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Analysing the Effects of Natural Resource Utilization, Biodiversity, and Globalization: The Role of Fintech in Sustainable Financing

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This research attempted to provide insights regarding the role of Fintech, globalization, natural resource utilization and biodiversity in sustainable finance in the context of Thailand. For this purpose, data for Thailand spanning over 2000 to 2024 period is analysed using Quantile Autoregressive Distributed Lag (QARDL) technique. The outcomes indicated that in the long run, none of the selected determinants is significantly associated with sustainable finance. But, in the short run, Fintech is significantly and positively associated with sustainable finance. Similar to this outcome, biodiversity is also significantly linked with carbon finance and it was demonstrated that rising levels of biodiversity increased carbon finance. Likewise, globalization and natural resource utilization are significantly and positively associated with sustainable finance in the long-run. Lastly, the short-run analysis confirmed the convergence to equilibrium with a negative and significant error correction term. The outcomes presented in the study demand policy response in Thailand to enhance sustainable financing. Along with policy recommendations, the study offers insights and recommendations that can be utilized by future researchers to advance the research in Thailand.

Keywords: *Fintech; Sustainable finance; Biodiversity; Natural Resource Utilization; Globalization; Thailand.*

Introduction

In current decades, there is an increasing concern regarding energy crisis, carbon emissions and changes in climate have brought global transformation towards sustainable energy for a sharper focus. The current nee for this transformation has been underscored by the depletion of valuable natural resources and the loss of bio-diversity. Alabdullah, Churiyah & Eksandy (2023) have focused that ecosystems are threatened by unsustainable use of resources while United Nations Economic and Social Commission for Asia and Pacific (ESCAP) (2023) has highlighted the need for immediate action. On the same time, this transformation is specifically relevant for economies such as Thailand, that has experienced significant growth as Ho (2018) mentioned that Thailand was "widely recognized as one of the Asian growth success stories… From 1986–1996 the economy grew at an average annual rate of 7.5 %, between 1999–2005 at about 5 %, and slowed to around 3.5 % in 2005–2015". On contrary to that, Thailand's economic advancement has been impressive but it is also abundant natural-resource base and bio-diversity are now increasingly exposed towards climatic risk.

There has been a symbolic relationship among natural-resources, low-carbon energy transitions and bio-diversity, which underpins the functioning of eco-systems that provide significant services such as pollination, carbon sequestration and water purification all of them support the deployment of renewable technologies (Streimikiene, 2024). Adoption of renewable energy technologies supports resource-conservation (Kabeyi & Olanrewaju, 2022) creating a positive feedback loop in which bio-diversity conservation and low-carbon transition reinforce each other (Li *et al.*, 2025). The strategic land-use planning to ensure co-existence of bio-diverse habitats and renewable infrastructure helps in reduction of conflict among nature conservation and deployment of energy (Hammelman *et al.*, 2022). However, the complexity of these relationships, there has been mounting recognition which achieve both sustainable development and economic growth demanding integration of approaches which link renewable energy deployment, bio-diversity preservation and natural-resource efficiency (Rozghon, & Oliukha, 2025). There has been a crucial barrier for this transformation, which lies in finance, high up-front cost of green technologies, together with uncertainties and constrained access for capital hampering deployment of low-carbon energy-efficient and renewable-energy projects (Huynh et al., 2025). Similarly, the sudden increase of financial-technology (FinTech) presents an innovative channel, by enabling digital, transparent, efficient financing tools such as block-chain based transactions and novel investments FinTech has the potential for accelerating sustainable financing (Oertli, 2020; Kalaiarasi & Kirubahari, 2023; Muganyi *et al.*, 2021; Mosnja-Skare, 2024). Current studies suggests that nexus between FinTech-enabled financial innovation and bio-diversity and

natural-resource conservation merits attention, since eco-system restoration and sustainable energy efforts align essentially (Zeng *et al.,* 2024).

However, there has been rich theoretical associations between natural-resource use, bio-diversity conservation, low-carbon energy transitions and green finance, there has been significant gaps in literature specifically in the context of Thailand. First, the role of FinTech in sustainable finance is rising (Bayram, 2022; IMF note, 2024), empirical country-specific examinations remain scarce, and the relationship between FinTech and bio-diversity, natural-resource utilisation in emerging economies has been underexplored. Bayram (2022) determined that in many studies that Fintech in sustainable-finance relationships lack country-specific cases reflecting varying regulatory and financial systems. Second, Thailand is rich in biodiversity, facing climate and resources challenges (UNDP/ BIOFIN Thailand, 2023) and they had launched sustainable-finance initiatives (Bank of Thailand, 2021), there has been limited research link in FinTech tools with bio-diversity finance and low-carbon energy transition in that country. Third and most important is studies on green FinTech in Thailand exist (Thanapongporn *et al.,* 2024) focusing on process of innovation, FinTech services rather than on how FinTech could specifically facilitate low-carbon energy transition and bio-diversity preservation. Therefore, there is a clear gap in literature that how FinTech-enabled sustainable financing mechanisms could integrate the triad of low-carbon energy transformation, natural-resource utilisation and biodiversity conservation in context of Thailand. Without this integration, Thailand may struggle to channel innovative finance into renewable energy and ecosystem preservation, thus undermining both its climate and development commitments. This study aims to determine the mechanism through which FinTech-based sustainable financing could support low-carbon energy transitions while preserving bio-diversity and utilisation of natural resources efficiency in Thailand. Following are the objectives of the study:

- To map the current state of sustainable finance and FinTech adoption in Thailand, especially as they relate to renewable energy, natural-resource use and biodiversity preservation.
- To examine the interlinkages among FinTech innovations, renewable energy deployment, resource conservation and biodiversity protection in the Thai context.
- To identify barriers and enablers for integrating FinTech-driven finance in low-carbon energy projects that safeguard biodiversity and natural-resource integrity in Thailand.
- To propose a conceptual framework or policy guidance for leveraging FinTech to mobilise sustainable finance that serves both energy transition and biodiversity goals in Thailand.

Literature Review

Financial technology is the transformative force in the financial landscape that has provided solutions to various financial problems. The role of FINTECH is significant in Thailand as natural resource utilization and biodiversity holds great importance in the region (Kijkasiwat, 2021). FINTECH plays significant role in sustainable financing and provide range of financial services in order to support such initiatives that are socially and environmentally responsible. This technology has provided transparency in transactions and helps in the efficient use of resources. The effective management of these resources is essential in order to get long term benefits and achievement of sustainable goals requires innovative approaches that help in the achievement of goals. Thailand is rich in natural resources and biodiversity but at the same time it also faces certain challenges for which FINTECH provides solutions and also promote responsible financing hence contributing to the economic growth of the region (Bakar, Nordin, & Amani Nordin, 2020). For addressing the gaps in understanding how digital financial innovations (FinTech) impact sustainable finance, natural resource utilization, bio-diversity preservation and globalization in Thailand, this research integrates three key theories: the Environmental Kuznets Curve (EKC), Stakeholder Theory, and Ecological Modernisation Theory (EMT). Every theory offers a distinctive but complementary lens on relationship between economic growth, institutional innovation and environmental between economic growth and institutional sustainability, by providing a comprehensive framework for the analysis of this study.

Theoretical Perspective

Environmental Kuznets Curve (EKC)

The Environmental Kuznets Curve (EKC) theory proposes the relationship between environmental degradation which follows an inverted U-shaped pattern: in early stages of growth, environmental degradation which tends to rise, but beyond a specific income threshold, further growth could lead towards environmental improvements as societies adopt cleaner technologies, developing stronger regulations and become more environmentally conscious (Youssef *et al.,* 2016; Moutinho *et al.,* 2017; Orubu & Omotor, 2011; Lyu *et al.,* 2024). Within the context of Thailand, the EKC framework provides a useful lens for the analysis of how FinTech-driven sustainable finance and renewable energy investments could influence the transition in country from rise of declining side of curve. Previously Thailand's rising industrialization and economic expansion have been linked with increased consumption of energy, deforestation and loss in bio-diversity, which indicates that nation remains on upward segment of EKC (Maneejuk *et al.,* 2020). Recent policy of Thailand focusing on renewable energy including the Alternative Energy Development Plan (AEDP) and Bio-Circular-Green (BCG) Economy Model that reflects an emerging turning point where technological innovation, financial reform and sustainability commitments are starting to decouple growth from environmental degradation (Kaewchutima *et al.,* 2025; Lulaj & Mekaniwati, 2025; Wu *et al.,* 2025).

From the perspective of EKC, innovations of FinTech acts as a catalyst for the acceleration of this transition. By enabling digital green financing, carbon credit trading and crowd-funding for renewable energy projects, plat-forms of FinTech could help channelling capital into low- carbon technologies and bio-diversity positive investments. This mechanism could promote cleaner production, energy

efficiency, and sustainable resource utilisation, which pushes Thailand closer to downward slope of EKC where economic growth aligns with environmental improvements.

Stakeholder Theory

Stakeholder Theory has been originated by Freeman (1984), who argues that organizations including institutions and policy makers should consider the values, interest and impacts of all the relevant stakeholders, employees, consumers, investors, suppliers, governments, communities and eco-systems in their strategic and operational decisions (Karim, 2021a; Karim, 2021b; Camilleri, 2022; Zemlickiene *et al.,* 2025; Yang *et al.,* 2024). This theory, also suggests that long-term sustainability and value creation emerges when there are diverse needs of stakeholders and they are balanced, rather than prioritising short-term economic gains. Within the context of Thailand, Stakeholder Theory is specifically significant given the country's ongoing efforts for the integration of FinTech solutions into sustainable financing frameworks to advance its energy transition in bio-diversity conservation goals. Biodiversity Finance Initiative (BIOFIN Thailand), has been implemented by United Nations Development Programme (UNDP) and the Thai government, that exemplifies the stakeholder-based approach for financing bio-diversity. This initiative promotes collaboration among public agencies, private financial institutions, FinTech enterprises, community organisations, and global investors for mobilising the capital for conservation and sustainable resource management (BIOFIN Thailand, 2023). Integration of stakeholder theory provides a multi-dimensional lens from which towards how the access of FinTech-enabled sustainable finance could equitably support environmental and social outcomes. Innovations in FinTech suh as block-chain, IoT carbon markets, and digital crowdfunding platforms could demonstrate the access for environmental finance, empowering local communities and small enterprises to participate in renewable energy and bio-diversity projects (Zhang & Su, 2024; Zeng *et al.,* 2025). With the adoption of Stakeholder theory in this study, make it clear that success of FinTech-driven sustainable finance depends on collaboration and trust among a braod network of actors which ranges from government regulators and banks to local communities and environmental NGOs. This study proposes a framework for leveraging FinTech to mobilise sustainable finance that advances Thailand's energy transition, natural resource conservation, and biodiversity protection in an equitable and participatory manner.

Ecological Modernisation Theory (EMT)

The Ecological Modernisation Theory (EMT) posits that environmental protection and economic development can be mutually reinforcing when societies integrate technological innovation, institutional reform, and participatory governance into their growth strategies (Weber & Weber, 2020; Lempriere, 2016). EMT suggests that states, private sectors, and civil society can jointly promote sustainability through cleaner production systems, renewable energy adoption, and resource-efficient technologies. Rather than viewing economic growth and environmental protection as conflicting objectives, EMT frames them as complementary forces in a technologically advanced, innovation-driven economy.

In the context of Thailand, EMT offers a powerful framework to understand the country's efforts to harmonise economic growth, biodiversity protection, and sustainable resource use. The Thai government's commitment to the *Bio-Circular-Green (BCG) Economy Model* and the *Alternative Energy Development Plan (AEDP)* embodies EMT principles by promoting low-carbon energy systems, sustainable industries, and digital innovation as pathways to ecological balance (Ministry of Higher Education, Science, Research and Innovation Trade.gov, 2024). These initiatives aim to reposition Thailand's economy toward renewable energy, energy efficiency, and biodiversity conservation while maintaining global competitiveness.

EMT also provides a theoretical foundation for understanding how FinTech innovations can accelerate Thailand's ecological modernisation. Emerging financial technologies such as blockchain-based carbon markets, AI-driven green credit scoring, decentralised crowdfunding platforms, and digital sustainability bonds are enabling new forms of green finance and investment transparency (Kalaiarasi & Kirubahari, 2023; Zhang & Su, 2024; Zhao *et al.,* 2024). These innovations align with EMT's emphasis on technological and institutional transformation by creating financial mechanisms that internalise environmental values and incentivise biodiversity-friendly investments.

Role of FINTECH in Sustainable Financing

The role of FINTECH is significant in sustainable financing as it drives positive environmental and social impact and also promotes economic growth as well as financial sustainability. It provides range of digital innovations for financial services (Macchiavello & Siri, 2022; Nar, 2025). This technology promotes the access of capital as due to lending and digital investments, it bridges the gap between investors and projects that are relevant to sustainability and also provide funds for renewable energy. This technology also enhance transparency and accountability by using block chain technology and the use of smart contracts helps in the automation of services hence keeping in transparent and it ensures that the funds are used effectively and also develop trust among the stakeholders (Cen & He, 2018; Li *et al.,* 2025; Zheng *et al.,* 2023; Li *et al.,* 2024). FINTECH also assists in managing risks as related to environment as well as social. This technology uses ESG environmental, social and global risk assessment models in order to assess risk and helps investors in taking informed decisions for future by keeping in consideration the risks. Moreover it also promotes financial inclusion by providing opportunities to underdeveloped areas where people can't access the financial institutions so they are provided with mobile banking apps and digital wallets so that they can use the services and promotes sustainable financing services. This technology has revolutionized the financial world by using artificial intelligence and data analytics and these technologies help in optimizing investment and enhance risk management (Arner, Buckley, Zetzsche, & Veidt, 2020).

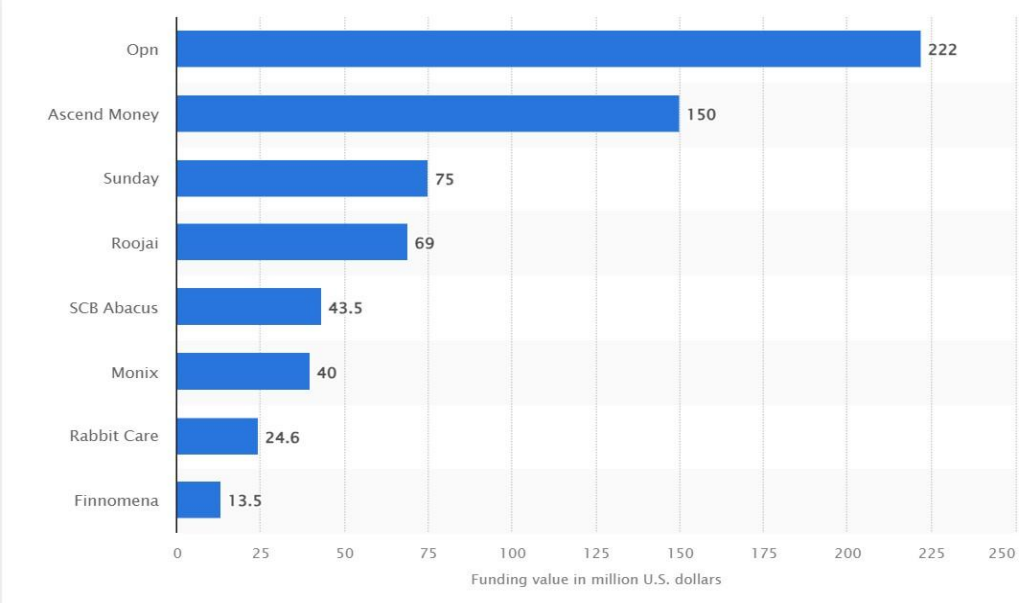

Figure 1. Leading FINTECH startups Thailand 2023 Source: (Statista)

Importance of Biodiversity Conservation for Sustainable Development

Biodiversity conservation plays significant role for sustainable development and it has string impact on human well-being and economic stability. It ensures the stability of ecosystems and manages certain environmental challenges like climate change, pollution etc. Biodiversity provides services like air and water purification, climate regulation etc. which is important for human well-being (Locke *et al.*, 2019). It also supports various industries like agriculture; tourism etc. and a healthy ecosystem contribute towards economic growth and individual well-being. Biodiversity also provides several opportunities for innovation in the field of medicine in order to generate revenue. It is basically linked to the human well-being and their health as it provides resources like food, clan water etc. According to Blicharska et al. (2019), the environments that are rich in biodiversity promote cultural identity and enhance the quality of life of individuals. It also plays crucial role in mitigation of climate change and adopts policies like forestation that help in mitigating greenhouse gas emissions and enhance resilience to climate change. This concept also promotes the ethical and moral perspectives of ecosystem as it helps in the protection of natural world for the generation that is yet to come and develop a relationship between human and nature (Opoku, 2019).

Natural Resource Utilization and Sustainable Financing

There is close relationship between natural resource utilization and sustainable financing as sustainability plays significant role in responsible and efficient management of resources for the economic benefits (Koval, Mikhno, Udovychenko, Gordiichuk, & Kalina, 2021). It encourages the investment in technologies that help in resource efficiency and include activities like renewable energy projects and efficient management of resources. Through the optimization of resources, organizations can reduce waste and increase their productivity. Sustainable financing promotes preservation of natural resources and promote projects related to biodiversity conservation in order to safeguard nature for future generation. It drives innovation in natural resource utilization like green technologies and sustainable infrastructure contribute towards reduction in carbon emission and promote eco-friendly practices (Koval *et al.*, 2021). The activities related to sustainable environment promote the stakeholder engagement and promote regulations that are aligned with the environmental well-being. The approaches liked with natural resource utilization aligned with the sustainable development goals. It also use risk management strategies related to natural resource utilization as it assess the climate change and impact of biodiversity and try to mitigate those risks that are related to unsustainable practices (Shen *et al.*, 2021). The integration of these policies helps in mitigating financial and environmental risks.

Globalization in Sustainable Financing

Globalization and sustainable financing are closely related with each other and influence each other. Globalization helps in the movement of capital across regions and provides opportunities to businesses to expand their services on global level. It promotes sustainable financing by investing in green infrastructures and sustainable development projects in order to get benefits (Xiaoman, Majeed, Vasbieva, Yameogo, & Hussain, 2021). The regions which are practicing sustainable activities are the source of attraction for investors from the global market as the investors who are concerned with the sustainable practices are more likely to invest in regions which are sustainable in environment (Jickling & Wals, 2019).

Globalization also promotes market integration as it includes initiative that is linked with the sustainable development goals as well as green financing. It promotes investment and transparency in financial market. Globalization also impacts the supply chain networks that influence the natural resource utilization. This aspect encourages the companies to adopt sustainable supply chain and also invest in technologies that are environmental friendly and this approach promotes the sustainable development goals and also addresses global challenges related to climate change. Moreover globalization also requires the adherence to regulatory frameworks for sustainable financing and certain international agreements and collaborations help in creating sustainable environment for investment and financial practices (Amin, Liu, Abbas, Hanif, & Vo, 2021).

Integration of FINTECH and Sustainable Financing in Thailand

The financial technology provides significant opportunities in Thailand for economic growth in order to promote environmental sustainability. In Thailand there is access to sustainable investment opportunities for individuals and businesses and digital investment platforms where investors can participate in sustainable projects i.e. green infrastructure, renewable energy resources etc. According to Mirchandani, Gupta, and Ndiweni (2020), use of FINTECH promotes transparency in projects. The use of digital technologies like block chain technology, smart contracts etc. promote secure and transparent transactions and they ensure that the funds are properly allocated to the projects that are relevant to sustainability and helps in building trust among investors and other stakeholders in order to foster the culture of sustainability. In Thailand, the use of FINTECH technology also helps in assessing the risks related to certain projects and help in making decisions accordingly. There are certain risk assessment models that help in assessing risk that are associated with investments i.e. data analytics, AI and machine learning etc. this approach is proactive in nature and promotes responsible investing practices and also mitigates financial risks for sustainability goals (Dorfleitner & Braun, 2019). The innovation related to FINTECH in Thailand has resulted in the promotion of financial products like green bonds and sustainable loans and these instruments provide solutions to certain investor preferences and provide wide range of sustainable projects. These projects generate capital towards the environmental benefits and positively impact the sustainable development outcomes. Moreover the government of Thailand and other regulatory authorities promote the integration of FINTECH and the regulations that support collaboration with FINTECH firms and promote environment for sustainable finance innovation in Thailand's green economy.

Policy Implications and Recommendations for Enhancing FINTECH's Role in Sustainable Financing

There are certain recommendations for the implication of FINTECH in sustainable financing one of which is clear regulatory frameworks for sustainable financing. The frameworks include ESG framework and also use certain methodologies in order to check the impact of these initiatives. The clarity in regulatory framework helps in the development of confidence among investors makes sure that the goals of the organization are aligned with the FINTECH solutions (Bu, Li, & Wu, 2022). The government can also provide support for FINTECH firms that are practicing the sustainable financing and the support can be in the form of tax incentives and subsidies so that the firms that are practicing these activities could get benefit from government and they thrive for the achievement of goals. The incentives provided by government promote innovation and reduce barriers for firms who want to practice sustainability and enhance investment flows for green initiatives. Organizations can also invest in capacity building programs and also educate employees in order to develop skills and knowledge in them for FINTECH innovation. Training programs help in increasing awareness as the training is provided by the experts who are professionals in their field and they share knowledge in order to build a pool of talent (Karkkainen, Panos, Broby, & Bracciali, 2018). There is also an opportunity in which the collaboration between public and private institutions can take place that are practicing sustainable financial goals. These partnerships help in building networks that involve experts from various sectors in order to address challenges related to sustainability. The engagement of stakeholder in sustainable practices is also an opportunity as it includes the services from communities and environmental experts and promotes alignment with the environmental priorities. The transparency in any system attracts the stakeholders and increases their credibility for sustainable finance initiatives.

Data and Empirical Methodology

Model and Data

This research sought to examine how sustainable finance can be enhanced by considering the effects of Fintech, biodiversity, natural resource utilization and globalization in Thailand over 2000 to 2024 period. The study primarily is centred on the case of Thailand; thus, data for Thailand is extracted from online databases. The econometric model for this study is shown in the equation below which is specified following the studies of Liang, Zhou, Zeng, and Wang (2024), Xu, Li, Chen, and Quan (2025), Liang et al. (2024) and Kulionis, Pfister, and Fernandez (2024)

$$SF = \beta_0 + \beta_1 FT + \beta_2 BD + \beta_3 RES + \beta_4 GLB + \varepsilon_t \quad (1)$$

where SF indicates sustainable finance while FT represents Fintech, BD is biodiversity, RES is resource utilization and GLB is globalization. The measurement of the variables and the description are provided in Table 1 below.

Table 1

Description of the Variables

Variable	Description	Sign	Data Source
Sustainable finance	Carbon finance	CF	Our World in Data
Fintech	Index comprising of percentage of individuals using internet, Fixed Telephone subscriptions and Fixed Broadband subscription (per 100 individuals)	FT	World Development indicators
Biodiversity	Fish Production	BD	World Development indicators
Natural resource utilization	Depletion of natural resources	RES	World Development indicators
Globalization	Globalization Index	GLB	KOF Swiss Economic Institute

Econometric Methodology

To analyse the relationship between dependent and independent variables, empirical estimation is done as follows. As the present study used time series data, it became imperative to ensure that data series to to stationarity. For this purpose, the stationarity of the variables is assessed using Augmented Dickey Fuller (ADF) test proposed by Dickey and Fuller (1979) and Phillips Perron (PP) test proposed by Phillips and Perron (1988). After verifying the stationarity of the data, the next part of the analysis is to apply the estimation technique. For this purpose, the QARDL technique is used proposed by (Cho, Kim, & Shin, 2015). This estimation approach shows quantile based asymmetries in the short run and long run modifications of the outcome and independent variables. The main strength of the QARDL model is that this technique takes into account the potential asymmetries which conventional ARDL estimation technique does not consider. The main strength of the QARDL model lies in its ability to capture these asymmetries which enables it to provide a more comprehensive understanding of the relationship between the variables. Contrary to linear ARDL estimation which assumes a constant impact of independent variables at all levels of the dependent variable, a more thorough and rich analysis is provided by this technique (X. Zhang, e Ali, Niu, Iqbal, & Wenbo, 2025). Additionally, this methodology is superior to other nonlinear estimation approaches, such the "Nonlinear Autoregressive Distributed Lag model which assumes the nonlinearity to be exogenously determined as data driven process does not determine the threshold level. Therefore, the QARDL estimation approach is considered to be the most relevant technique as it incorporates both the nonlinear and asymmetric linkages. The basic expression of the ARDL model is given as follows:

$$SF_t = \alpha + \sum_i^p \beta_1 SF_{t-i} + \sum_i^r \beta_2 FT_{t-i} + \sum_i^q \beta_3 RES_{t-i} + \sum_i^u \beta_4 GLB_{t-i} + \sum_i^s \beta_5 BD_{t-i} + \epsilon_t \quad (2)$$

Where, SF, FT, RES, GLB and BD represent sustainable finance, Fintech, resource utilization, globalization and biodiversity, respectively. The lag order determined by SIC criterion is determined by p, q, r, s and u. The modification of equation (2) for quantile estimation is represented as follows:

$$QSF_t = \alpha(\tau) + \sum_i^p \beta_1(\tau) SF_{t-i} + \sum_i^r \beta_2(\tau) FT_{t-i} + \sum_i^q \beta_3(\tau) RES_{t-i} + \sum_i^u \beta_4(\tau) GLB_{t-i} + \sum_i^s \beta_5(\tau) BD_{t-i} + \varepsilon_t(\tau) \quad (3)$$

where, εt(τ) is the error term and (τ) is the conditional quantile level.

Findings and Discussion

Descriptive Statistics

Firstly, Table 2 represents descriptive statistics of the variables namely SF, GLB, RES, BD and FT. Descriptive statistics indicate mean, standard deviation, minimum and maximum values (showing the range) of data series. According to descriptive statistics, all variables have positive average value. SF has average value of 56577 and has minimum value of 0.000 and maximum value of 32408000. Similarly, the mean or average value of GLB is 68.986 and its range lies between 62.522 and 73.893. The mean values of FT and BD are 1.208 and 30598, respectively and their minimum values are -1.315 and 2377 and maximum values are 1.630 and 41185, respectively. Likewise, the data range of RES lies between 0.688 and 2.521 and has mean value of 1.543. Also, the J-B statistics showing the normality of data series are also given in Table 2. It can be noticed that J-B test statistics for SF is highly significant which confirm the non-normality of data series. Therefore, the application of the QARDL is necessary in this case that give detailed information as compared to the conventional estimation approaches.

Table 2

Descriptive Statistics

Variables	Mean	Standard deviation	Minimum value	Maximum value	J-B test
SF	56577	90371	0.000	32408000	26.122***
GLB	68.986	3.606	62.522	73.893	1.715
FT	1.208	1.0007	-1.315	1.630	2.195
BD	30598	64109	23770	41185	2.671
RES	1.543	0.504	0.688	2.521	1.840

Stationarity Analysis

An essential component of time series analysis is validation of absence of unit root. Table 3 provides results of ADF and PP unit root tests. The first analysis depicts that only SF is stationary at level as per the ADF and PP result. In contrast, all other variables are non-stationary at level and the results depict that at first difference, no unit root is present. Thus, all variables have conformed to stationarity at first difference.

Table 3

Unit Root Analysis

Variable	Level		First difference	
	ADF	PP	ADF	PP
SF	-3.990**	-3.988***	---------	----------
GLB	-2.752*	-1.856	--------	-8.121***
FT	-0.799	-0.458	-2.677*	-4.548**
BD	-0.592	-0.720	-3.466**	-3.472**
RES	-1.942	-1.942	-6.165***	-6.278***

QARDL Estimation

The researcher progressed to analyse how the variables understudy influence SF in the context of Thailand. Table 4 exhibits the results of QARDL over quartiles where coefficients and probability values are presented to confirm the associations between the variables. According to the results of the study, none of the regressors have significant impact on SF in the long run. However, in the short run, FT, GLB, RES and BD are found to impact SF significantly at higher quartiles i.e., 0.75 and 0.90. Moreover, the error correction model (ECM) is significant and has a negative sign, validating long-run association between the variables and also showing that variables adjust to reinstate the equilibrium from the preceding year to present year. Let's interpret the findings one by one.

First, in the short-run effects, the study gained significant results for all the designed associations. Thus, the study verified that in Thailand, there is a significant participation of companies in making sustainable financing and in this domain, the natural resources and biodiversity also show prominent effects. First of all, the results show that FT affects CF positively and the effect is statistically significant at extreme higher quartiles only. This finding is according to expectation as FT provides all decision making capabilities and data processing technologies necessary for the development of sustainable finance (Muganyi *et al.,* 2021). This outcome is consistent with Xu et al. (2025) who also found that FT facilitate green finance by green innovations and financial efficiency. Similarly, Nassiry (2019) has argued that block chains facilitate financial flows for climate investments and climate finance. Likewise, the findings of Liu and You (2023) are also strongly in line with the outcomes of the present research as they have found that FT enhances the development of green credit in Chinese firms.

Similarly, the impact of RES is also positive and significant on SF in the short run. This implies that natural resource utilization promotes the use of sustainable finance. This is justified in the light of the fact that wealth generated through natural resources can be utilized to finance green projects (Do Phuong *et al.,* 2025). From earlier studies, although this finding is in contrast to Do Phuong et al. (2025) and Tan, Su, and Wang (2023) who found that natural resources hinder the development of climate or sustainable finance, this outcome is consistent with Liang et al. (2024) who found that natural resources promote green finance in developing countries.

Third, the result obtained validated a positive and significant association between BD and CF, implying that increasing BD leads to an increase in CF in Thailand but with increasing magnitude as we move from 3rd to 4th quartile. This finding is in line with Kulionis et al. (2024) who posit that according to the double materiality concept that loss in biodiversity has a significant impact on the financial performance of company and the loss in biodiversity leads to several biodiversity related financial risks which highlighted the significance of biodiversity integration in financial operations to mitigate risks. Fourth, the impact of GLB on CF is found to be positive as well as statistically significant at higher quartiles. This finding implies that GLB makes countries globally integrated, by which financial institutions invest in green projects and green financial products and it also helps these institutions to improve their financial system. Moreover, special banks facilitate the integrated countries to make policies to facilitate green or sustainable finance (Sheraz, Deyi, Ahmed, Ullah, & Ullah, 2021). Furthermore, collaborations with international institutions and organizations lead to best practices and expertise that promote green patent applications (Aslam *et al.,* 2024). This outcome is consistent with Sheraz et al. (2021), Balcilar, Gungor, and Olasehinde-Williams (2019) and Zaidi et al. (2019) who have also observed the positive role of GLB in financial sector.

Table 4

Short Run and Long Run QARDL Results

Quantiles	Constant	ECM	Long Term						Short-Term	
(τ)	$\alpha_*(\tau)$	$\rho_*(\tau)$	$B_{FT}(\tau)$	$B_{GLB}(\tau)$	$B_{RES}(\tau)$	$B_{BD}(\tau)$	$\Phi_{FT}(\tau)$	$\Omega_{GLB}(\tau)$	$\Psi_{RES}(\tau)$	$\Lambda_{BD}(\tau)$
0.25	-5.304 (0.997)	-5.995*** (0.000)	-3.748 (0.997)	7.940 (0.998)	-1.118 (0.996)	-1.695 (0.993)	-7.804** (0.0036)	6.907 (0.329)	2.082 (0.195)	-7.416 (0.807)
0.50	1.137 (0.999)	-7.410** (0.032)	1.236 (0.993)	-9.704 (0.999)	2.181 (0.999)	-1.016 (0.999)	1.1833 (0.916)	8.074 (0.983)	2.372 (0.970)	-4.461 (0.969)
0.75	6.013 (0.872)	-1.199*** (0.000)	1.973 (0.905)	-6.840 (0.894)	2.254 (0.832)	-4.231 (0.796)	3.031** (0.022)	6.778* (0.064)	1.283 (0.806)	1.697** (0.0132)
0.90	4.055 (0.988)	-1.511*** (0.000)	8.714 (0.998)	-4.484 (0.997)	1.463 (0.978)	-3.149 (0.987)	4.694*** (0.000)	1.107*** (0.000)	5.467*** (0.000	2.458*** (0.000)

Where, ***,** and * show significance at 10, 5 and 1%, respectively

Conclusion and Implications

Sustainability has become a global objective after the worldwide recognition of the 17 SDGs developed by the UN in 2017. In this regard, various countries took robust and highly incumbent initiatives to maximize their all types of strategies and contemporary activities including financing into sustainable practices. To visualize the narrated transformations in sustainability and rapid advancement in the digital world, this study aimed to analyze the impact of biodiversity, natural resource utilization, Fintech and globalization on the sustainable financing in Thailand over 2000 to 2024 period. To fulfill this aim, the study adopted the QARDL technique and elucidated the long and short-run effects of the targeted variables. In this myriad, the study has disclosed that in the long run, none of the variables have statistically significant impact on sustainable finance. This implies that Thailand has made efforts to align fintech, biodiversity, natural resource utilization and globalization with sustainable financing, but this effort is still in its embryonic or developing stage. However, contrary to the long run results, the effect of these variables is positive and statistically significant on sustainable finance in the short run. In a summarized manner, it can be emphasized that globalization, fintech, natural resource use and biodiversity increase sustainable or carbon financing.

From the results, the study has implied that in Thailand there is a significant trend toward sustainability and companies or corporations pay prominent attention to sustainable financing by adding value and showing concern for the environmental and natural resources preservation by tracking their global activities as well as domestic resources utilization. Specifically, on the basis of these findings, the following policies are proposed for the policy makers and government in Thailand. First of all, as globalization impacts sustainable finance positively, making trade policies more greener is an effective way to allow the flow of finance to sustainable sectors. For this purpose, sustainable and environmental finance must be integrated into trade agreements and trade in environmental technologies and goods must be encouraged. Fast track approvals and tax credits must be given to the foreign investors and bilateral investment treaties must be included for the provision of sustainable finance. Second, policy makers who deal with green finance or climate finance should focus on development of block-chain and fintech technologies. Tax grants, incentives and carbon credits should be provided for fintech startups which incorporate sustainability matrices and promote green or sustainable investments. Policy makers must be engaged with the blockchain technologies and fintech sectors as these technologies have the potential to reach targets of financial, economic and environmental sustainability. Furthermore, government should make partnerships with fintech firms to develop platforms for climate finance and green credit scoring.

Likewise, financial institutions should consider biodiversity benefits and risks in their investment, lending and insurance decisions and government should offer incentives or guarantees to reduce risks in green finance investments. Moreover, government should ensure accountability and transparency in natural resource revenues to attract more sustainable finance and build investor's trust. International sustainable finance platforms must be joined at government level that will attract more investment. Government should engage in finance agreements and cross border resource management agendas to facilitate circular economy practices and use of resource funds for green credits and investments.

Significance, Implications and Contributions of the Research

This study has paid attention to the most critical factors that prevail in our living environment as well as the literature for damaging and hindering the sustainability goals. This study has centered its attention on biodiversity and natural resource utilization for their implications for promoting sustainable finance. The study made double efforts by highlighting both short and long-run predictions for the concerned variables. First, this study implied the fact from adequate past time, Thailand has shown involvement in the sustainable practices and it has turned its page of activities toward more investment in the environmental protection. Moreover, the study has added to the body of literature, that countries and their companies that have

affection and awareness for the value of the natural environment show significant and prominent involvement in the financing of green activities like sustainable globalization, safe use of natural resources and high Fintech to mitigate or to balance out the CO2 emissions. This study has added novel contributions to the literature by portraying the facts that globalization, fintech, natural resources utilization and biodiversity have a certain role in sustainable financing, so the researchers can use this insight to highlight a path for the countries that are the victim of environmental pollution to get rid of the burden of CO_2 emission and negative resources utilizations.

Observed Limitations of the Study

Despite the above-mentioned numerous useful insights, there are boundaries present in the research which have been narrated in this section as limitations which can be used as useful insights or bright roadmaps for the future research. So, first, this study has methodological strategy limitations in the form of secondary data that already existed in the field and the research has only gathered and summarized those using statistical techniques. Furthermore, the study would be of great deal if it had used a mixed method study and provided verified results from the practical field professionals about Fintech and sustainability. In the last, the study has implied its contributions only within the demographical and geographical boundaries of Thailand, and no major countries that have been striving with sustainability adoption as a challenge has been investigated. Lastly, this study has faced limitation in data availability and any comparative data is not available to compare and contrast the outcomes before and after Fintech.

Future Suggestions Based on Limitations

Using the above-highlighted limitations, future researchers can take novel paths and can make their efforts to discover some more interesting insights for the literature and practical field. First, the limitation of research methodology can be used as a bright line in the form of three different methods in the form of qualitative interviews-based, second, quantitative primary questionnaire-based research strategy with more constructs addition, and third, an amalgamation of both styles by first investigating the quantitative strategy followed by the qualitative one. Next, the limitation of limited and plan variables can be replaced by adding the most discussed and popular constructs in the sustainability domain like dimensions of resources in the form of renewable and non-renewable resources, environmental degraders like toxic fuels emission and disposal, pollution and other sustainability goals with Fintech. Moreover, the most badly reputed countries in terms of environmental sustainability due to pollution production like China, India, Russia and others can be targeted with Thailand to follow a comparative style and highlight the proficiency of the efforts made by targeted countries in sustaining the environment. Lastly, the next studies can also study the same addressed variables using a time-lapse-based longitudinal study to evaluate the rate of pollution production and environmental safety before the industrial and technological revolutions and advancements.

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