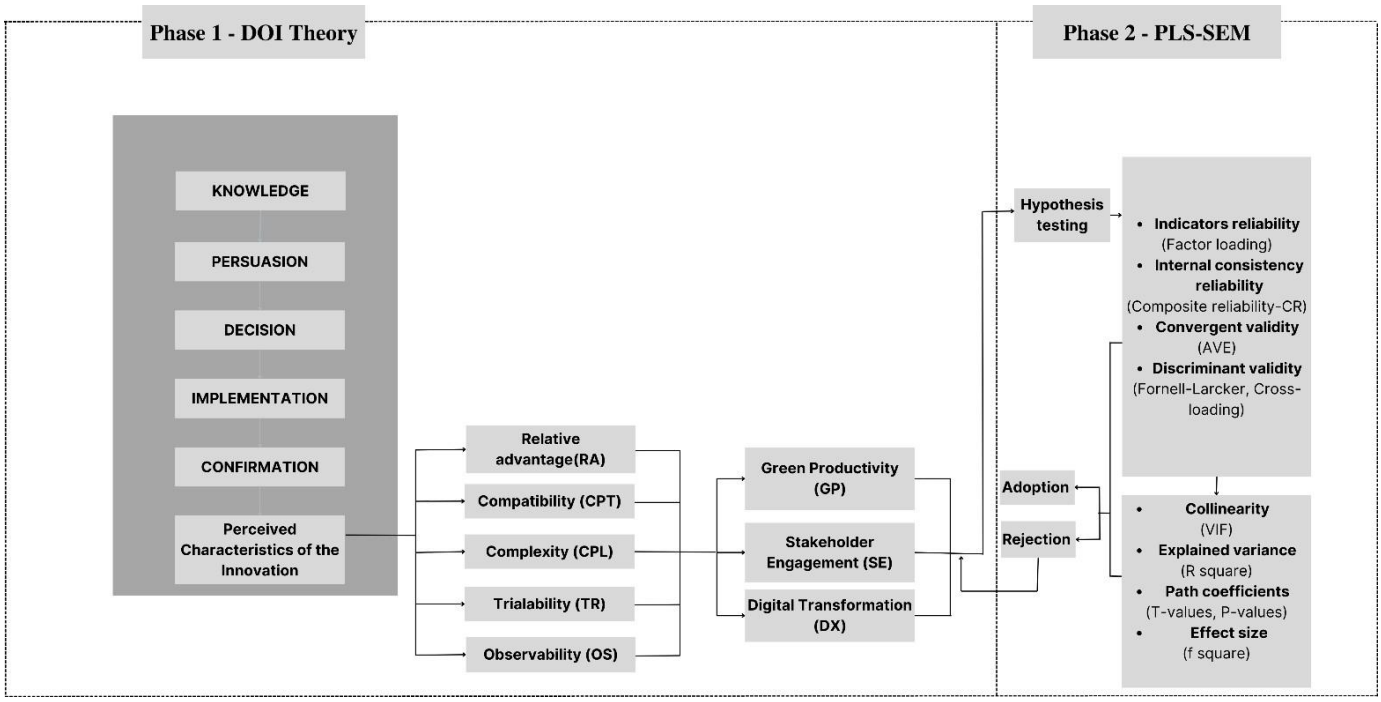

Figure 2 A hybrid approach of DOI & PLS-SEM.

3. A case study

3.1. Selected green tea farm in the Northern Mountains of Vietnam

The selected study area is Tan Cuong, an agricultural commune nestled in the mountains, situated 11 kilometers west of the city center of Thai Nguyen, covering an expanse of 14.7 square kilometers. Endowed with an advantageous climate and soil conducive to tea tree cultivation, Tan Cuong has gained renown for its production of premium-quality tea products. The commune boasts extensive green tea plantations, rendering it a sought-after destination for tourists. In addition to the traditional crafts and activities found amidst the tea-covered slopes, many production facilities have expanded their offerings to cater to visitors, culminating in the creation of an agritourism hub where visitors can fully immerse themselves in the unique tea culture.

Several factors influenced the selection of Tan Cuong as the study area: (i) *Historical significance of Tan Cuong tea:* Tan Cuong tea has held a longstanding reputation as a distinguished product within Vietnam. It serves as the primary crop in this hilly terrain, not only providing economic value and employment opportunities for the local population but also contributing to the stability and prosperity of farmers in the mountainous midlands. Additionally, it plays a pivotal role in enhancing the cultural and social fabric of the community, which is instrumental in poverty alleviation, environmental conservation, and the overall social advancement of the region; (ii) *Agritourism potential and OCOP products:* Tan Cuong exhibits substantial potential for the development of One Commune One Product (OCOP) items intertwined with agritourism. The number of OCOP products has been steadily on the rise, marked by advancements in design and product quality, resulting in a collection of distinct regional offerings. This area is home to numerous tea cooperatives, such as Hao Dat, Tam Tra Thai, and others, which operate on a large scale and hold considerable prospects for growth; and (iii) *Government support for agritourism:* The local government is actively engaged in investing in and fostering the expansion of agritourism centered around green tea production. In 2023, the Thai Nguyen provincial government enacted the newest Resolution No. 159, endorsing a comprehensive program for the advancement of tourism throughout the province. This initiative underscores the commitment to nurturing and enhancing the agritourism sector based on the cultivation of green tea.

3.2. Hypotheses based on DOI

3.2.1. Green Productivity

Tourism is beneficial and compatible with the process of economic growth (OECD Tourism Trends and Policies 2020). As the number of tourists seeking agricultural experiences increases, more resorts and hotels are opening their doors to them (Cahill 2018). Economic and ecological sustainability necessitates balancing the needs of tourist development with environmental limits (Baloch et al 2022). To address this need, the concept of green productivity, which aims to enhance output without adversely affecting the environment, has been developed (APO 2022). Reduced fuel and raw material use, along with decreased insurance costs, are just a few examples of the bottom-line benefits made possible by green productivity. All green productivity strategies should strive to reduce costs, increase profits, enhance competitiveness, and improve the workplace environment (Yeang 2012).

Hence, this study develops 5 hypotheses, in which the "positive effect" shows that an increase in a observed variable will lead to an increase in the latent variable:

H1.1: Relative advantage has a positive effect on Green Productivity in the development of agritourism.
H1.2: Compatibility has a positive effect on Green Productivity in the development of agritourism.
H1.3: Complexity has a positive effect on Green Productivity in the development of agritourism.
H1.4: Trialability has a positive effect on Green Productivity in the development of agritourism.
H1.5: Observability has a positive effect on Green Productivity in the development of agritourism.
H2: Green Productivity has a positive effect on the Development of Agritourism.

3.2.2. Stakeholder engagement

Stakeholder engagement in the context of agritourism pertains to the systematic inclusion and cooperative interaction with individuals, groups, organizations, and communities that possess a significant interest in or are impacted by the operations and outcomes of agritourism endeavors. In the realm of agritourism, stakeholders encompass a diverse array of entities, including farmers, producers, visitors, officials, and several others. The growth of promotional tools and initiatives (Garrod et al 2006; Lucha et al 2016; Stanovi et al 2018; Krishna et al 2020), as well as the interest shown by farmers to engage in agritourism (Bhatta et al 2019), all point to the promising future of this industry (Bhatta et al 2019). Many modern-day tourists not only want to do their part as environmentally conscious global citizens by visiting environmentally safe locations but also seek firsthand knowledge and experience in these practices (Recio 2014). Farm access, sales marketing efforts, agritourism events, and environmental conditions can all have an effect on both suppliers and tourists (Barbieri 2009; Broccardo et al 2017). Institutional interventions, such as policy and research assistance, are necessary to enhance this (Krishna et al 2020). This includes government policies and initiatives to expand agritourism. Destination development, ecotourism, product promotion, domestic tourist promotion, and cultural and historical enhancement are just some of the efforts and programs carried out by the provincial development program (Tew 2010; Reyes 2012).

Hence, this study developed 5 hypotheses:

H3.1: Relative advantage has a positive effect on Stakeholder engagement in the development of agritourism
H3.2: Compatibility has a positive effect on Stakeholder engagement in the development of agritourism
H3.3: Complexity has a positive effect on Stakeholder engagement in the development of agritourism
H3.4: Trialability has a positive effect on Stakeholder engagement in the development of agritourism
H3.5: Observability has a positive effect on Stakeholder engagement in the development of agritourism
H4: Stakeholder engagement has a positive effect on the Development of Agritourism

3.2.3. Digital Transformation

Digital transformation in agritourism involves the integration of digital technologies, data-driven solutions, and online platforms to enhance and streamline agritourism experiences. This transformation has the potential to benefit both farmers and visitors by improving efficiency, accessibility, sustainability, and overall satisfaction. Agritourism is undergoing a significant digital revolution, driven by advancements in technology, therefore, it must establish new connections and devise innovative business strategies (Snezhinka 2019). Agritourism can greatly benefit from the adoption of digital technologies, which can enhance the industry's competitiveness. The internet, with its diverse multimedia capabilities, offers new avenues of communication between tourists and agritourism destinations while reducing distribution and research costs (Buhalis 2003). Nowadays, especially with the proliferation of social media, customers increasingly demand transparency and integrity from the businesses they engage with. The internet has made it easier than ever for visitors to discover, book, and purchase tickets for attractions (Mpiti 2015). Social media is increasingly used by visitors to assist them before, during, and after their journeys. Customer feedback serves as a valuable source of new ideas for enhancing a vacation destination (Sona 2021). Therefore, this study developed five hypotheses:

H5.1: Relative advantage has a positive effect on digital transformation in the development of agritourism
H5.2: Compatibility has a positive effect on digital transformation in the development of agritourism
H5.3: Complexity has a positive effect on digital transformation in the development of agritourism
H5.4: Trialability has a positive effect on digital transformation in the development of agritourism
H5.5: Observability has a positive effect on digital transformation in the development of agritourism
H6: Digital Transformation has a positive effect on the Development of Agritourism.

Figure 3 illustrates a proposed framework for conducting research on the Development of Agritourism in the Tan Cuong area. Structural Equation Modeling (SEM) is employed to investigate cause-effect relationships, with Partial Least Squares (PLS) being the method used to perform SEM. In this model, observed variables and latent variables, derived from observed variables, are considered at two distinct levels. In the determinant level, observed variables, namely the five DOI attributes of Relative Advantage, Compatibility, Complexity, Trialability, and Observability, are linked to each latent variable, namely Green Productivity, Stakeholder Engagement, and Digital Transformation. At the goal level, Green Productivity, Stakeholder Engagement, and Digital Transformation serve as observed variables measuring the latent variable of Development of Agritourism.

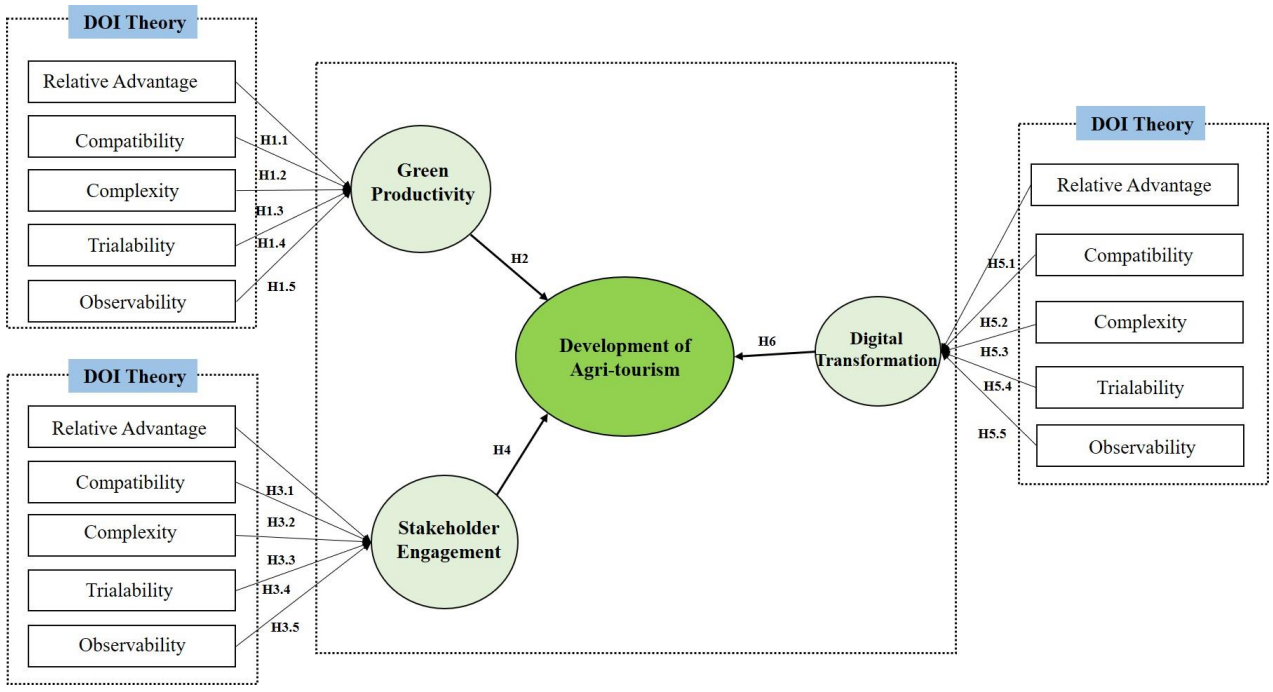

Figure 3 Research framework.

3.3. Data collection

3.3.1 Questionnaires

Participants who have personally been impacted by tourism, particularly agritourism, are interviewed using a combination of semi-structured and open-ended questions. A survey instrument is used to collect responses on a Likert-5 scale to measure the level of agreement, with 1 representing strongly disagreeing and 5 representing strongly agreeing. The questionnaire consists of two parts. Respondents' interest in pursuing the study's stated aims for agritourism's growth in Thai Nguyen province (Green Productivity, Stakeholder Engagement, and Digital Transformation) is assessed by asking the aforementioned questions. The survey is developed based on Rogers' (1962) theory on the spread of new ideas.

Here are summaries of the two parts. The first part gathers data about locals and their operations. It includes basic profile-building questions such as name, gender, and contact information. Other inquiries focus on the respondents' background and experience in running an agritourism operation. The second part is dedicated entirely to agritourism. The questionnaire is structured using the DOI framework, which divides each component into 6 questions. These questions address the challenges of implementing the three objectives of Green Productivity (GP), Stakeholder Engagement (SE), and Digital Transformation (DX) in the expansion of agritourism. Green productivity offers various benefits, including waste reduction in manufacturing and commercial operations, cost savings, and the development of environmentally friendly products and services. The rapid advancement of science and technology has also made digital transformation an increasingly important issue. With the aid of digital transformation, business models can be shifted, creating new possibilities, income streams, and value for the agricultural tourism sector. Local governments, tourist cooperatives, and other tourism-related infrastructure also play critical roles in the development of agritourism. The advantages, applicability, accessibility, and so on, of GP, SE, and DX are based on previous studies. Researchers assess local satisfaction with these three objectives by inquiring about their experiences.

3.3.2. Sampling

The primary location for the survey is Tan Cuong. Farmers from tea cooperatives and locals are interviewed. A total of 350 questionnaires are distributed, and 344 valid responses are collected. Of these, 197 questionnaires are completed by men, and 147 by women. Among 344 accepted respondents, 313 observations coming from Tan Cuong commune, while the remaining 31 from the surrounding area.

4. Results

4.1. Measurement model

The measurement model is tested for convergent validity through factor loadings, composite reliability (CR), and average variance extracted (AVE) (Hair et al 2006). Table 1 shows that all item loadings exceeded the recommended value of 0.6 (Chin 1998). The composite reliability values, which depict the degree to which the construct indicators reflect the latent construct, exceeded the recommended value of 0.7. The average variance extracted, which reflects the overall amount of variance in the indicators accounted for by the latent construct, exceeded the recommended value of 0.5.

Table 1 Validity and reliability for constructs.

	Outer loadings	CR	AVE
(1) GREEN PRODUCTIVITY			
Relative Advantage (GP-RA)		0.753	0.504
GP-RA1: Enhances professional and scientific space design	0.700		
GP-RA2: Improves agricultural production effectiveness and reduces production waste	0.723		
GP-RA3: Contributes to preserving the traditional agricultural profession	0.707		
Compatibility (GP-CPT)		0.772	0.530
GP-CPT1: Enhance the tourist experience	0.703		
GP-CPT2: Boost the management team's ability	0.726		
GP-CPT3: Aligns with the development trend and policy of the province	0.755		
Complexity (GP-CPL)		0.782	0.546
GP-CPL1: Feasibility for farm owners and households in terms of time	0.709		
GP-CPL2: Focuses on daily operations and investment costs for small initiatives	0.704		
GP-CPL3: Doesn't require changing current goals and directions	0.799		
Trialability (GP-TR)		0.752	0.502
GP-TR1: Strengthens management according to the green productivity method	0.701		
GP-TR2: Determines the future development of this model	0.712		
GP-TR3: The effect is clearly visible	0.713		
Observability (GP-OS)		0.751	0.501
GP-OS1: The environment is less polluted	0.710		
GP-OS2: Visitors to Thai Nguyen experience an increase	0.712		
GP-OS3: Creates positive effects on interested parties	0.703		
Green Productivity in the Development of Agritourism (GP)		0.748	0.503

GP1: Increases profits and revenue for local residents	0.543		
GP2: Improves visitor satisfaction	0.787		
GP3: Increases social responsibility	0.771		
(2) STAKEHOLDER ENGAGEMENT			
Relative Advantage (SE-RA)		0.757	0.510
SE-RA1: Connectivity between the central area and the Agritourism area is positive	0.701		
SE-RA2: Provincial policies support the sustainable development of agritourism	0.731		
SE-RA3: Labor resources in the province have appropriate technical qualifications	0.709		
Compatibility (SE-CPT)		0.751	0.501
SE-CPT1: Recognizing the benefits of stakeholders to mutually develop	0.712		
SE-CPT2: The province has many famous scenic spots and historical sites	0.706		
SE-CPT3: Visitors are attracted by local cultural and people's activities	0.706		
Complexity (SE-CPL)		0.752	0.503
SE-CPL1: Incorporating agritourism based on an existing platform	0.703		
SE-CPL2: Tourist companies will have easy access to new tourism products	0.712		
SE-CPL3: The policy of integrating tourism development with the overall rural development plan	0.714		
Trialability (SE-TR)		0.766	0.522
SE-TR1: Measurable short-term economic, environmental and social effects	0.710		
SE-TR2: Creating a model of agritourism community villages according to themes	0.751		
SE-TR3: Have the cooperation of authorities, businesses and the community	0.705		
Observability (SE-OS)		0.752	0.503
SE-OS1: The sharing of benefits, commitment to service quality and protecting the environment	0.711		
SE-OS2: Conflicts may arise	0.715		
SE-OS3: State policies have a prerequisite	0.703		
Stakeholder Engagement in Development of Agritourism (SE)		0.774	0.534
SE1: More people are engaged in agritourism	0.713		
SE2: Many tourists have visited Thai Nguyen to experience the agritourism	0.753		
SE3: Officials have issued policies to sustainably develop agritourism	0.725		
(3) DIGITAL TRANSFORMATION			
Relative Advantage (DX-RA)		0.802	0.577
DX-RA1: Effectiveness of online marketing will increase compared to the traditional way	0.705		
DX-RA2: Increases visitors' awareness of agritourism through advertising	0.850		
DX-RA3: Easier to contact and exchange through smartphones	0.714		
Compatibility (DX-CPT)		0.813	0.592
DX-CPT1: Internet and Wi-Fi are available in every household	0.762		
DX-CPT2: Availability of supporting equipment	0.807		
DX-CPT3: The digital transformation program has a positive impact on the perception of local people	0.737		
Complexity (DX-CPL)		0.765	0.619
DX-CPL2: Needs support to use and to exploit information on the Internet	0.772		
DX-CPL3: Employees have a clear understanding of the Internet and technology applications	0.801		
Trialability (DX-TR)		0.782	0.643
DX-TR2: Knows about technology applications that help tourists better understand tourist destinations	0.843		
DX-TR3: It is possible to combine digital transformation and local agritourism	0.758		
Observability (DX-OS)		0.794	0.563
DX-OS1: Visitors through media and websites increases	0.704		
DX-OS2: Spread of the agritourism activities	0.819		
DX-OS3: Creates job opportunities for locals	0.724		
Digital Transformation in Development of Agritourism (DX)		0.832	0.623
DX1: Using new digital applications gives tourists a better experience	0.786		
DX2: Attracts more visitors to the agritourism	0.781		
DX3: Promote local products on e-commerce platforms to help increase locals' income	0.800		
(4) DEVELOPMENT OF AGRITOURISM	*Single-Item construct*		
Development of Agritourism (DA)	1.00	1.00	

AVE = (summation oF-Squared factor loadings)/(summation oF-Squared factor loadings) (summation of error variances)

Composite reliability = (square of the summation of the factor loadings) / [(square of the summation of the factor loadings) + (square of the summation of the error variances)]

4.2. Structural model

Before evaluating the structural model, the multicollinearity in the inner model is checked (Table 2). The results showed that there is no multicollinearity problem in the model with VIF values less than 3.3.

Table 2 Collinearity assessment (inner VIF).

Constructs	Digital Transformation in Development of Agritourism (DX)	Green Productivity in the Development of Agritourism (GP)	Stakeholder Engagement in Development of Agritourism (SE)	Development of Agritourism (DA)
DX-CPL	1.455			
DX-CPT	1.361			
DX-OS	1.471			
DX-RA	1.408			
DX-TR	1.299			
GP-CPL		1.336		
GP-CPT		1.538		
GP-OS		1.251		
GP-RA		1.402		
GP-TR		1.477		
SE-CPL			1.522	
SE-CPT			1.635	
SE-OS			1.486	
SE-RA			1.677	
SE-TR			1.643	
DX				1.135
GP				1.125
SE				1.200

The hypothesized relationships in the structural model are tested. Figure 4 shows the results of the analysis. Compatibility, Trialability, and Observability explain 35.8% of local's perception of Green Productivity (R^2 = 0.358). Compatibility, Complexity, and Observability explain 30.6% of Stakeholder engagement (R^2 = 0.306). Relative advantage, Complexity, Trialability, and Observability explain 34.6% of local's perception of Digital Transformation (R^2 = 0.346).

Regarding model validity, endogenous latent variables are classified as substantial, moderate, or weak based on R^2 values of 0.67, 0.33, or 0.19, respectively (Chin et al 2008). Accordingly, Green Productivity (R^2 = 0.360), Digital Transformation (R^2 = 0.346), and Development of Agritourism (R^2 = 0.551) are considered moderate, while Stakeholder engagement (R^2 = 0.306) is classified as weak.

The measure of significance in hypothesis testing using t-test and p-value from the path coefficient. The value of the t-value analysis should be higher than 2.4 and the value of the p-value should be within the limit of statistical significance, less than 0.05 (Rasoolimanesh et al 2017) (Table 3).

Table 3 Structural estimates (hypotheses testing).

	Hypothesis	Standard Beta	Standard Deviation	T Statistics	P Values	Decision
H1.1	GP-RA → GP	0.074	0.054	1.364	0.172	Not Supported
H1.2	GP-CPT → GP	0.158	0.050	3.169	0.002	Supported
H1.3	GP-CPL → GP	0.036	0.055	0.648	0.517	Not Supported
H1.4	GP-TR → GP	0.131	0.054	2.444	0.015	Supported
H1.5	GP-OS → GP	0.397	0.047	8.381	0.000	Supported
H3.1	SE-RA → SE	0.034	0.058	0.596	0.551	Not Supported
H3.2	SE-CPT → SE	0.239	0.053	4.529	0.000	Supported
H3.3	SE-CPL → SE	0.221	0.054	4.054	0.000	Supported
H3.4	SE-TR → SE	0.071	0.054	1.319	0.187	Not Supported
H3.5	SE-OS → SE	0.152	0.055	2.763	0.006	Supported
H5.1	DX-RA → DX	0.256	0.058	4.380	0.000	Supported
H5.2	DX-CPT → DX	-0.011	0.048	0.237	0.812	Not Supported
H5.3	DX-CPL → DX	0.227	0.054	4.219	0.000	Supported
H5.4	DX-TR → DX	0.171	0.053	3.216	0.001	Supported
H5.5	DX-OS → DX	0.163	0.056	2.917	0.004	Supported
H2	GP → DA	0.305	0.042	7.313	0.000	Supported
H4	SE → DA	0.367	0.038	9.734	0.000	Supported
H6	DX → DA	0.352	0.044	8.079	0.000	Supported

Note: Critical P Value (P < 0.05)

The effect size (F-Square) identifies how much an exogenous variable contributes to an endogenous variable. Observability (F-Square = 19.6%) plays an important role in explaining the change in green productivity. Compatibility (F-Square = 5%) plays an important role in explaining the change in stakeholder engagement. Relative advantage (F-Square = 7.2%) plays an important role in explaining the change in digital transformation. Green productivity (F-Square = 18.4%),

stakeholder engagement (F-Square = 25.1%), and digital transformation (F-Square = 24.2%) play important roles in explaining the change in the development of agritourism.

5. Discussion

Numerous nations have become increasingly interested in agritourism in recent years (Karabati et al 2009). Agritourism is the fastest-growing segment of the tourism industry over these nations (Karthik et al 2019). The introduction of agritourism and other alternative forms of tourism arose as a result of the ecological movement and the heightened concern in cultures where mass tourism was prevalent (Bramwell 1994). Increasing interest in environmental protection, nature preservation, and outdoor activities is also positive for rural endeavors (Davies et al 1992; Karabati et al 2009). The mentality of the local populace is crucial for the expansion of tourism in order to promote agritourism (Stylidis et al 2014). Understanding farmers' perspectives on agritourism is crucial because they are the industry's key actors (Kunasekaran et al 2012). People are more likely to be aware of agritourism's advantages, such as improved infrastructure, higher income and employment opportunities, and enhanced quality of life (Moghavvemi et al 2017). Small communities are becoming increasingly supportive of agritourism as rural residents recognize the benefits of sustainable development from comparable forms of nature tourism (Recio 2014). In addition, farmers have access to future plans for various types of agritourism activities in which they are willing to provide agricultural products and services of interest to tourists (Recio 2014; Krishna et al 2020). This optimistic outlook can contribute to the overall growth of the region's tourism industry. It is then possible to increase the participation and support of the local community in agritourism development (Choong et al 2018).

Vietnam, with its extensive history of agricultural production, now places a high priority on expanding agritourism. This study addresses the development of agritourism in the Northern Mountains, an economic region of Vietnam with significant potential for agritourism due to the combination of spectacular natural landscapes and the unique cultures of ethnic minority groups. However, the development of agritourism in this region must be executed carefully to ensure a balance between economic growth and environmental protection, while also preserving and promoting local culture and ensuring benefits for the communities. Identifying and analyzing the factors affecting agritourism development is considered a key task to reach sustainable development goals in this region. In reality, the number of visitors to green tea farms in the selected Tan Cuong area of the Northern Mountains of Vietnam has experienced a significant increase in recent years. This upward trend is expected to persist in the near future. To understand determinants of agritourism development, this study employs a combination of DOI theory and PLS-SEM. Five DOI attributes as Relative Advantage, Compatibility, Complexity, Trialability, and Observability which belong to three determinants of Green Productivity, Stakeholder Engagement, and Digital Transformation, have all played pivotal roles in shaping, predicting, and assessing the adoption of innovation within the current agritourism industry.

Figure 4 illustrates that Compatibility, Trialability, and Observability impact significantly on Green Productivity in agritourism development. When an innovation aligns with an individual's needs and preferences, it reduces uncertainty and accelerates adoption rates. The integration of Green Productivity harmonizes with traditional agriculture, aligning with the province's developmental trajectory and policies. Furthermore, there exists a positive correlation between trialability and adoption rates—more innovations lead to quicker adoption. The growth of agritourism is intrinsically linked to environmental preservation and the conservation of natural landscapes. Thus, implementing Green Productivity into the agritourism model is entirely viable, as it encourages businesses and visitors to adopt environmentally conscious practices. Furthermore, farms are adopting innovative techniques in their management.

These findings also highlight the influence of Compatibility, Complexity, and Observability on Stakeholder Engagement. By recognizing their mutual interests in advancing agritourism, stakeholders can effectively leverage this model. It's worth noting that, unlike other attributes, there's a negative correlation between complexity and approval rates. An overly complex innovation can hinder widespread adoption. Stakeholders have ready access to the agritourism, which relies primarily on local labor and adheres to the traditional production and business practices of rural households and agricultural estates. State policies play a pivotal role in shaping the province's agritourism paradigm, particularly during its initial stages.

Within the agritourism development model, Digital Transformation is influenced by factors such as Relative Advantage, Complexity, Trialability, and Observability. The internet facilitates communication and interaction between visitors and locals. Therefore, when digital transformation is applied to agritourism, farm owners can attract more visitors and increase product sales. It's important to note that today, nearly every household has access to electronic devices like smartphones and laptops, which accelerates the adoption of digital transformation within agritourism. However, employees, especially managers, must possess a firm understanding of the internet and technological applications. Therefore, simpler innovations tend to be adopted more quickly. Enhancing the effective utilization of information and communication technology will promote agritourism and attract investment, given the growing relevance of digital transformation in the context of rapidly evolving technology.

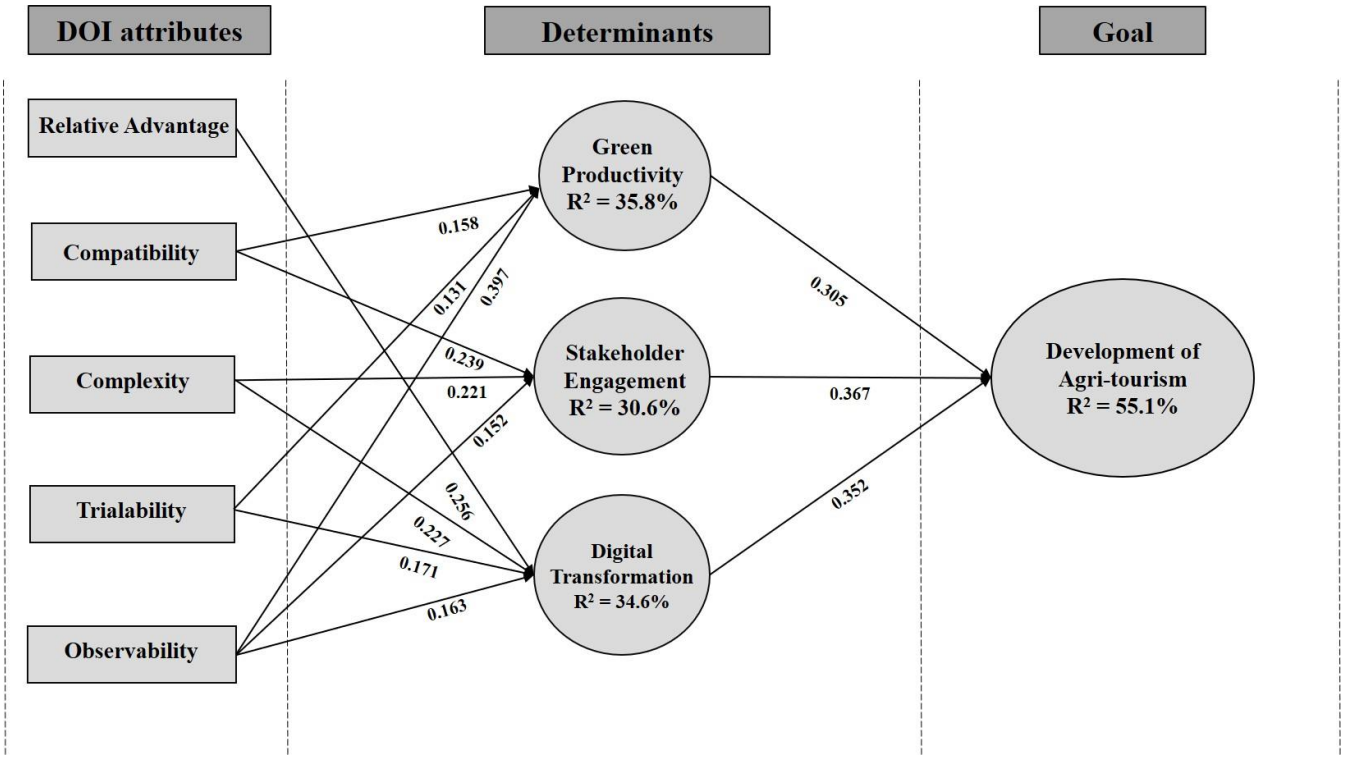

Figure 4 Structural model of the influence of DOI attributes on determinants and goals in agritourism development in Thai Nguyen, Vietnam.

3.4. Policy recommendations

At the local level, we propose the implementation of policies to promote agritourism in Tan Cuong, encompassing the following measures: (i) *Tourism marketing:* Communities in Tan Cuong have the potential to allocate resources towards a robust advertising campaign aimed at establishing themselves as a compelling agricultural tourist destination. Utilizing both online and offline advertising strategies, along with active participation in tourist fairs, can effectively contribute to promoting and disseminating information about the region's agritourism sector; (ii) *Financial assistance:* This proposal aims to provide financial assistance and contractual frameworks to enterprises or individuals seeking to establish agritourism initiatives within tea-producing regions. Whether for constructing infrastructure, providing lodging facilities, or cultivating specialized agricultural goods, financial resources may be required; (iii) *Training and awareness:* Facilitating educational programs and instructional materials for individuals and enterprises focused on effective agritourism management, environmental conservation, and the preservation of indigenous cultural heritage; (iv) *Collaboration among stakeholders:* Promoting collaboration among local government entities, tourist enterprises, and community members to ensure inclusive and equitable outcomes from the advancement of agritourism; (v) *Distinctive tourism offerings:* Developing unique tourist product packages centered around tea resources, including visits to tea gardens, participation in tea processing procedures, and immersion in the local cultural milieu; (vi) *Environmental protection and ecosystem conservation:* Ensuring that tourist activities are conducted in a manner that minimizes negative impacts on the natural environment and may even contribute to its enhancement within the region; (vii) *Advocating for food safety standards:* To guarantee the safety of food for visitors, providing assistance and encouraging tea farmers and other agricultural stakeholders to adhere to rigorous cleanliness and safety requirements; and (viii) *Creating engaging experiences for visitors:* Developing distinctive events, festivals, and tourist activities with the aim of generating allure and excitement among visitors.

At regional level, we suggest integrating agricultural tourism development into the Vietnam national target initiative on building new rural areas and the One Commune One Product (OCOP) initiative. This policy promotes organic agriculture and unique tourism experiences using OCOP products in each commune. Beside, the program of building new rural areas support transportation infrastructure for agritourism. The OCOP program, designed for rural economic growth, is focused on harnessing internal resources and creating added value. The primary objective of the OCOP is to cultivate business structures and production methods that empower producers of traditional products and services to compete effectively on both domestic and international fronts, adhere to industry standards, and contribute to rural economic advancement. Cooperatives and small to medium-sized enterprises are accorded priority throughout this process. The OCOP, in its current

state, remains limited, with primary products undergoing preliminary or rudimentary processing. Agritourism products often fall short of meeting market demands, a situation that doesn't align with the inherent potential of these provinces.

At the national level, study results underscore the pivotal role of state management in propelling agritourism development programs in Vietnam, thereby advancing the socioeconomic development strategy of this country. We propose the following policies: (i) Balancing agritourism development: Agritourism development should strike a balance between environmental considerations and the sustainable well-being of local communities; (ii) Community-centric approach: It is imperative to implement activities that foster agritourism within communities, nurturing the development of national cultural identity, agriculture, and local economic growth; (iii) Incentivizing participation: Mechanisms should be put in place to incentivize both organizations and individuals to actively participate in agritourism development; (iv) Leadership and expert networks: We advocate for the creation of leadership and expert networks to conduct research and development (R&D) within the agritourism community, thereby promoting sustainability; (v) Strategic investments in green productivity: The central government should strategically invest in green productivity testing, adapting the numbers to create robust testing models to facilitate learning and promote expansion in subsequent phases; and (vi) Promoting green productivity and efficiency: There should be a concerted effort to support green productivity and efficiency through public awareness campaigns, translating data into social consciousness and sound socioeconomic strategies.

4. Conclusions

The study employed a hybrid approach combining the Diffusion of Innovation (DOI) theory and Partial Least Squares Structural Equation Modeling (PLS-SEM) to investigate the impact of determinants, including Green Productivity, Stakeholder Engagement, and Digital Transformation, on the promotion of agritourism in a green tea farm located in the Northern Mountains of Vietnam. The relevance of five DOI attributes to each of these determinants of agritourism development was analyzed.

The study's findings reveal several key insights. Compatibility, when combined with trialability and observability, plays a pivotal role in enhancing the potential for green productivity within the context of agritourism development. Furthermore, compatibility, complexity, and observability exhibit positive influences on stakeholder engagement, while digital transformation contributes positively to agritourism development. Digital transformation is driven by attributes such as relative advantage, complexity, trialability, and observability.

Based on these research findings, it is evident that policies for fostering agritourism should be considered at local, regional, and national levels. Policymakers are strongly encouraged to formulate strategies aimed at promoting agritourism with a focus on achieving sustainable development in the Northern Mountains of Vietnam. Additionally, these findings offer valuable scientific reference points for tourism businesses, providing essential insights to guide necessary adjustments to their agritourism models.

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Ethical considerations

The study correctly followed the ethical policies for a study that includes human subjects, in addition to confirming the consent of all the respondents involved.

Conflict of Interest

The authors declare no conflicts of interest.

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