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Sustainable Development and Climate Change Adaptation in Vietnam (2011-2024)

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ABSTRACT: This study aims to analyse Vietnam's sustainable development pathway in adapting to climate change during the 2011 - 2024 period from the perspectives of resilience and green transition, thereby assessing the extent of structural transformation in its growth model. The research employs policy analysis combined with secondary data on greenhouse gas emissions, energy structure, forest area, and disaster-related losses, alongside a longitudinal trend comparison. The results indicate that Vietnam has made significant progress in institutionalising climate adaptation and expanding renewable energy, as reflected in declining emissions intensity per unit of GDP and a rising share of clean energy. However, total greenhouse gas emissions continue to increase, and the growth model remains reliant on carbon-intensive sectors. The findings suggest that incremental adaptation is insufficient to achieve long-term sustainability goals. A systemic transformation approach- emphasising economic restructuring and institutional reform - is necessary to enhance resilience and ensure sustainable development in the context of escalating climate risks.

KEYWORDS: Sustainable development, climate change, resilience, green transition, Vietnam.

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Introduction

Climate Change and the Sustainable Development Challenge

The Sixth Assessment Report of the Intergovernmental Panel on Climate Change confirms that global warming is occurring at an unprecedented rate, with the global average temperature approximately 1.1°C above pre-industrial levels (IPCC, 2021). The report highlights a marked rise in the frequency and intensity of extreme weather events, including heatwaves, heavy precipitation, tropical cyclones, and prolonged droughts. These changes are no longer considered distant environmental risks but immediate systemic threats to socioeconomic stability.

Climate change represents not only an environmental concern but also a fundamental development challenge, affecting food security, livelihoods, infrastructure resilience, and macroeconomic stability (World Bank, 2022). Developing countries are particularly vulnerable due to limited financial resources, institutional constraints, and high dependence on climate-sensitive sectors such as agriculture and fisheries. Without effective adaptation and structural transformation, climate impacts may reverse decades of development gains.

Vietnam as a Highly Vulnerable Country

Vietnam is widely recognised as one of the countries most vulnerable to climate change. With a coastline exceeding 3,260 kilometres and two major deltas - the Red River Delta and the Mekong River Delta - Vietnam faces significant exposure to sea-level rise and extreme weather events. These regions host dense populations and contribute substantially to the national GDP. According to Dasgupta et al. (2007), a one-meter sea-level rise could affect approximately 12% of Vietnam's land area and 17% of its population.

In Vietnam, natural disasters generate substantial economic losses each year, estimated at approximately 1-1.5% of national GDP (World Bank, 2020). Beyond direct physical damages, climate-related disruptions undermine agricultural productivity, increase infrastructure vulnerability, and exacerbate social inequality. These risks underscore the urgency of integrating climate adaptation into Vietnam's sustainable development strategy.

Research Gap and Theoretical Positioning

A growing body of literature has examined the impacts of climate change and adaptation policies in Vietnam. However, most studies focus either on sector-specific vulnerability assessments or on discrete policy evaluations. There remains limited research that systematically analyses Vietnam's development trajectory through an integrated theoretical framework that combines resilience theory and green transition theory.

Resilience theory conceptualises socio-ecological systems as dynamic structures capable of absorbing disturbances, adapting to environmental changes, and undergoing transformative shifts when existing development pathways become unsustainable (Folke et al., 2010). Meanwhile, the multi-level perspective on sustainability transitions explains how structural changes in socio-technical systems enable the shift toward low-carbon and environmentally sustainable development pathways (Geels, 2011). Integrating these frameworks enables a more comprehensive understanding of whether Vietnam's adaptation efforts represent incremental adjustments or deeper structural transformation.

Addressing this gap is scientifically significant because it enables evaluation not only of policy outputs but also of systemic change. It further contributes to the broader debate on how emerging economies can reconcile rapid economic growth with climate resilience and decarbonization goals.

Research Aim and Research Questions

This study aims to examine Vietnam's sustainable development pathway in adapting to climate change during the period 2011-2024, assessing the extent to which the country has undergone structural transformation from the perspectives of resilience and green transition.

Research Aim

To achieve this aim, the study pursues the following objectives:

- (1) To evaluate Vietnam's progress in integrating climate adaptation into sustainable development strategies between 2011 and 2024.
- (2) To identify structural constraints that limit the effectiveness of green transition and resilience-building efforts.
- (3) To determine the necessary conditions for shifting from incremental adaptation to systemic transformation.

Research Aim and Research Questions

Accordingly, the study addresses three central research questions:

1. What progress has Vietnam achieved in sustainable development adaptation to climate change during 2011-2024?
2. What structural barriers constrain the green transition and resilience-building process?
3. What institutional and economic conditions are required to move from incremental adaptation toward systemic transformation?

Research Results

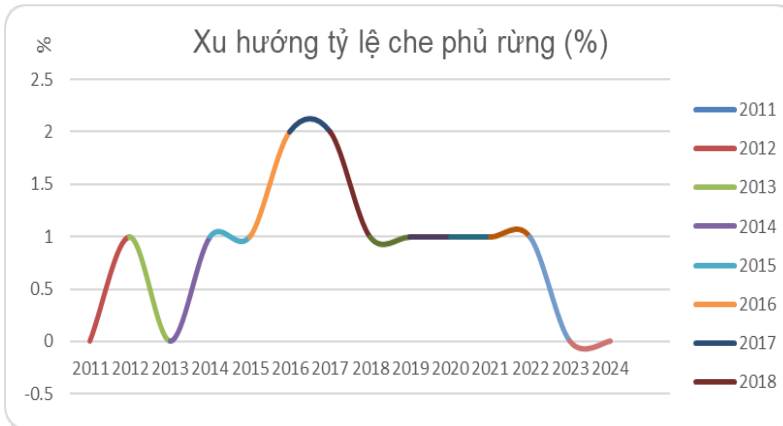
Forest Area Dynamics and Carbon Sequestration Capacity

Forest protection and restoration represent an important component of Viet Nam's climate change mitigation and sustainable development strategies. National policy frameworks on green growth emphasise the expansion and sustainable management of forest resources as a key mechanism to enhance carbon sequestration and ecological resilience (Prime Minister of Viet Nam, 2012; Prime Minister of Viet Nam, 2021). In addition, Viet Nam's updated nationally determined contribution highlights the role of the land use, land-use change and forestry (LULUCF) sector in achieving national greenhouse gas mitigation targets (UNFCCC, 2023).

During the period 2011-2024, Viet Nam recorded a gradual increase in overall forest cover, although the internal structure of forest resources changed considerably between natural forests and planted forests (See Figure 1).

Figure 1

Forest area and forest cover rate in Viet Nam, 2011-2024 (%).



Source: Author's compilation based on data from the Ministry of Agriculture and Rural Development (2012-2024) and Global Forest Watch (n.d.).

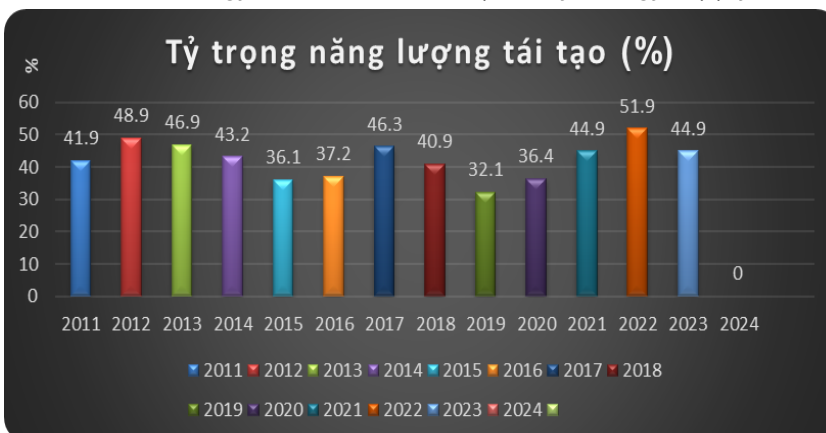
The results indicate that total forest area increased by approximately 1.3 million hectares over twelve years. Nevertheless, the proportion of natural forests declined from around 74% to approximately 67%, while the share of planted forests increased correspondingly. This pattern suggests that forest recovery has largely prioritised quantitative expansion over the restoration of ecological quality. Although forest cover has improved, differences in forest composition and quality remain an important issue for long-term ecosystem resilience and climate mitigation capacity (Global Forest Watch, n.d.; World Bank, 2021).

Energy Structure Transformation and Drivers of Green Transition

The period 2015-2023 witnessed a significant expansion of renewable energy in Viet Nam, particularly in solar and wind power. This development was strongly influenced by feed-in tariff (FIT) mechanisms and policy incentives introduced under the National Green Growth Strategy and subsequent power sector planning frameworks (Prime Minister of Viet Nam, 2012; Ministry of Industry and Trade, 2023) (See Figure 2).

Figure 2.

Share of renewable energy in Viet Nam's total primary energy supply, 2011-2024 (%).



Source: Author's compilation based on data from the Ministry of Industry and Trade (2015, 2020, 2023) and the International Renewable Energy Agency (IRENA, 2021, 2024).

The share of renewable energy—particularly solar and wind—has increased steadily over the past decade, reflecting accelerated deployment after 2018. According to IRENA’s Renewable Capacity Statistics, Viet Nam experienced one of the fastest solar capacity expansions in Southeast Asia during the period 2019-2021 (IRENA, 2021; 2024).

Despite this rapid growth, coal-fired power plants continue to represent a substantial share of the national electricity system. In 2023, coal accounted for roughly one-third of installed power capacity and remained a key source for maintaining electricity supply stability (Ministry of Industry and Trade, 2023). The Updated Nationally Determined Contribution further confirms that fossil fuels still play a significant role in Viet Nam’s current energy structure (UNFCCC, 2023).

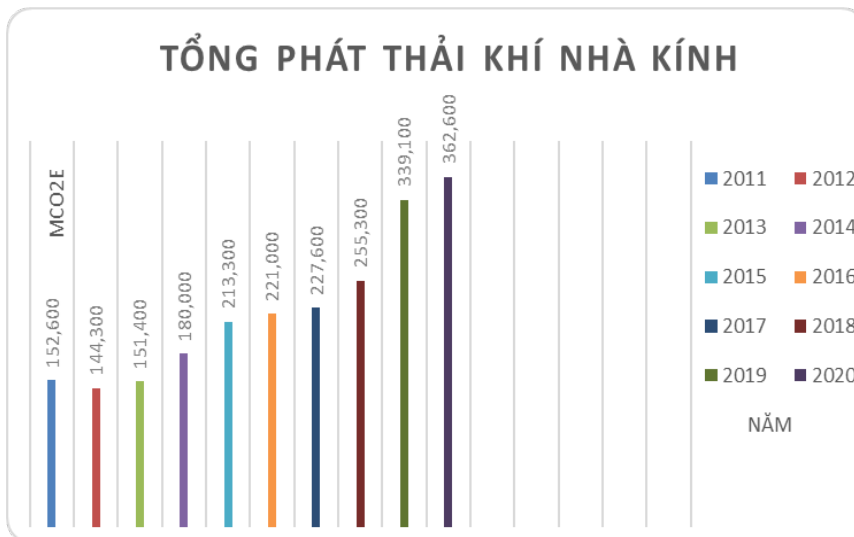
These findings suggest that Viet Nam’s green transition is currently situated at the stage of technological expansion rather than systemic restructuring. While renewable energy capacity has grown rapidly, the structural dependence on coal suggests that a comprehensive transformation of the energy system has not yet been fully realised.

Emissions Trends and the Growth-Carbon Nexus

Despite the rapid expansion of renewable energy, Viet Nam’s total greenhouse gas (GHG) emissions have continued to increase, largely driven by sustained economic growth and industrialisation (see Figure 3).

Figure 3.

Total greenhouse gas emissions in Viet Nam, 2011–2024 (million tons CO₂e).



Source: Author’s compilation based on data from the Ministry of Natural Resources and Environment (2022), UNFCCC (2023), and World Bank (2021).

The results indicate that Viet Nam’s Gross Domestic Product (GDP) increased more than threefold from 2011 to 2024, reflecting rapid economic expansion. During the same period, total GHG emissions rose by approximately 66%. However, emissions intensity per unit of GDP declined from approximately 1.85 to 1.01 tons CO₂e per thousand USD of GDP.

These trends suggest improvements in energy efficiency and carbon productivity. In analytical terms, this pattern reflects relative decoupling, whereby economic growth outpaces emissions growth. Nevertheless, absolute decoupling has not yet been achieved, as total emissions continue to increase alongside economic expansion.

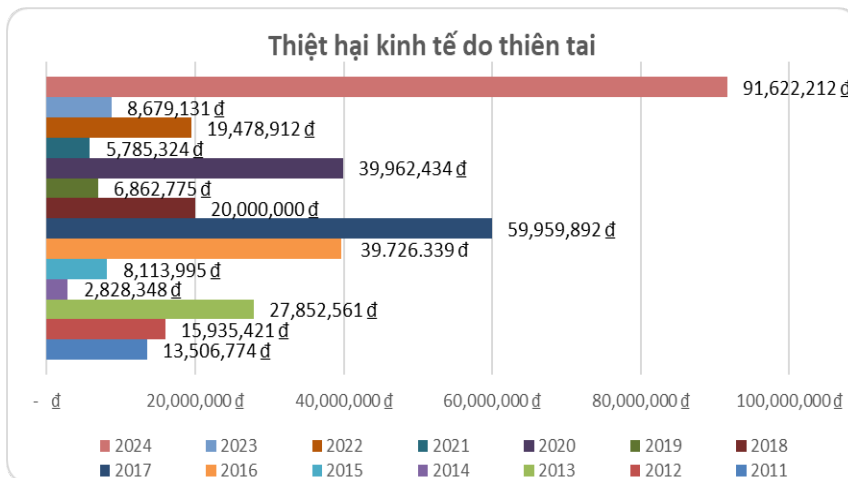
National greenhouse gas inventory reports confirm that the energy sector remains the largest and fastest-growing source of emissions in Viet Nam, reflecting the continued dominance of fossil fuels in the national energy mix (Ministry of Natural Resources and Environment, 2022; UNFCCC, 2023).

From the perspective of green transition theory, these findings indicate that Viet Nam’s climate trajectory currently reflects incremental improvements in efficiency rather than a structural transformation of the development model, as economic growth remains closely linked to energy consumption and industrial expansion (World Bank, 2021).

Economic Losses from Natural Disasters and Limits of Adaptive Capacity (see Figure 4)

Figure 4.

Economic losses from natural disasters in Viet Nam, 2011–2024 (billion VND).



Source: Author’s compilation based on reports from the National Steering Committee for Natural Disaster Prevention and Control (2011 - 2024).

Economic losses from natural disasters fluctuated considerably during the study period, ranging from approximately 1% to 3% of GDP annually (World Bank, 2021). Major extreme weather events—including typhoons, floods, and landslides – have repeatedly caused severe damage to infrastructure, agricultural production, and local livelihoods.

Although public investment in disaster risk reduction and climate adaptation has increased under national climate policies and strategies (Prime Minister of Viet Nam, 2011; Ministry of Natural Resources and Environment, 2022), the magnitude of economic losses does not show a consistent downward trend.

This pattern suggests that while absorptive and adaptive capacities have improved in certain sectors, systemic resilience remains constrained when confronted with increasingly frequent and intense climate shocks. The persistence of substantial disaster-related losses highlights structural limits in adaptive capacity, particularly in vulnerable coastal and mountainous regions (World Bank, 2021).

Vietnam's Position in the Green Transition Process

The findings indicate that Viet Nam has made measurable progress in expanding renewable energy capacity, increasing forest cover, and reducing emissions intensity per unit of GDP. However, total greenhouse gas emissions continue to rise, and coal remains a significant component of the national power mix (Ministry of Industry and Trade, 2023; UNFCCC, 2023).

From a multi-level transition perspective (Geels, 2011), sustainability transitions typically evolve from niche experimentation to regime expansion and eventually systemic restructuring. The Vietnamese case suggests that the transition has moved beyond the early experimentation phase and entered a stage of technological scaling, particularly in solar and wind power development. Nevertheless, several structural elements - such as fossil fuel dependence, grid infrastructure constraints, and industrial growth patterns- remain largely unchanged.

This configuration reflects an intermediate transition stage in which new and incumbent energy systems coexist. The persistence of coal-based infrastructure increases the risk of carbon lock-in, potentially constraining long-term decarbonization pathways. Without deeper institutional and structural reforms, technological expansion alone may not be sufficient to achieve a comprehensive systemic transformation.

Resilience: From Absorptive to Transformative Capacity

Applying the resilience framework (Folke et al., 2010), the empirical results reveal differentiated capacities across three dimensions.

First, absorptive capacity has improved through forest expansion and increasing public investment in disaster risk reduction and climate adaptation. National greenhouse gas inventory reports indicate that the land use, land-use change and forestry (LULUCF) sector continues to function as a net carbon sink in Viet Nam, thereby contributing to national mitigation efforts (Ministry of Natural Resources and Environment, 2022).

Second, adaptive capacity is reflected in policy adjustments and institutional responses, including renewable energy incentives and the implementation of national green growth strategies (Prime Minister of Viet Nam, 2012). The rapid expansion of solar and wind power since the late 2010s demonstrates increasing institutional responsiveness to emerging climate and energy challenges.

However, transformative capacity remains limited. Economic growth continues to rely heavily on energy-intensive industrial production and rapidly expanding electricity demand. The absence of absolute decoupling between greenhouse gas emissions and economic growth indicates that the structural drivers of emissions remain embedded in the current development model.

Overall, the findings suggest that while Viet Nam has strengthened absorptive and adaptive capacities, transformative capacity—defined as the ability to restructure socio-economic systems toward low-carbon development fundamentally—has not yet been fully realised.

The Growth-Emission Paradox

The study identifies a pattern of relative decoupling, in which emissions intensity declined substantially while total greenhouse gas emissions continued to increase during the period 2011–2024 (Ministry of Natural Resources and Environment, 2022; UNFCCC, 2023). Empirical estimates indicate that total emissions increased by approximately two-thirds over the study period.

This outcome reflects a common structural paradox observed in many emerging economies. Economic growth creates fiscal space for green investment and technological upgrading, but it simultaneously expands energy consumption and material demand. In the Vietnamese context, improvements in carbon productivity have not yet offset the scale effects associated with rapid GDP growth.

Consequently, absolute decoupling – defined as a situation in which total emissions decline while economic output continues to grow – has not yet been achieved. This suggests that efficiency improvements alone are insufficient to meet long-term climate targets. Structural transformations in production systems, energy infrastructure, and consumption patterns will likely be required to align economic development with the country's net-zero commitments.

Limits of Incremental Adaptation

Economic losses associated with natural disasters have remained substantial over the past decade. Available data indicate that disaster-related damages in Viet Nam typically range from approximately 1% to 3% of GDP annually, reflecting persistent exposure to climate-related shocks (National Steering Committee for Natural Disaster Prevention and Control, 2012-2024; World Bank, 2021).

Current adaptation measures—including infrastructure reinforcement, early warning systems, and forest restoration—primarily represent incremental adjustments within the existing development framework. While such measures contribute to short-term risk reduction and resilience enhancement, they may not sufficiently address systemic or non-linear climate risks.

In this context, transformative adaptation—involving structural policy reforms such as climate-integrated spatial planning, livelihood diversification, and long-term climate mainstreaming into development strategies—may be necessary to reduce underlying vulnerability.

Viet Nam in Comparative Perspective

In regional terms, Viet Nam has emerged as one of the fastest-growing renewable energy markets in Southeast Asia, particularly in solar power deployment since 2018 (IRENA, 2024).

At the same time, rising per capita emissions and continued dependence on coal-fired power generation distinguish the country from economies that have already initiated deeper decarbonization pathways. This dual dynamic reflects the structural tensions between rapid industrialisation and long-term climate mitigation.

As both a climate-vulnerable country and a rapidly industrialising emitter, Viet Nam occupies a critical position in the global transition landscape. Its capacity to reconcile sustained economic growth with structural decarbonization will carry broader implications for other emerging economies confronting similar development constraints.

Policy implications

The empirical findings indicate that Viet Nam's current transition trajectory remains largely incremental. Moving toward a systemic transformation, therefore, requires policy orientations that address structural drivers of emissions and vulnerability rather than relying primarily on isolated technical interventions.

A critical priority involves the effective implementation of carbon pricing mechanisms accompanied by robust measurement, reporting, and verification systems. By internalising the environmental costs of emissions, such mechanisms can create stronger incentives for low-carbon investment and facilitate progress toward absolute decoupling of economic growth from greenhouse gas emissions.

Equally important is the restructuring of the national energy system. While the rapid expansion of solar and wind power represents a significant step forward, long-term decarbonization will depend on gradually reducing structural dependence on coal-based electricity generation. Achieving this transition requires coordinated investment in grid modernisation, transmission infrastructure, and energy storage capacity to accommodate increasing shares of variable renewable energy (Ministry of Industry and Trade, 2023).

Forest governance also plays a strategic role in climate mitigation. Current policy outcomes suggest that the growth of planted forests has largely driven forest expansion, whereas natural forests continue to decline in relative proportion. A more balanced policy approach should therefore emphasise ecological restoration and the protection of natural forest ecosystems, which provide higher biodiversity value and greater long-term carbon sequestration capacity.

Strengthening climate resilience further necessitates the systematic integration of climate risk considerations into regional and local development planning. Subnational governance levels remain particularly vulnerable to extreme climate events, highlighting the importance of embedding climate adaptation into spatial planning, infrastructure investment, and livelihood diversification strategies (World Bank, 2021).

Finally, the mobilisation of climate finance—both domestic and international—represents a key enabling condition for large-scale transformation. However, financial expansion alone is insufficient. Ensuring the effective utilisation of climate resources requires improvements in institutional transparency, governance capacity, and policy coordination across sectors.

Taken together, these policy directions suggest that progressing from incremental adaptation toward a transformative green transition will depend on coordinated institutional reform, structural economic adjustment, and sustained innovation within the national development strategy.

Conclusions

Between 2011 and 2024, Viet Nam achieved notable progress in several dimensions of climate-related development. Renewable energy capacity expanded rapidly, forest cover increased, and emissions intensity relative to economic output declined. These developments indicate measurable advances toward a greener development pathway.

Despite these improvements, important structural challenges remain. Total greenhouse gas emissions have continued to rise alongside rapid economic growth, while disaster-related economic losses remain significant. Such patterns reveal that efficiency gains and technological deployment alone have not yet translated into a comprehensive transformation of the development model.

The empirical evidence suggests that Viet Nam currently occupies an intermediate stage in the sustainability transition process. This stage is characterised by relative decoupling between emissions and economic growth, as

well as incremental forms of climate adaptation, rather than by a fully systemic restructuring of production and energy systems.

Achieving the national commitment to net-zero emissions by 2050 will therefore require bigger structural changes that extend beyond technological upgrades or efficiency improvements. Long-term progress will depend on comprehensive energy system restructuring, economic diversification toward lower-carbon sectors, and the strengthening of transformative institutional capacity.

More broadly, the Vietnamese experience illustrates a fundamental dilemma faced by many developing economies. Rapid industrialisation and economic growth remain essential for improving living standards, yet these objectives must increasingly be reconciled with the urgent demands of climate mitigation and adaptation. Navigating this tension will be central to determining whether emerging economies can pursue sustainable development within an increasingly unstable global climate system.

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