Leveraging Artificial Intelligence and Cultural Dynamics for Sustainable Rubber Farming

William Philip Wall
Stamford International University, Thailand
E-mail : William.wall@stamford.edu

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Abstract

This paper explores the impact of artificial intelligence and cultural factors on rubber farming, focusing on sustainability. The study variables include Technological Advancement, Artificial Intelligence, Satisfaction, Culture, Perceived Value, and Sustainability. The study adopted a quantitative survey research design. A questionnaire was used to elicit responses from 407 rubber farmers in Thailand. The results were analyzed using structural equation modeling. The findings indicated that technological advancement positively and significantly impacts sustainability, supporting the hypothesis that adopting advanced technologies contributes to sustainable practices. This suggests that incorporating technological innovations can improve rubber farming efficiency, resource utilization, and environmental outcomes. Also, the study found that artificial intelligence does not significantly impact sustainability. Contrarily, culture was found to have a significant positive effect on sustainability. This result highlights the importance of cultural factors, including traditional knowledge and local practices, in shaping sustainable approaches to rubber farming. Acknowledging and integrating cultural values and practices into sustainable strategies can lead to more contextually relevant and socially accepted solutions. While technology advancement and culture significantly impacted sustainability, artificial intelligence, and satisfaction did not exhibit significant direct effects. However, the mediating effects of culture, technology advancement, and artificial intelligence suggest that these factors can enhance the relationship between satisfaction, perceived value, and sustainability in rubber farming. These findings contribute to a better understanding of the complex interplay between different variables and sustainability outcomes, providing valuable insights for practitioners, policymakers, and researchers aiming to promote sustainability in the rubber farming industry.

Keywords: Artificial Intelligence; Culture; Rubber Farming; Sustainability; Precision Agriculture.

Introduction

Rubber farming in Thailand significantly impacts the country's economy and position as the world's leading natural rubber producer. Somboonsuke et al. (2019) claim that the climate and soil conditions favor rubber tree plantations, which contribute considerably to the rural economy and provide economic prospects for thousands of agricultural families. Thailand's natural rubber output reached 4.48 million tons in 2019 (Statista, 2023a), up from about 190,000 metric tons in 1961. Thailand has consolidated its position as the world's biggest natural rubber producer, accounting for 35% of worldwide output (Statista, 2023a). Thailand exported around 3.28 million tons of rubber in 2022 (Statista, 2023b). Thailand has been a prominent player in the global rubber market, maintaining relatively consistent export

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volumes from 2013 to 2022. The highest export volume was recorded in 2017, amounting to approximately 3.76 million tons (Statista, 2023b).

Thailand's rubber sector success may be ascribed to its favorable climate, plentiful land resources, and ongoing attempts to enhance rubber growing practices and technology (Kawano et al., 2019). Farmers get assistance and resources from the government and other agricultural organizations, such as training programs, research and development efforts, and loan facilities (Leepromrath et al., 2021). Despite its market dominance, Thailand confronts obstacles such as changing global rubber prices, weather-related hazards, and an obligation to resolve facility sustainability issues (Leepromrath et al., 2021; Pyay et al., 2019). Thailand maintains its competitiveness and sustainability by fostering research and development, encouraging sustainable rubber farming techniques, and exploring new rubber product markets.Rubber farming sustainability entails cultivating rubber trees and producing rubber in an environmentally, socially, and economically responsible manner. It encompasses various aspects, including land and resource management, biodiversity conservation, water and energy efficiency, waste management, fair labor practices, and community engagement. According to Phoungthong et al. (2021), sustainable rubber farming aims to minimize adverse environmental impacts, preserve natural resources, protect ecosystems, promote social equity, and ensure long-term economic viability. in Thailand, sustainability in rubber farming is crucial due to the country's position as the most prominent natural rubber producer globally. the thai government and relevant agencies have implemented laws and regulations to address sustainability concerns in the rubber industry.

Thailand's rubber industry recognizes the need for sustainability and has significantly enhanced its practices. The government, in collaboration with research institutions and industry stakeholders, promotes sustainable rubber farming techniques and provides training and education to farmers (Saosee et al., 2022). Certification programs like Thai Rubber standards under the Forest Stewardship Council (FSC) certification scheme ensure adherence to sustainability criteria and provide market recognition for environmentally and socially responsible rubber production (FSC, 2018; Saosee et al., 2022). To further enhance sustainability, Thailand also encourages diversification in the rubber sector, which includes promoting downstream industries, such as rubber processing and value-added manufacturing products, which can create higher-value employment opportunities and reduce dependency on raw rubber exports (World Bank Group, 2017).

The adoption of Artificial Intelligence (AI) in farming, including rubber farming, is gaining traction worldwide, and Thailand is no exception. AI technologies can potentially revolutionize the agricultural sector by improving productivity, efficiency, and sustainability. In Thailand's rubber farming, AI can be utilized in various ways, for instance, in managing rubber plantations. AI-powered drones and satellite imagery can provide real-time data on plant health, detect diseases or nutrient deficiencies early, yield prediction and quality assessment, and pest and disease management in rubber farming by analyzing vast amounts of data, including pest and disease patterns, and optimizing resource use (Liu et al., 2021; Ullo & Sinha, 2021). Thailand has been investing in research and development and developing collaborations between the government, agricultural institutions, and technology businesses to enable the implementation of AI in rubber production (World Bank Group, 2017).

Despite the potential advantages, research on AI's particular use in Thailand's rubber cultivation is still being determined. As a result, further research and study of AI's potential in improving sustainable practices in the rubber business is required. Despite the significant role of rubber farming in Thailand's economy and its global prominence as a natural rubber producer, there is a lack of research on AI adoption in rubber farming. Hence, this research aims to exhaustively review the application of Artificial Intelligence (AI) in rubber farming in Thailand, with a specific focus on sustainability. Research in this area can contribute to developing innovative solutions and best practices that optimize productivity while minimizing environmental impact and ensuring social welfare.

Literature Review

This overview of the literature on sustainable agriculture covers the present level of research, concentrating on components of sustainable agricultural techniques, particularly artificial intelligence. This review highlights significant discoveries and gaps in knowledge by reviewing current studies and offering a complete overview of the issue.

The concept of sustainability in agriculture

Sustainability entails meeting present agricultural needs while retaining the capacity to fulfill future requirements (Vinuesa et al., 2020). According to Lazaroiu et al. (2019), it balances environmental, social, and economic factors while acknowledging their interdependence. Phoungthong et al. (2021) also point out that environmentally sustainable actions lessen negative environmental impacts by protecting natural resources, reducing waste and pollution, promoting biodiversity, and addressing climate change. In order to ensure secure working environments, resource availability, and cultural variety, social sustainability strongly emphasizes the well-being of farmers, workers, and local communities (Saosee et al., 2022; Somboonsuke et al., 2019). Economic viability is attained by efficient and profitable farming practices that encourage spending, creativity, and equal financial advantages (Negash et al., 2021).

Organic farming, agroecology, precision agriculture, conservation agriculture, and sustainable livestock management are all part of sustainable agriculture (Phoungthong et al., 2021; Saosee et al., 2022). Leepromrath et al. (2021) acknowledge that it encourages a holistic perspective considering the larger environment, society, and economy. Sustainable agriculture attempts to fulfill food and resource needs while conserving human and environmental well-being through saving resources, assisting rural livelihoods, and fostering long-term economic stability (Basso & Antle, 2020; Singh & Yadav, 2020; Yadav, 2020).

Sustainable rubber farming in Thailand with technology

The implementation of technology has the potential to enhance the sustainability of rubber cultivation in Thailand. Technologies like remote sensing, smart farming, and artificial intelligence provide numerous advantages (Jung et al., 2021; Sishodia et al., 2020). Farmers can effectively manage resources, detect stressed regions, and monitor rubber tree development using remote sensing (Hara et al., 2021). Ballesteros et al. (2020), smart farming and sensor-based irrigation systems make precision water management possible, which lowers waste and preserves water supplies. Machine learning and AI data analysis may forecast yields, identify diseases, use fertilizer more effectively, and lessen pesticide dependency (Triantafyllou et al., 2019). The social and economic elements of rubber growth are also improved by technology using market data provided via mobile applications and digital platforms, enabling fair pricing and empowering farmers (Sharma et al., 2022). Additionally, technology helps traceability systems ensure that rubber goods are obtained ethically and sustainably, which increases market demand (Ballesteros et al., 2020; Mohamed et al., 2021). Sustainability in agriculture entails a broad notion that includes many different areas of human activity and how they affect the environment, society, and economy in terms of satisfaction, perceived value, culture, artificial intelligence, and technological advancement.

Technological advancement and artificial intelligence

By fostering creativity and offering answers to the world's problems, technological advancement is essential to sustainability. Sustainable technologies prioritize decreasing their harmful effects on the environment, conserving resources, and supporting renewable energy sources (Galaz et al., 2021; Khan et al., 2021). According to Jung et al. (2021), clean transportation, waste management, energy efficiency, and renewable energy developments make a more sustainable future possible. It is crucial to properly evaluate their environmental and social implications to ensure that new technologies support sustainability objectives and do not have unanticipated negative effects (Gilbertson et al.., 2020; Trivelli et al., 2019). As a result, the following hypothesis is put forth:

Artificial intelligence may have several positive effects on sustainability. AI can streamline operations, boost productivity, and use fewer resources in the energy, transportation, and agriculture industries (Chaterji et al., 2020; Vinuesa et al., 2020). Additionally, it may support proactive measures by assisting with climate modeling, natural catastrophe prediction, and environmental monitoring (Jang & Lee, 2020; Yeh et al., 2021). However, the development and use of AI technology must be done consistently with sustainability ideals, which entails considering the ethical implications of AI, dealing with any biases, and guaranteeing accountability and transparency in AI systems (Sridhar et al., 2023; Vinuesa et al., 2020). As a result, the following hypotheses are put forth:

H1: *Technological advancements have a significant influence on the sustainability of rubber farming in Thailand.*

H2: *Artificial intelligence has a significant influence on the sustainability of rubber farming in Thailand.*

H3: *Technological advancements significantly mediate the effect satisfaction on the sustainability of rubber farming in Thailand.*

Satisfaction

From a sustainability perspective, satisfaction can be understood as meeting the anticipations of consumers regarding a product or service, which is vital for fostering enduring and sustainable relationships with customers (Yigitcanlar et al., 2022). Finding a balance between meeting current demands and preserving the availability of resources and opportunities for future generations is necessary for achieving sustainability (Dora et al., 2022; Hou & Wen, 2021). By promoting the use of renewable resources, lowering waste production, and considering the social and environmental effects of goods and services, sustainable consumption practices, for instance, encourage enjoyment (Robinson, 2022; Yigitcanlar et al., 2022). With this understanding, hypothesis four is proposed thus:

H4: *Satisfaction has a significant influence on the sustainability of rubber farming in Thailand*

Culture

Culture substantially impacts sustainability by affecting people's actions, beliefs, and attitudes toward the environment (Bhat & Huang, 2021). According to Fountas et al. (2020), culture-appropriate sustainable development should consider regional expertise, customs, and practices. Culturally sustainable methods respect and integrate communities' traditions, beliefs, and identities, allowing them to maintain them while achieving sustainable objectives (Ben Ayed & Hanana, 2021). Cultural variety also supports sustainable development by encouraging innovation, creativity, resilience, traditional knowledge, and local practices in tackling global issues (Mhlanga, 2021). As a result, the following hypothesis stated thus:

H5: *Culture has a significant influence on the sustainability of rubber farming in Thailand.*

H6a: *Culture significantly mediates the effects of satisfaction on the sustainability of rubber farming in Thailand.*

H6b: *Culture significantly mediates the effects of perceived value on the sustainability of rubber farming in Thailand.*

H6c: *Culture significantly mediates artificial intelligence's effects on rubber farming sustainability in Thailand.*

Perceived value

Perceived value is how people or groups evaluate the value or significance of a product, service, or event (Lazaroiu et al., 2019). Supporting moral and ecologically responsible behavior, guaranteeing supply chain openness, and disseminating details about the sustainability features of goods or services may help raise perceived value (Hsu et al., 2019; Li et al., 2020). Various stakeholders may influence farmers and encourage more sustainable practices by valuing sustainability in purchasing decisions (Matzembacher & Meira, 2019). Hypotheses seven and eight explore the relationship binding sustainability and artificial intelligence in rubber farming.

H7: *Perceived value has a significant influence on the sustainability of rubber farming in Thailand.*

H8: *Perceived value significantly influences artificial intelligence within the context of the sustainability of rubber farming in Thailand.*

These empirical studies elucidate the various sustainability issues in rubber farming, including farmer satisfaction, the value that technologies are perceived to have, the impact of culture, and the contribution of artificial intelligence and other technological advancements to promoting sustainable practices. They emphasize the possible advantages and difficulties of using cutting-edge technology to pursue sustainability objectives and add to our knowledge of the elements that influence sustainable rubber farming.

Research Methods

This research aimed to conduct a sustainability review of adopting artificial intelligence in rubber farming in Thailand. The research employed a quantitative survey design based on the primary data collected from rubber farmers in Thailand – both individual and cooperative rubber farmers who, thus, served as the study population. Since this population is large, a representative sample was selected. The target sample comprised 500 farmers. The random sampling technique was adopted in selecting the respondents to be included in the study. The data was collected using a structured questionnaire. The respondents were required to fill in the questionnaire and return it or complete the online version. The data collection instrument was developed following the research observed variables items; data was collected from November 1, 2022 to May 31, 2023. The collected data was reviewed and cleaned to eliminate partially completed copies of the questionnaires and outliers. Out of the target sample of 500, 436 copies of the questionnaire were filled and returned successfully. They were cleaned, and 407 copies were found suitable for data analysis. The reliability tests were done using Cronbach's Alpha and convergent reliability. The validity tests were conducted using average variance extracted (AVE) and standardized factor loadings. The model fitness tests, such as goodness of fit index (GFI), comparative fit index (CFI), and normal fit index (NFI), were also evaluated using confirmatory factor analysis (CFA). The hypotheses of the study were evaluated by running the structural equation modeling. SPSS Amos vs. 26 was used to run the analysis.

Research Conceptual framework

The following conceptual framework was developed from the critical review of the above literature review and the stated hypothesis (Fig. 1). The framework comprises sustainability as the sole dependent variable. The independent variables were perceived value, artificial intelligence, culture, satisfaction, and technology advancement. Artificial intelligence, culture, satisfaction, and technological advancement also act as mediating variables.

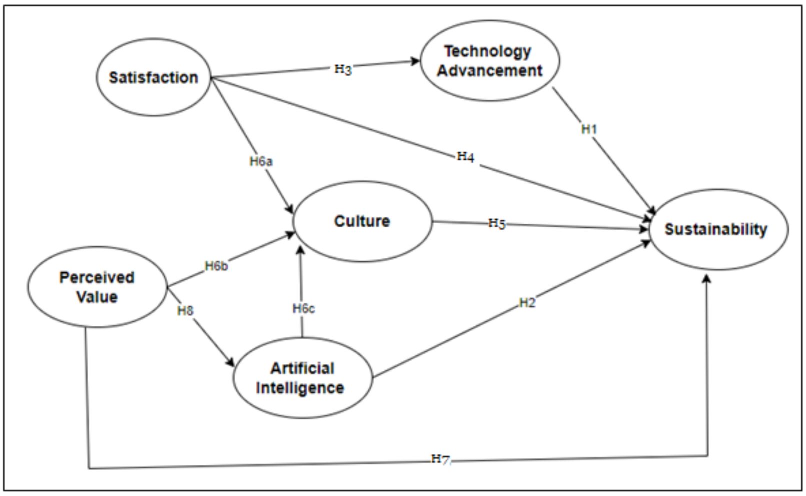

Fig. 1 Research Conceptual framework

Research Results

In the initial analysis, the demographic characteristics of the participants were examined. These characteristics covered were gender, age, educational background, and marital status. The results revealed the following extraneous information. Regarding the gender distribution of the sample respondents, males constituted 63.1% and females 36.9%. Age-wise, participants were categorized into three groups: 37.3% fell within the 20-30 age range, 25.6% were between 30-40 years, and 37.1% were aged 40 and above. When assessing the educational qualifications of the participants, the majority (38.6%) held undergraduate degrees, followed by 35.1% with college-level education. Those with high school education or below accounted for 14.5%, while postgraduate degree holders constituted 11.8%. In terms of marital status, 58.2% of respondents were married, while the remaining 41.8% were unmarried. The unmarried also accounted for the divorced and widowed. The separated but still legally married were considered married since the law still recognized them as married.

Table 1 Gender distribution of the research population

Variables		Frequency	Percent
Gender	Female	150	36.9
	Male	257	63.1
Age	20 - 30	152	37.3
	30 - 40	104	25.6
	40+	151	37.1
Education	High schools and below	59	14.5
	College	143	35.1
	Undergraduates	157	38.6
	Post graduate	48	11.8
Marital Status	Married	237	58.2
	Not Married	170	41.8
	Total	407	100.0

The CFA was conducted to evaluate the model fitness, reliability and validity of the model. In the analysis, the first check that was done was for the standardized factor loadings. The required threshold is >5.0. The observed variable items AInt3 and TAdv4 were removed because their values were below 5.0. The validity tests was also evaluated using the average variance extracted. The required threshold is 0.50 and above (Alarcón & Sánchez, 2015). The AVE values ranged from 0.529 – 0.787, which satisfied this threshold. The reliability was tested using the convergent reliability and Cronbach's alpha. The required threshold is 7.0. The values for both of them were above this threshold. These results confirmed that the reliability and validity of the study constructs items were satisfactory (Table 2).

Table 2 Reliability and validity analysis results

Latent Variables	Observed Variables	Estimate	CR	AVE	Cronbach's alpha
AInt	AInt1	0.702	0.711	0.787	0.736
	Aint2	0.717			
	Aint4	0.468			
	Aint5	0.567			
Cul	Cul1	0.666	0.830	0.695	0.833
	Cul2	0.663			
	Cul3	0.736			
	Cul4	0.735			
	Cul5	0.713			
Pval	Pval1	0.73	0.858	0.548	0.861
	Pval2	0.797			
	Pval3	0.72			
	Pval4	0.74			
	Pval5	0.712			
Sat	Sat1	0.684	0.846	0.625	0.848
	Sat2	0.764			
	Sat3	0.715			
	Sat4	0.746			
	Sat5	0.71			
Sus	Sus1	0.693	0.848	0.529	0.854
	Sus2	0.737			
	Sus3	0.786			
	Sus4	0.767			
	Sus5	0.643			
TAdv	TAdv1	0.552	0.724	0.598	0.731
	TAdv2	0.63			
	TAdv3	0.689			
	TAdv5	0.645			

CFA analysis for the study

In addition to the reliability and validity tests, the fitness of the proposed model was evaluated. The tests conducted included goodness of fit index (GFI), comparative fit index (CFI), normal fit index (NFI), and root mean square error of approximation (RMSEA). The results of these tests are summarized in Table 3. The results indicated that the results of the fitness tests were within the required threshold, as suggested by Bentler (1990), Bollen (1990), and Hu and Bentler (1999). Since these tests were satisfactory, it was considered appropriate to conduct the tests for the hypotheses of the study and ascertain their congruence with the study objectives.

Table 3 Evaluation of model fitness

Fit Index	CFI	TLI	IFI	GFI	CMIN/DF	RMSEA
Results	0.913	0.901	0.914	0.865	2.653	0.064
Threshold	0.90	0.90	0.90	0.80	5.00	0.08
Conclusion	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Satisfactory

Empirical Results

The results (Table 4) indicated that the path coefficient between technology advancement and sustainability was positive and significant (β = 0.408, p=0.000), hence accepting hypothesis 1. The path coefficient between artificial intelligence and sustainability was negative and insignificant (β = -0.213, p=0.566), hence rejecting H2. Additionally, technology advancement was found to significantly mediate the effect of satisfaction on sustainability (β = 0.944, p=0.000), consequently supporting H3. The path coefficient between satisfaction and sustainability was negative and insignificant (β = -0.232, p=0.080), accordingly rejecting H4. The path coefficient between culture and sustainability was positive and significant (β = 0.725, p=0.023), thus accepting hypothesis 5.

Table 4 Empirical results of the study hypothesis

Hypothesis	Path Relationships					Estimate	S.E.	C.R.	P-value
Direct Effects									
H1	TAdv	→			Sus	.408	.064	6.348	***
H2	AInt	→			Sus	-.213	.372	-.574	.566
H4	Sat	→			Sus	-.232	.132	-1.748	.080
H5	Cul	→			Sus	.725	.319	2.271	.023
H7	Pval	→			Sus	.165	.120	1.374	.169
Indirect Effects									
H3	Sat	→	TAdv	→	Sus	.944	.111	8.486	***
H6a	Sat	→	Cul	→	Sus	.364	.048	7.599	***
H6b	Pval	→	Cul	→	Sus	-.508	.188	-2.710	.007
H6c	AInt	→	Cul	→	Sus	1.511	.293	5.150	***
H8	Pval	→	AInt	→	Sus	.675	.071	9.522	***

Note : * = significant at 95% confidence level; TAdv = technology advancement, AInt = artificial intelligence; Pval = perceived value; Sus = sustainability; Cul = culture; Sat = satisfaction.**

SEM analysis for hypothesis evaluation

The mediating effects of various variables were also evaluated. The results indicated that culture significantly mediated the effect of satisfaction on sustainability (($\beta = 0.364$, p=0.000); perceived value on sustainability ($\beta = -0.508$, p=0.007); and artificial intelligence on sustainability ($\beta = 1.511$, p=0.000). as a result, H6a, H6b, and H6c was supported. The path coefficient between perceived value and sustainability was positive and insignificant ($\beta = 0.165$, p=0.169), rejecting hypothesis 7. Artificial intelligence was found to significantly mediate the effect of perceived value on sustainability ($\beta = 0.675$, p=0.000), therefore supporting H8.

Discussion

The main aim of this research was to investigate the various elements of sustainability in rubber farming in Thailand, with a specific focus on the utilization of artificial intelligence and the influence of cultural dynamics. This focus emerged in light of an observable shift: many rubber farmers in Thailand are transitioning away from traditional farming techniques towards more sustainable rubber cultivation methods. Such methods emphasize environmental and social sustainability in the cultivation of rubber trees (Min et al., 2020). In dissecting the determinants of sustainable practices, a salient finding of this research was the undeniable positive influence of technological advancements on sustainable rubber farming. A unit increment in technological advancement correlated with an enhancement in sustainability by 0.408 units. This relationship can be substantiated by the increasing reliance of rubber farmers on technological methodologies and insights for rubber production optimization. Complementing this is the technique of rubber agroforestry, highlighted by Warren-Thomas et al. (2020). This approach integrates the growth of rubber trees with forest trees, reinforcing the symbiotic relationship between agricultural production and ecological preservation. Moreover, the infusion of data analytics in the sector acts as a catalyst, with digital tools supplying rubber farmers with indispensable insights, thereby driving informed decisions and bolstering sustainable outcomes.

Culture emerged as a significant determinant, exerting a significant favorable influence on the sustainability practices of rubber farmers. This research asserts that rubber farmers' deeply entrenched beliefs and traditions are pivotal in shaping their inclination towards sustainable farming activities, such as adopting agroforestry methods. Agroforestry harmoniously integrates trees within agricultural systems, paving the way for enhanced ecological sustainability. Intriguingly, when the prevailing local culture holds reverence for aspects like biodiversity and environmental conservation, farmers demonstrate a heightened propensity to embrace techniques resonating with these sustainability tenets. The cultural fabric, thus, serves as a compass, guiding and motivating farmers toward more ecologically balanced and sustainable choices in their farming practices (Gitz et al., 2020).

Perceived value emerged as a critical determinant in steering the sustainability practices in rubber farming. Min et al. (2020) highlighted that the advanced sustainability practices of rubber farmers are intrinsically linked to various facets of sustainability, notably environmental repercussions. The imperative for rubber sustainability stems from the pressing challenges it faces. Issues such as deforestation, habitat destruction, and indiscriminate use of chemicals can compromise the future viability of rubber farming if left unchecked. Consequently, when farmers discern tangible value linked to sustainable practices, the proclivity to enhance rubber farming's sustainability rises. Furthermore, this study resonates with the findings of Min et al. (2017) in emphasizing the role of perceived risks, often termed as 'cognitive value,' in rubber farming. Factors like price volatility, fluctuating market demand, and the ever-looming impacts of climate change can significantly sway farmers' choices—potentially prompting them to specialize in rubber cultivation or diversify their crop portfolio, seeking more stable or resilient alternatives.

Independently, artificial intelligence does not have a direct influence on the sustainability of rubber farming. However, its effect on sustainability is significantly and positively mediated by culture. The inclusion of the cultural aspects enhanced the effect of artificial intelligence to influence sustainability. This research advocates that with consideration of the cultural aspects of rubber farmers, artificial intelligence technologies, such as remote sensing, satellite imagery, and machine learning algorithms, can enable precision farming practices in rubber cultivation. This aligns with the introspection by Monteiro and Barata (2021), who indicated that artificial intelligence technologies could enhance sustainability by analyzing data related to soil moisture, nutrient levels, disease outbreaks, and weather patterns. Besides, Bhagat et al. (2022) pointed out that by providing real-time insights, AI can help farmers optimize the use of resources, reduce waste, and enhance crop productivity. Culture was also found to significantly mediate the influence of satisfaction and perceived value on rubber farming sustainability.

Implications and Recommendations

From a theoretical perspective, this study explored and included new perspectives in the field of rubber farming sustainability. These are the aspects of artificial intelligence, technological advancement, and cultural practices. These aspects were proved to be critical aspects because of the role they play in the rubber farming sustainability efforts. This research also developed a conceptual framework that could be further enhanced to explore the sustainability of rubber farming in Thailand. From a theoretical perspective, this research recommends that the importance of rubber farming sustainability lies in its positive environmental, social, and economic impacts. Sustainable practices could play a vital part in preserving ecosystems, meeting market demands, improving livelihoods, and enhancing the rubber industry's long-term resilience.

From a practical perspective, this research recommends that as far as the aspects of a direct effect on sustainability are concerned, technological advancement, culture, and perceived value are significant factors. The stakeholders interested in directly influencing the sustainability of rubber farming should consider evaluating and realigning these three aspects. Additionally, culture and artificial intelligence have proved to have significant importance in rubber farming sustainability. Artificial intelligence technologies, such as remote sensing, satellite imagery, and machine learning algorithms, can enable precision farming practices in rubber cultivation, thus promoting sustainability efforts.

Conclusions

This research strived to review the sustainability of rubber farming in Thailand through the lenses of artificial intelligence and culture. The objective was to investigate the factors that influence rubber sustainability in Thailand. The study was developed on the background of sustainability in agriculture. The quantitative methodology was adopted to analyze the study's hypotheses, using primary data collected from rubber farmers in Thailand.

The data were collected using a structured questionnaire, from which a sample size of 407 respondents was used to analyze the data. The CFA was used to analyze the model fitness, and SEM was used to test the study hypothesis. The study's results indicated that results indicated that rubber farmers' sustainability was directly and significantly influenced by technological advancement, culture, and perceived value. The culture was found to significantly mediate the effect of satisfaction and artificial intelligence on the sustainability of rubber farming. Satisfaction was found to have a significant effect on technology advancement, while technology advancement mediated the effect of satisfaction on sustainability. Artificial intelligence also mediated the effect of perceived value on sustainability. The research recommended that stakeholders interested in sustainability in rubber farming should critically consider the aspects of artificial intelligence, culture, and technology advancement to enhance productivity and sustainability.

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