

Digital Trade, Carbon Finance, and Sustainable Natural Resource Management: A Case Study of Thailand in the Globalized Economy

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This research has examined the role of carbon finance, globalization, and digital trade for shaping sustainable management of total natural resources (TNR) in Thailand over the period of 2000 to 2022. For the analysis of these relationships and capturing potential asymmetries, the research employs a Non-linear Autoregressive Distributed Lag (NARDL) model, which allows both short-run and long-run effects to be determined across different quantiles. The empirical outcomes reveals that globalization has a negative and significant effect on TNR in both short and long run, which suggests an increased economic integration would worsen natural resource depletion. Digital trade also reveals generally negative relationship with TNR, although its long-run impact is significantly adverse, the short-run effects are statistically insignificant, highlighting complex temporal dynamics. On contrast, carbon finance shows a positive and significant impacts on natural resource management across time horizons, underscoring its potential as a sustainable financial mechanism. Moreover, the economic growth is found to have a positive relationship with TNR, that likely to reflect increased extraction and utilization of finite resources rather than sustainable use, signalling a potential trade-off which challenges long-term environmental objectives. The findings of study offer crucial insights for policy implications for Thailand, focusing the need to refine globalization and digital trade policies for mitigating their environmental impacts, while simultaneously leveraging carbon finance to promote sustainable resource management. These insights contribute towards development of integrated strategies for balancing economic development with environmental sustainability in context of Thailand's evolving digital economy.

Keywords: *Digital Trade; Globalization; Thailand; Nonlinear ARDL; Carbon Finance; Sustainable Natural Resource Management.*

Introduction

The sustainable management of natural resources has now become a main issue for global development, as the depletion of natural capital threatens ecological integrity and economic stability (Turnpenny *et al.*, 2009). Over the current decades, the rise of financial mechanism such as green bonds and carbon finance has been transformed environmental governance by providing innovative tools for funding sustainable projects and reducing greenhouse gas emissions (Koval *et al.*, 2021). The effective management of natural resources has been supported by sustainable finance and technological innovation which has therefore become important for achieving long-term environmental sustainability, specifically in developing economies. Therefore, the persistent challenges of government inefficiency and corruption in these economies often hinder the transition of green technologies and successful implementation of sustainable financial instruments (Erum & Hussain, 2019).

Carbon finance specifically, presents a crucial strategy for addressing changes in climate by assigning a financial value to carbon finance reductions and facilitating market-based incentives for emissions control (Bridge *et al.*, 2020). International recognition of carbon finance as an instrument

of policy gained prominence with Paris Agreement (COP21), that focus on alignment of financial flows with pathways towards low-carbon and climate-resilient development (Andresen *et al.*, 2016; Li *et al.*, 2024).

Literature Review

Sustainable management of natural resources has been multifaceted challenge influenced by economic, technological and policy factors. This literature review has integrated the key concepts of carbon finance, digital trade, globalization and natural resources rents within the unifying theoretical frameworks for guiding the empirical analysis.

Carbon Finance

Carbon finance establishes market-based financial mechanisms which is designed for reducing greenhouse gas emissions through tools such as carbon trading and carbon offsets (Mohsin *et al.*, 2021). Mitigation in climate, carbon finance has the implications for natural resource management by incentivising the conservation and sustainable practices which lower the emissions linked with the extraction of resources (Bridge *et al.*, 2020). Theoretically under the Porter hypothesis, the stringent environmental policies such as

those embedded in carbon finance schemes, which could stimulate innovation and improvement in efficiency in use of resources, which enables the sustainable economic growth (Porter & van der Linde, 1995). There are several studies empirically finding a positive relationship between carbon finance activities and sustainable resource outcomes, which suggests the carbon finance mechanism could enhance the economic valuation of natural resources and reduces the overextraction (Koval *et al.*, 2021; Mohsin *et al.*, 2021).

Globalization, Digital Trade, and their Impact on Natural Resources

Globalization has been characterized by an increased economic integration, international trade and capital flows having crucial and complex effects of natural resources. Traditional globalization could derive depletion of resources through scale effects as economies expand their production and consumption (Bhattarai & Hammig, 2001). However, globalization would weaken the domestic environmental regulations due to competitive pressures (Copeland & Taylor, 2004). Digital trade is considered as a subset of globalization enabled by digital technologies, facilitating faster and more efficient cross-border commerce while an improving the transparency in supply chain (Gonzalez & Ferencz, 2018). The environmental influence on digital trade is ambiguous, as digital infrastructure consumes energy but it also promotes green innovations and circular economy practices (Zairis, 2021; Fayyaz, 2018). Thus, the net effect of digital trade on natural resource rents depends on how technological adoption impacts the production and patterns of consumption.

Theoretical Framework: Integrating Carbon Finance, Globalization, and Digital Trade with Natural Resource Rents

Environmental Kuznets Curve (EKC) hypothesizes and provides a basis of theoretical lens that suggests an inverted-U relationship between economic growth and by the extension of globalization and degradation of environment (Grossman & Krueger, 1995). At an earlier stage of globalization and economic integration, natural resources rents would rise due to an increase extraction, however, beyond a threshold better technologies and policies which include carbon finance and digital trade, leading towards resource conservation. The EKC therefore, implies a non-linear and asymmetric dynamics among CF, DT, GLB and TNR variables. Economic evaluation of carbon finance projects traditionally relies on Cost-Benefit Analysis (Mishan & Quah, 2020; Waniak-Michalak *et al.*, 2024; Skare *et al.*, 2024), that evaluates the emission of benefits reduction outweighing the costs of interventions like clean technology investments. However, the significant Cost Benefit Analysis alone insufficient for understanding systematic environmental-economic interactions. The integration of theory of environmental policy instruments, that categorizes market-based instruments like carbon trading as efficient alternatives for direct regulations (Keohane *et al.*, 2019; Zemlickiene *et al.*, 2025; Zhang, 2024), that enhances theoretical rigor. The research has

leverage these theories within non-linear auto-regressive distributed lag (NARDL) framework for modelling asymmetric responses in resource rents to carbon finance and globalization shocks.

The Impact of Digital Trade on Globalization

There is diverse impact of digital trade on globalization as it influences international trade, economic development etc. According to González and Ferencz (2018), digital trade has helped in expansion of market for businesses and help them in reaching out to wider audience in global markets. This has helped organizations to overcome traditional barriers of entry as it is the more advanced form and it reduces the geographical distances. It has helped in increasing the process of trade through streamlining of processes and develops communication strategy in order to stay up to date from any happening taking place around the globe. The enhanced efficiency has resulted in increasing faster exchange of goods. Similarly digital trade has also helped small and medium businesses in reaching global markets and using certain resources in order to compete on a larger level (Zairis, 2021). It has reduced paperwork and the processes are shifted towards digital technology and the work can be done in no time. The security of data is also ensured through certain technologies like block chain, data analytics etc. However the rapid growth of digital trade has certain challenges for traditional system as well as data privacy issues and new regulatory frameworks are required in meeting those challenges.

Carbon Initiatives in Thailand

Carbon markets represent those platforms where organizations involve in carbon credits and get a right for emission of certain amount of greenhouse gases and incentives are given to the businesses in order to reduce the emission (Pigeolet & Van Waeyenberge, 2019). According to Wattanakuljarus (2019), the carbon markets of Thailand have been addressing climate change issues and design strategies that help in the promotion of sustainability. Thailand has implemented certain policies including T-VER (Thailand Voluntary Emission Reduction) that encourages the reduction of carbon emission by providing incentives to participants. It has also participated in international carbon markets including CDM Clean Development Mechanism that include those projects that help in reduction of carbon emission in developing countries. There are certain stakeholders that play important role in achieving sustainability i.e. MONRE (Ministry of Natural Resources and Environment) and TGO (Thailand Greenhouse gas Management Organization) that formulate policies and monitor the emission of carbon in Thailand and many international organizations provide financial assistance in achieving the objective (Arunrat *et al.*, 2021; Ahmed *et al.*, 2025; Yan *et al.*, 2025; Liu *et al.*, 2025). There are certain successful energy projects in Thailand that generate electricity without polluting environment and use solar and wind for producing energy. There are certain limitations of implementing carbon regulations in Thailand including lack of clear guidelines for the projects and limited support of government in executing those projects. Similarly, the major issue is of finance in which there is lack of investment for

such projects and the technical expertise required to monitor such projects is also a challenge. Limited capacity as well as resources in mitigating environmental risk is a threat as it hinders sustainability and impact the projects (Sureeyatanapas *et al.*, 2021; Chau *et al.*, 2024; Zeng *et al.*, 2025).

Sustainable Natural Resource Management Strategies in Thailand

There are certain traditional practices that have been practiced in Thailand for managing natural resources. One of which is agroforestry in which the trees and crops are grown in Thailand in order to develop green environment and these practices help in improving the quality of soil and store water and is also a source of income for most of the farmers (Kittitornkool *et al.*, 2019). Similarly, there are many water conserving techniques being used in Thailand in order to maintain the quality of water and improves the health of the people. There exist knowledge among people for managing natural resources and they are inclined towards those practices that help in promoting cultural and environmental sustainability. The government of Thailand has also taken certain steps in order to enhance the sustainability through the development of natural parks in order to provide a habitat and conserve biodiversity. The government agencies like DNP (Department of National Parks, Wildlife and Plant Conservation) play their role in preserving nature (Sriarkarin & Lee, 2018; Offiong *et al.*, 2024; Che, 2025). Similarly, the government has also implemented policies to promote sustainable forest management and protect forests through certain laws and plan initiatives in reducing deforestation. Thailand has adopted certain activities regarding environmental education and raising sustainability awareness among people that develop a sense of responsibility among people for natural resource management. Hence the natural resource management practices in Thailand involve traditional knowledge as well as collaboration among certain agencies including government and local communities in achieving long term sustainability.

Digital Trade and Advancement of Sustainable Resource Management

Digital technologies can help in gaining sustaining natural resource management through modernized techniques for instance the remote sensing of geographic information helps in monitoring of natural resources i.e. forest, water etc. and helps in identifying the accurate location and also provide information for any changes in the land. According to Balsalobre-Lorente, Abbas, He, Pilar, and Shah (2023), there are smart sensors that help in identifying the quality of water and monitor the natural resources and provide valuable insights for pollution control measurements. Big data analytics process large volume of data that is generated through various sources and the data is analyzed for taking decisions regarding resources allocation and use and also helps in designing future policies. There are certain benefits of e-commerce in sustainability as it enhances supply chain transparency by providing relevant information to all the stakeholders regarding product, processes and manufacturing etc. (Fayyaz, 2018). It also helps in connecting businesses with sustainable suppliers and provides those products that

are environmentally friendly in nature and also design initiatives like product recycling, reuse, waste reduction mechanism etc. Digital trade needs to address issues like data security and protection of consumer data in order to build trust and protect data from any kind of unauthorized access. Government needs to design legal framework for preventing cybercrime activities and enhance trust on digital trade so that more businesses can use this technology (Daza Jaller, Gaillard, & Molinuevo, 2020). Similarly, the policies should be designed for sharing data across borders but at the same time maintaining the security and national interest of the country. There should be exchange of data while maintaining the balance of information that requires privacy. Moreover, the government should design tax policies that are transparent and clear in nature and there should be no discrimination.

Data and Methodology

The goal of this study is analyzing the dynamic association between carbon finance, digital trade, globalization and natural resource management in Thailand. For this purpose, time series data spanning from 2000 to 2022 is collected from different secondary data sources. The model of the study is framed following the studies of Sun, Li, and Wang (2024), Du, Liu, Xu, and Taghizadeh-Hesary (2024) and Tu, Suweis, and D’Odorico (2019) as follows:

$$TNR_t = \beta_0 + \beta_1 CF_t + \beta_2 DT_t + \beta_3 GLOB_t + \beta_4 GDP_t + \varepsilon_t \quad (1)$$

Where, TNR= total natural resources, CF = carbon finance, GLOB= globalization and GDP = Gross Domestic Product per Capita. ε is error term and t shows time subscript. The description of dependent and independent variables is given as follows:

Total Natural Resources (TNR)

For natural resources, the total natural resources rent (as percentage of GDP) which consolidates oil, coal, natural gas, forest and minerals is the dependent variable of the study. We collected its data from the World Development Indicators (WDI).

Carbon Finance (CF)

The first main independent variable of the study is carbon finance. This is measured international financial flows to developing countries for research and development and production of clean generation. The data is extracted from Our World in Data.

Globalization (GLOB)

The second main independent variable is globalization which is measured by using the KOF index of globalization (Hassan *et al.*, 2019). This index takes into account the economic, social and political aspects of all countries. Data of globalization is collected from

Digital Trade (DT)

The third main independent variable is digital trade. This variable is measured by ICT goods exports (% total goods exports) and ICT imports (% total goods imports). The annual data for DT is taken from WDI.

Economic Growth (GDPC)

The control variable added to the study is economic growth. Economic growth is measured using gross domestic product per capita and its data is taken from WDI.

Estimation Technique

Unit Root Tests

First of all, the Augmented Dickey-Fuller (ADF) test proposed by Dickey and Fuller (1979) is applied to check the unit root or stationarity properties of data series. The following equation with intercept is the test statistics which is used to assess the non-stationarity.

$$\Delta Y_t = \alpha + \delta Y_{t-1} + \gamma_1 \Delta Y_{t-1} + \gamma_2 \Delta Y_{t-2} + \dots + \gamma_m \Delta Y_{t-m} + \mu_t \tag{2}$$

where, Δ denotes the difference operator, μ is the error term and t is the time period. The variable investigated for stationarity. The correlation issue between error term and independent variables is corrected through $\gamma_1 \Delta Y_{t-1} + \gamma_2 \Delta Y_{t-2} + \dots + \gamma_m \Delta Y_{t-m}$ in equation (2). The intercept is included in the equation (2) and time-trend T and intercept can be included as follows:

$$\Delta Y_t = \alpha + \lambda T + \delta Y_{t-1} + \gamma_1 \Delta Y_{t-1} + \gamma_2 \Delta Y_{t-2} + \dots + \gamma_m \Delta Y_{t-m} + \mu_t \tag{3}$$

Where, the coefficient of time trend is denoted by λ . The null hypothesis of ADF unit root test assumes that data series has unit root problem, whereas the alternative hypothesis states that data series is stationary.

The second unit root tests which is applied in the present study is the Phillips and Perron (PP) test proposed by (Phillips & Perron, 1988). The dealing of this test with the issues of serial correlation and heteroscedasticity, differentiates this test from the ADF test. PP test eliminates the problem of the serial correlation by ranking the residuals. The test statistics of PP test is as follows:

$$\Delta Y_t = \alpha + \lambda T + \delta Y_{t-1} + \mu_t \tag{4}$$

In above equation (4), μ may have heteroscedasticity and PP test is advantageous over ADF test as this test accounts for this issue. Moreover, no specific lag length is required for the estimation of this test (Mahmood, 2012).

QARDL Approach

The aim of the study is to estimate the relationship between globalization, carbon finance and digital trade and natural resource management. For this purpose, To do so, the QARDL estimation approach introduced by (Cho *et al.*, 2015) is used. The application of the QARDL estimation has several advantages as compared to traditional methods. For instance, the QARDL technique estimates both the short run and long run relationship over a range of quantiles. Moreover, this approach accounts for the conditional distribution of different explanatory variables (Dagar & Malik, 2023). The basic QARDL model is represented as follows:

$$TNR_t = \alpha + \sum_i^p \beta_1 TNR_{t-i} + \sum_i^q \beta_2 CF_{t-i} + \sum_i^r \beta_3 DT_{t-i} + \sum_i^s \beta_4 GLOB_{t-i} + \sum_i^u \beta_5 GDP_{t-i} + \epsilon_t \tag{2}$$

Where TNR_t , $GLOB_t$, DT_t and GDP_t represent the natural resource management, globalization, digital trade and economic growth, respectively. p , q , r , s and u are the respective lags of each variable selected on the basis of Schwarz Information Criterion (SIC). The QARDL model is formulated by adjusting equation (2) to a quantile framework as follows:

$$QTNR_t = \alpha(\tau) + \sum_i^p \beta_1(\tau) TNR_{t-i} + \sum_i^q \beta_2(\tau) CF_{t-i} + \sum_i^r \beta_3(\tau) DT_{t-i} + \sum_i^s \beta_4(\tau) GLOB_{t-i} + \sum_i^u \beta_5(\tau) GDP_{t-i} + \epsilon_t(\tau) \tag{3}$$

where, $\epsilon_t(\tau)$ is the error term and (τ) is the conditional quantile level in equation (3).

Results and Discussion

To begin the estimation of the associations among the variables under consideration, the descriptive statistics of the variables of the study is given in Table 1. CF has the highest mean value of 56577600 and TNR has the lowest mean value 2.194 among all series. GDPC has mean of 5230.28 while DT and GLOB have mean values of 34.79216 and 68.986, respectively. In terms of symmetrical distribution, it can be deduced that GLOB and GDPC are negatively skewed while CF, TNR and DT are positively skewed. Normality of the variables is also checked using Jarque-Bera values which imply that except CF, all variables are normally distributed.

Table 1

Summary Statistics

	TNR	GLOB	GDPC	DT	CF
Mean	2.194	68.986	5230.28	34.79216	0.56577600
Median	2.035	69.863	5403.879	30.96800	7420000
Maximum	3.623097	73.893	6573.44	52.25000	3.240000
Minimum	1.109	62.522	3514.717	26.89000	0.000000
Std. Dev.	0.6566	3.6069	956.2185	7.634839	90371325
Skewness	0.2835	-0.2759	-0.29058	0.959118	1.987991
Kurtosis	2.092	1.8412	1.859569	2.568516	6.044596
Jarque-Bera	1.192	1.7159	1.706606	4.026883	26.12292**
Probability	0.550	0.424	0.426006	0.133528	0.0000
Observations	25	25	25	25	25

In order to ascertain the long-run association between the variables, the unit root tests named ADF and PP tests are performed. The results of both tests are provided in Table 2. According to the outcomes, variables of the study follow mixed order of integration as some of them follow

stationarity at level and other follow stationarity at the first difference.

Table 2

Findings of Unit Root Tests					
Variables	ADF Test			PP-Test	
	I(0)	I(1)	I(0)	I(1)	
TNR	-1.582	-6.654***	-1.397	-6.755***	
CF	-3.990**	-----	-3.988**	-----	
GLOB	-2.752*	-----	-1.860	-8.121***	
DT	-2.747*	-----	-5.766***	-----	
GDP	-1.302	-4.794***	-1.944	-4.798***	

***, ** and * denote significance at 10, 5 and 1%, respectively.

The findings of QARDL approach showing the short and the long run relationship between dependent and independent variables are given in Table 3. First of all, the findings indicate that DT has negative and significant impact on TNR both in the short and long run at different quantiles. This highlights that while DT helps in efficient allocation of resources and access to market, it might also result in patterns of consumption that are unsustainable and environmental degradation. Factors such as the unequal distribution of digital infrastructure, regulatory frameworks, and socio-

economic disparities may contribute to these contrasting effects. This implies that DT helps in efficient allocation of resources and assess to market patterns of consumption that are unsustainable and degradation of environment. Investigation from Tian and Son (2023) are in line with the present study as they also argued that ICT services exports have negative impact on natural resource sustainability. Likewise, the findings are also partially in line with Irfan, Quddus, Shahzad, and Wang (2025) who argued that ICT exports and imports increase CO₂ emissions.

Table 3

Findings of QARDL Model											
Quantiles	Constant		ECM		Long Term				Short-Term		
	(τ)	α _c (τ)	ρ _c (τ)	B _{DT} (τ)	B _{GF} (τ)	B _{GLOB} (τ)	B _{GDP} (τ)	φ ₁ (τ)	ω ₀ (τ)	ψ ₀ (τ)	λ ₀ (τ)
0.25	29.79**	-0.439**	-0.119**	0.000	-0.343*	-0.001	-0.103	0.000	0.0223	0.000	
	(0.007)	(0.043)	(0.030)	(0.963)	(0.062)	(0.992)	(0.131)	(0.387)	(0.860)	(0.931)	
0.50	10.89	-0.253	-0.044	0.000**	-0.145	0.002	-0.082	0.000	0.0927	-0.003	
	(0.234)	(0.3100)	(0.346)	(0.0424)	(0.224)	(0.616)	(0.129)	(0.628)	(0.550)	(0.783)	
0.75	16.48	-0.375*	-0.055	0.000	-2.07	0.000	-0.128**	0.000	-0.139*	-0.0005	
	(0.438)	(0.069)	(0.584)	(0.889)	(0.465)	(0.854)	(0.004)	(0.122)	(0.098)	(0.563)	
0.90	13.76	-1.056***	-0.088	0.000	-0.090	-0.004	-0.120***	0.000***	-0.294***	-0.0015*	
	(0.781)	(0.000)	(0.5777)	(0.898)	(0.902)	(0.815)	(0.000)	(0.000)	(0.000)	(0.054)	

***, ** and * denote significance at 10, 5 and 1 %, respectively.

Secondly, the association between GLOB and TNR is negative and significant in the short and long run at different quantiles. Although these findings are not related with previous studies highlighting the role of globalization to develop environmental sustainability and utilization of resources (Keohane *et al.*, 2019), they are justifiable as the economic integration among countries enhances trade that ultimately needs more resource consumption to fulfill the production needs (Plank *et al.*, 2018). In fact, these economic activities lead to depletion of the natural resources as improvement in trade policies significantly enhances resource consumption (Guo, Meng, Luan, & Wang, 2023). The findings of Guo *et al.* (2023) are in line with the present study who argued that GLOB enhanced natural resource depletion. Similarly, Dou, Wang, Shi, and Sannah Gbolo (2024) favour the findings of the present study by arguing that trade activities negatively impact mineral rents in East Asian countries.

Third, according to the QARDL estimation, the effect of CF is statistically significant and positive at different quantiles in the short run and long run both. This finding is expected as green or carbon financing facilities offer more resources, knowledge and capacity to initiate natural resource management (Dai & Chen, 2023). In addition, green financing promotes mineral resource sustainability by promoting technological advancement and infrastructure construction (Du *et al.*, 2024). From existing studies, Dai

and Chen (2023) strongly support the present study’s outcomes as they also report green investment funds promote efficient resource management in China. Likewise, Du *et al.* (2024) support our findings by reporting that green financing ensures sustainability of mineral resources.

Lastly, the effect of GDP on TNR is also negative and statistically significant at different quantiles in the long and short run both in line with Zambrano-Monserrate and Kostakis (2025) who argued that GDP leads to natural resource depletion. Likewise, Mittal and Gupta (2015) argued that economic growth enhances un-sustainable use of natural resources and therefore support the outcomes of the present study. The negative and significant ECM value, depicted as CointEq(-1), indicates that there is cointegration among the variables, leading to the conclusion that in the long-run, the variables converge to the equilibrium.

Conclusion and Policy Recommendations

This study examines the impact of globalization, digital trade and carbon finance on natural resource management in Thailand. The study used secondary data over 2000 to 2024 period and QARDL model for empirical estimation which shows that the effect of the selected regressors vary over various quantiles. The outcomes of the study showed that digital trade and globalization reduce natural resource management both in the short run and the long run. However,

the impact of carbon finance is positive and significant on natural resource utilization. Thus, this study has provided valuable insights into the complex dynamics of globalization, digital trade, and carbon finance in shaping sustainable natural resource management in Thailand. The findings highlight the significant influence of these factors on total natural resources, with implications for environmental sustainability and policy development.

On the basis of these findings, certain strategies can be adopted and policies can be developed for sustainable resource management i.e. forestation, water management, air pollution control. The findings have critical implications for researchers, practitioners and policymakers to navigate the challenges regarding the globalization and digital transformation for environmental sustainability. First of all, strict laws should be present for environment and prevent any illegal logging and reduce those practices that require illegal extraction of resources (Owen, Brennan, & Lyon, 2018). Local community can participate in sustainable practices and community must be empowered to plan and practice and government needs to invest in sustainable infrastructures that ensure resource efficiency and environment sustainability along with the financial incentives that can be provided to businesses that are practicing sustainability and are adopting those projects that need finances for carbon control practices.

As it is evident that there is negative relationship between natural resource management and digital trade, which arise challenges for the existing models, recommending that the existing mechanisms of digital trade might not effectively provides contribution towards the enhancement of natural resources. The influence of digital trade on sustainable natural resource management recommends the requirement for businesses and policymakers to carefully evaluate the digitalization's role in strategies of resource management. While digital trade shows the opportunities to gain the efficiency and evaluate the market, it may also discuss the patterns of consumption that are not much sustainable and results in degradation of environment. Therefore, the investments in digital technologies must be preferred by the stakeholders that encourages utilization of sustainable resources and practices of conservation like supply chain transparency with help of blockchain or resource monitoring by IoT. As digital trade has negative impact on natural resource management, green digital trade framework must be adopted by the government of Thailand. For this purpose, government must develop environmental standards for trade in digital products and services, such as digital platforms and digital supplies to reveal environmental impacts. Government must integrate eco-certification systems for digital trade. Moreover, life cycle assessment standards must be enforced for digitally traded goods and services, especially industrial and electronic products. Additionally, there is a need to address the potential negative externalities of digital trade, such as e-waste generation and energy consumption, through targeted policy interventions. Moreover, government can provide funds for initiating startups that require digital innovation and provide digital solutions in order to address any environmental challenges. Thailand can implement these strategies in order to enhance sustainable digital trade practices in order to achieve sustainable goals.

Moreover, particular theoretical insights are provided in the current study, regarding the carbon finance integration and development of sustainable resources in Thailand. They research findings have potential implications for policies in Thailand who struggle to encourage the sustainable natural resource management. As there is a positive relationship between natural resources and carbon finance which outlines the requirement for refinement of policies in the sector of carbon finance. Policymakers must have an emphasis on creation of strong regulatory models that improves the environmental integrity, transparency and accountability within the activities of carbon finance. This includes integration of procedure to evaluate the projects regarding carbon offsets to confirm that they deliver accurate advantages to environment.

Thirdly, the negative association between globalization and natural resource management underscores the importance of aligning increasing economic integration with environmental objectives. Policymakers should focus on refining globalization policies to enhance transparency, accountability, and environmental integrity within the natural resource sectors. This involves strengthening environmental regulatory frameworks to ensure that trade activities prioritize long-term environmental sustainability over short-term financial gains. Moreover, policymakers must acknowledge to give incentives to the investments in green technologies and practices that are sustainable via mechanisms of policies like grant, tax incentives and subsidies. By relating the incentives of policies with objectives of environment and implementing the digital technology in a strategic manner, Thailand can enhance a resilient and sustainable strategy to natural resource management, confirming the well-being of society and environment for long run.

Limitations and Directions for Future Research Studies

This study considers various limitations in methodology that may influence its generalizability. Firstly, utilization of QARDL technique, despite of being strong, is based on certain assumptions and not fully captures the relationship complexities. In addition, the dependency on data sources that are secondary might propose significant biases or limitations that are based on processes of data collection. Moreover, the study focuses on Thailand and specific aspects of carbon finance and sustainable resource management imposes limitations on the generalizability of findings to other contexts. The findings may not be applicable to regions with different socio-economic conditions, policy environments, or natural resource management challenges.

Future studies must navigate these imitations by integrating diverse approaches of methodologies involving qualitative research design and longitudinal studies to offer a more detailed knowledge regarding the dynamics in sustainable resource management. Moreover, exploring the role of other determinants like stakeholder's engagement, government structures and cultural contexts, further provides strong understanding regarding the practices of sustainable resource management. In addition, the cross-country analysis can help to recognize the particular context or determinants that impact the effectiveness of carbon finance procedure and provide informed interventions for policies. Further research

is needed to explore the nuanced interactions between digital trade, carbon finance, and resource management, considering the evolving nature of digital technologies and their impact on environmental outcomes. Additionally, policy refinement is crucial to address the shortcomings identified in current

carbon finance mechanisms and to harness the potential of digital trade for sustainable resource management. By addressing these areas, future efforts can contribute to enhancing the effectiveness of policies and strategies aimed at promoting environmental sustainability in Thailand.

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