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EVALUATING GREEN GROWTH PERFORMANCE AT THE LOCAL LEVEL: EMPIRICAL EVIDENCE FROM PHU THO PROVINCE, VIETNAM

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Abstract. This study examines how Vietnam's National Green Growth Strategy is operationalized at the provincial level, using Phu Tho Province as an empirical case to evaluate economic, environmental, and social outcomes of green growth implementation. Employing an implementation-focused mixed-methods design, the research integrates secondary quantitative data with systematic policy and institutional analysis to assess green growth outcomes across agriculture, industry, energy, and tourism during the period 2010–2024. The analytical framework is grounded in the Triple Bottom Line approach, enabling an evaluation of economic performance, environmental sustainability, and social inclusiveness through harmonized indicators aligned with national strategies and international benchmarks. The results reveal that Phu Tho has achieved measurable progress in rural income enhancement, expansion of ecotourism linked to OCOP value chains, improvements in energy efficiency, and increased deployment of renewable energy. These outcomes suggest an emerging pattern of relative decoupling between economic growth and resource use at the subnational level. However, the analysis also identifies persistent constraints related to green finance readiness, institutional fragmentation, and uneven technical capacity, which limit the scalability and durability of green growth initiatives. The study contributes to the green growth literature by proposing a practical framework for operationalizing green growth at the provincial level and by empirically linking policy design, institutional coordination, and development outcomes. It further demonstrates that theory-informed descriptive analysis, based on secondary data and policy triangulation, can yield robust insights into subnational green growth pathways in developing-country contexts.

Keywords: green growth, sustainable development, circular economy, renewable energy, eco-industrial parks, digital agriculture, OCOP, green finance

1. Introduction

Over the past two decades, the concept of green growth has emerged as an important policy framework for addressing the complex challenges associated with economic development, environmental degradation, and social inequality. Rapid economic expansion in many developing and emerging economies has contributed significantly to

improvements in income and living standards; however, it has also intensified pressures on natural resources, ecosystems, and climate systems. As a result, policymakers and international organizations increasingly emphasize development strategies that integrate economic growth with environmental sustainability and social inclusiveness [1, 2].

Green growth aims to promote economic development while ensuring that natural capital continues to provide essential ecosystem services that support human well-being. Unlike conventional growth models that often treat environmental protection as a constraint on economic expansion, green growth emphasizes improving resource efficiency, reducing pollution and greenhouse gas emissions, and fostering innovation in environmentally sustainable sectors [3]. This approach has gained global attention as countries seek to balance economic competitiveness with environmental stewardship in the context of climate change and sustainable development goals.

International organizations such as the World Bank and the Organisation for Economic Co-operation and Development (OECD) have played a key role in shaping the global discourse on green growth. The OECD introduced the concept as part of its strategy to support sustainable economic development by improving environmental and resource productivity while maintaining economic prosperity [1]. Similarly, the World Bank promotes the concept of inclusive green growth, which emphasizes the need to integrate environmental sustainability with poverty reduction and social equity [2]. In developing economies, where economic transformation often occurs alongside environmental degradation and social disparities, inclusive green growth provides a policy framework for achieving long-term sustainable development.

In recent years, many countries have incorporated green growth principles into national development strategies and policy frameworks. Governments increasingly recognize that transitioning toward low-carbon and resource-efficient development models is essential for maintaining economic resilience, protecting ecosystems, and improving quality of life. However, while green growth strategies are often formulated at the national level, their successful implementation largely depends on the capacity of local and regional governments to translate policy objectives into concrete development programs and sectoral interventions.

In Vietnam, green growth has become an important component of the country's sustainable development strategy. As one of the fastest-growing economies in Southeast Asia, Vietnam has experienced significant structural transformation, industrialization, and

urbanization over the past three decades. These processes have contributed to rapid economic growth and poverty reduction but have also generated increasing environmental pressures, including air and water pollution, land degradation, and rising greenhouse gas emissions. Recognizing these challenges, the Vietnamese government has gradually integrated green growth principles into its national policy framework.

A major milestone in this process was the adoption of the National Green Growth Strategy for the period 2011–2020 with a vision to 2050, approved by the Prime Minister under Decision No. 1393/QĐ-TTg in 2012. This strategy marked the first comprehensive attempt to incorporate green growth into Vietnam's national development planning by promoting resource-efficient production, reducing greenhouse gas emissions, and encouraging sustainable consumption patterns [4]. The strategy also emphasized the importance of technological innovation, institutional reforms, and environmental governance in supporting the transition toward a greener economy.

Building on the initial strategy, the government later introduced the National Green Growth Strategy for the period 2021–2030 with a vision to 2050, approved under Decision No. 1658/QĐ-TTg [5]. This updated strategy reflects Vietnam's stronger commitment to sustainable development and climate change mitigation, particularly in the context of global environmental challenges and international climate agreements. The strategy sets ambitious targets for reducing greenhouse gas emission intensity, improving energy efficiency, expanding renewable energy development, and promoting sustainable infrastructure and production systems. In addition, the strategy highlights the importance of green investment, technological innovation, and institutional coordination in supporting green economic transformation.

To implement these strategic objectives, the government adopted the National Action Plan on Green Growth for the period 2021–2030 under Decision No. 882/QĐ-TTg [6]. This action plan provides detailed guidance for ministries, sectors, and local governments to integrate green growth goals into socio-economic development planning and sectoral policies. Key priorities include greening economic sectors, promoting circular economy practices, improving energy efficiency, and strengthening environmental governance. Furthermore, Vietnam has strengthened its environmental regulatory framework through the Law on Environmental Protection 2020, which introduces new mechanisms such as carbon market development, environmental impact assessment reforms, and policies encouraging circular economy models [7].

While these national policies provide an important institutional foundation for green growth, the implementation of green growth strategies largely occurs at the subnational level. Provincial governments are responsible for integrating national policy objectives into local development plans, managing land and natural resources, and overseeing sectoral economic activities such as agriculture, industry, energy, and tourism. Consequently, evaluating green growth implementation at the provincial level is essential for understanding how national sustainability strategies are translated into practical development outcomes.

Phu Tho Province provides a relevant case for examining these dynamics. Located in the northern midland region of Vietnam, Phu Tho has experienced rapid socio-economic development in recent years, characterized by expanding industrial production, agricultural modernization, infrastructure development, and growing tourism activities. These sectors represent important drivers of regional economic growth but also generate environmental and social challenges related to resource use, pollution, and rural livelihoods. In response, provincial authorities have gradually incorporated green growth principles into local development strategies. Phu Tho's socio-economic development plans emphasize sustainable agricultural practices, cleaner industrial production, renewable energy development, and eco-tourism promotion. The province has also implemented programs aimed at forest conservation, environmental monitoring, and green urban development. These initiatives reflect local efforts to align provincial development strategies with Vietnam's broader national green growth agenda.

Despite these policy initiatives, the implementation of green growth at the provincial level still faces several challenges, including limited financial resources, technological constraints, and institutional coordination gaps across sectors and administrative levels. Moreover, empirical research examining how green growth strategies are operationalized at the local level in Vietnam remains relatively limited. Existing studies often focus on national policy frameworks or specific environmental sectors, leaving a gap in understanding how green growth policies interact with sectoral development dynamics at the provincial scale. To address this gap, this study examines the implementation of green growth in Phu Tho Province by analyzing development outcomes across four key sectors: agriculture, industry, energy, and tourism. These sectors play central roles in regional economic transformation while simultaneously influencing environmental sustainability and social well-being. By evaluating the interactions between sectoral development policies

and sustainability outcomes, the study contributes to the growing literature on green growth governance and regional sustainable development in emerging economies.

2. Theoretical framework for evaluating green growth at the local level

Green growth has emerged as an important policy paradigm aimed at reconciling economic development with environmental sustainability and social well-being. Unlike traditional growth models that prioritize economic expansion without fully considering ecological constraints, green growth emphasizes improving resource efficiency, reducing environmental risks, and ensuring that economic progress contributes to inclusive and sustainable development outcomes. International organizations, particularly the OECD and the World Bank, have played a central role in conceptualizing green growth and developing analytical frameworks for measuring its implementation and impacts.

The OECD defines green growth as a development pathway that fosters economic growth while ensuring that natural assets continue to provide the resources and environmental services essential for human well-being [1]. In this framework, economic prosperity must be achieved alongside the sustainable management of ecosystems and natural resources. To operationalize this concept, the OECD developed the Green Growth Indicators framework, which evaluates development performance through multiple dimensions, including resource productivity, environmental quality of life, natural asset preservation, and economic opportunities generated through green investment and innovation [3]. These indicators provide a structured approach for assessing whether economic development trajectories are becoming more resource-efficient and environmentally sustainable.

Complementing this perspective, the World Bank emphasizes the concept of inclusive green growth, which integrates environmental sustainability with poverty reduction and social equity. According to the World Bank, green growth policies should simultaneously promote economic development, reduce environmental risks, and improve the resilience of vulnerable populations [2, 8]. In many developing economies, rapid industrialization and urbanization have generated economic opportunities but also increased environmental pressures and social inequalities. Inclusive green growth therefore requires policy interventions that combine economic productivity with ecosystem protection and livelihood improvement, supported by effective governance and institutional capacity.

To evaluate these multidimensional objectives, sustainability research frequently adopts the Triple Bottom Line (TBL) approach, originally proposed by Elkington [9]. The TBL framework evaluates development outcomes across three interconnected dimensions: economic performance, environmental sustainability, and social inclusiveness. Unlike traditional evaluation frameworks that focus primarily on financial outcomes, the TBL perspective highlights the need for balanced progress across economic systems, environmental resources, and social well-being. As a result, the framework has become widely used in sustainability and green growth assessments at different governance levels.

Within the context of green growth analysis, the economic dimension typically reflects productivity improvements, investment, and value creation. The environmental dimension focuses on resource efficiency, emissions reduction, and ecosystem protection, while the social dimension captures employment generation, income distribution, and community participation in development processes. By integrating these dimensions, the TBL framework provides a comprehensive analytical structure for assessing the outcomes of green growth policies across sectors and regions. The application of the TBL framework is particularly relevant at the subnational level, where provincial and local governments play a critical role in implementing national sustainability strategies. Local authorities are responsible for land-use planning, industrial development, infrastructure investment, and natural resource management. These responsibilities directly influence how economic activities interact with environmental systems and local communities. Consequently, evaluating green growth performance at the provincial level requires analytical frameworks capable of capturing both sectoral development patterns and governance dynamics.

Building on OECD and World Bank frameworks, this study applies the TBL approach to evaluate green growth implementation across four key sectors: agriculture, industry, energy, and tourism. These sectors represent the primary drivers of economic transformation in many developing regions while also generating significant environmental and social impacts. Agriculture is particularly important for inclusive green growth because it directly affects rural livelihoods, food security, and land-use sustainability. International studies emphasize that sustainable agricultural development should focus on productivity improvements, sustainable land management, and the integration of farmers into value-added supply chains [3, 8]. Industrial development, meanwhile, presents both opportunities and challenges for green growth. While

industrialization contributes to economic expansion, it can also increase environmental pressures through energy consumption and pollution. International policy frameworks therefore promote cleaner production technologies, eco-industrial parks, and circular economy practices to reduce resource intensity [10, 11].

Energy systems also play a central role in green growth because energy production and consumption are closely linked to greenhouse gas emissions and environmental degradation. Transitioning toward renewable energy sources and improving energy efficiency are therefore key priorities in international green growth frameworks [3, 8]. Similarly, tourism has emerged as a promising sector for inclusive green growth, particularly in regions rich in natural and cultural heritage resources. Sustainable tourism development can generate economic opportunities while supporting environmental conservation and community-based livelihoods [12].

Based on these theoretical foundations, this study develops an analytical framework that integrates OECD and World Bank green growth principles with the Triple Bottom Line approach to evaluate development outcomes across agriculture, industry, energy, and tourism. The framework enables a multidimensional assessment of economic productivity, environmental sustainability, and social inclusion at the provincial level. By applying this framework to the case of Phu Tho Province, the study provides empirical insights into how national green growth strategies are translated into sectoral policies and development outcomes at the subnational level.

Figure 1 presents the conceptual framework used to analyze the localization of Vietnam's National Green Growth Strategy at the provincial level. The framework illustrates a sequential linkage from national policy instruments to provincial governance and institutional mechanisms, which mediate the implementation of sectoral green interventions across agriculture, industry, energy, and tourism. These interventions jointly generate measurable outcomes along the Triple Bottom Line dimensions of economic performance, environmental sustainability, and social inclusiveness. Empirically, the framework is operationalized through secondary data analysis and systematic policy document triangulation, demonstrating how institutional coordination and sectoral integration at the subnational level translate strategic objectives into observable development outcomes. The framework thus provides an analytical basis for assessing green growth implementation in data-constrained provincial contexts.

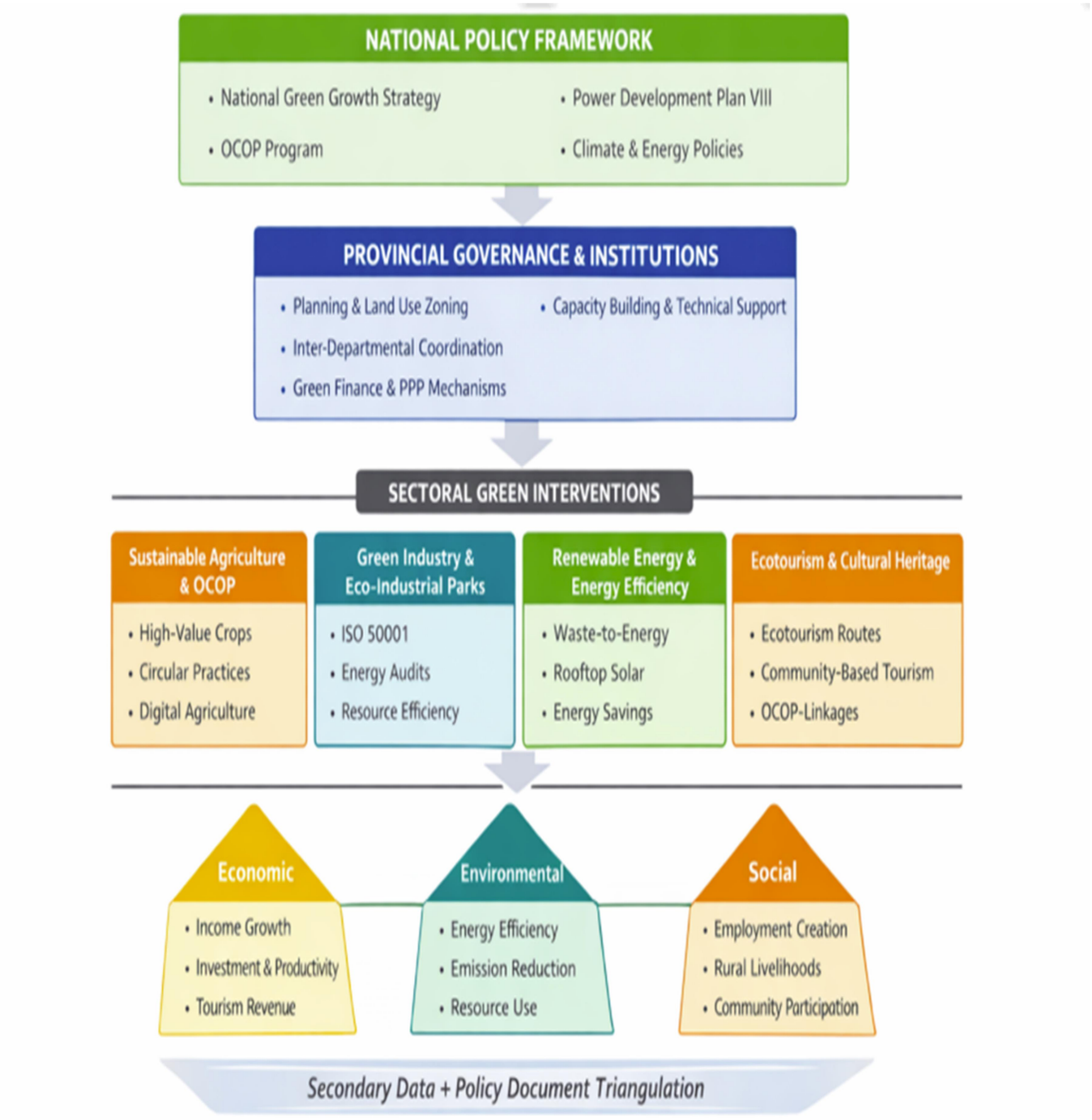

Figure 1. Analytical framework for evaluating provincial green growth performance based on the OECD green growth indicators, the World Bank inclusive green growth framework, and the Triple Bottom Line approach

Source: Authors' conceptualization based on OECD [3] and World Bank [8]

3. Materials and Methods

This study employs a mixed-methods case study approach to examine the localization and implementation of Vietnam's National Green Growth Strategy at the provincial level, using Phu Tho Province as an empirical case. Given the policy-oriented objective of this study, the analysis prioritizes implementation effectiveness and institutional coherence over causal inference. The methodological focus is therefore placed on theory-informed descriptive assessment and policy triangulation, which is consistent with established approaches in subnational governance and green growth evaluation [12, 13]. The analytical framework developed in Section 2 is operationalized using the Triple Bottom Line (TBL) approach, integrating economic, environmental, and social dimensions of green growth [9]. Green growth is operationalized through three interrelated pillars: (i) economic performance, reflected in income growth, tourism revenue, investment, and productivity; (ii) environmental sustainability, measured by renewable energy deployment, energy efficiency improvements, and resource-use efficiency; and (iii) social inclusiveness, assessed through employment creation, rural income enhancement, and community participation in OCOP-linked value chains. Indicator selection aligns with Vietnam's National Green Growth Strategy 2021–2030, the Power Development Plan VIII, and international frameworks [3, 8].

The study relies primarily on secondary data from official sources, including provincial socio-economic reports (2023–2025), sectoral statistics from the General Statistics Office of Vietnam, energy data from the Ministry of Industry and Trade and the Vietnam National Energy Efficiency Center, and agricultural and OCOP databases. These data cover the period 2018–2024, enabling longitudinal and sectoral analysis. In parallel, a structured policy document review was conducted to assess coherence between provincial initiatives and national strategies across land-use planning, green growth action plans, eco-industrial park development, and tourism–OCOP integration.

Quantitative indicators were compiled across four thematic domains: sustainable agriculture, green industrial development, renewable energy and energy efficiency, and ecotourism-led inclusive growth. Where relevant, compound indicators such as growth rates and energy savings were calculated using official methodologies. Data analysis combines descriptive statistics, comparative temporal analysis (pre- and post-2021), and qualitative content analysis of policy documents. Triangulation across data sources and methods was applied to enhance internal validity [14].

Table 1. Evaluation criteria for green growth assessment at the provincial level

Sector	Economic Dimension	Environmental Dimension	Social Dimension
Agriculture	Agricultural productivity, OCOP product value, value chain development	Sustainable land use, reduced chemical inputs, circular agriculture practices	Rural income growth, employment in agricultural value chains
Industry	Industrial output, investment in eco-industrial parks, FDI attraction	Energy efficiency improvements, waste treatment, cleaner production	Job creation, skills development, compliance with labor standards
Energy	Energy supply diversification, renewable energy investment	Renewable energy share, energy efficiency, electricity savings	Access to reliable energy, reduced energy costs for enterprises
Tourism	Tourism revenue, tourism investment	Conservation of natural resources, eco-tourism development	Community participation, income from tourism-linked activities

Source: Authors' conceptualization drawing on OECD green growth indicators, World Bank's inclusive green growth, and the Triple Bottom Line framework, adapted to Vietnam's provincial context

A key limitation is the reliance on secondary data, which constrains causal inference at the micro level. However, the integration of multi-source quantitative indicators and policy analysis provides a robust and policy-relevant assessment of provincial green growth implementation.

4. Results and Discussion

4.1. Economic transformation and inclusive growth

To better understand the role of green growth in Phu Tho's development trajectory, it is necessary to examine the province's economic performance and structural

transformation over time. Longitudinal analysis of gross regional domestic product (GRDP) growth and sectoral restructuring provides an empirical basis for assessing whether economic expansion has been accompanied by shifts toward higher value-added and more resource-efficient activities.

During the past decade, Phu Tho has maintained relatively stable economic growth while undergoing gradual structural transformation. As shown in Table 2, the province recorded an average GRDP growth rate of approximately 7.1% per year during 2016–2020, which increased to around 7.8% annually in the 2021–2024 period, despite the economic disruptions caused by the COVID-19 pandemic. This growth trajectory reflects both industrial expansion and the rapid development of the service sector, particularly tourism and trade-related activities.

Table 2. GRDP growth and economic structure of Phu Tho Province

Indicator	2010	2015	2020	2024
GRDP growth rate (%)	7.3	7.0	7.1	7.8
Agriculture, forestry & fisheries (%)	23.4	21.0	19.8	18.4
Industry & construction (%)	29.1	35.5	40.2	42.5
Services (%)	40.7	39.5	38.7	39.1

Source: [15, 16, 17, 18]

More importantly, economic growth has been accompanied by a gradual restructuring of the provincial economy. The share of agriculture, forestry, and fisheries declined significantly, while the industry–construction sector emerged as the primary driver of growth, and services expanded steadily. This structural transition is consistent with broader development patterns observed in Vietnam's regional economies, where industrialization and service-sector expansion increasingly replace agriculture as the main engines of economic growth. The data indicate a clear shift toward industrial and service-based economic activities. Between 2010 and 2024, the share of industry and construction increased by more than 13%, reflecting strong growth in manufacturing, infrastructure development, and industrial park investment. At the same time, the agriculture sector's contribution declined gradually, not because of contraction but due to productivity improvements and structural diversification.

Within the industrial sector, growth has been driven primarily by manufacturing activities, foreign direct investment (FDI) projects, and the development of industrial parks such as Phu Ha and Cam Khe. These investments have significantly increased provincial industrial output and export capacity. Meanwhile, the service sector has expanded through tourism, logistics, and commercial services linked to regional economic integration.

From a green growth perspective, this structural transformation has important implications. Economic upgrading from primary production toward value-added manufacturing, services, and tourism can potentially reduce the environmental intensity of economic growth if accompanied by improvements in energy efficiency, cleaner production technologies, and sustainable resource management. In the case of Phu Tho, this transformation provides the economic foundation for implementing green growth policies across key sectors such as agriculture, industry, energy, and tourism.

Despite its declining share, agriculture remains central to inclusive growth through internal diversification and integration into value chains. High-value crops and branded products increasingly underpin rural livelihoods. Table 3 summarizes key indicators of agricultural and craft village development in 2024. Tea cultivation covered 15,700 ha, producing approximately 180,000 tons of fresh tea leaves processed through a dense network of 59 large-scale facilities, 1,280 small-scale processors, 15 cooperatives, and 18 craft villages. Pomelo cultivation reached 5,593 ha with an annual output of 52,000 tons, reinforcing its role as a flagship OCOP product with growing market penetration. Rice production remained stable at 319,000 tons in 2023, ensuring food security while benefiting from ongoing irrigation upgrades. In parallel, 75 recognized craft villages specializing in bamboo, rattan, and medicinal plants were integrated into OCOP and tourism value chains, generating supplementary income for rural households.

Rather than relying on agricultural expansion, Phu Tho's strategy emphasizes productivity improvements, processing capacity, and market integration. This pattern aligns with green growth principles that prioritize value creation over resource intensification and supports relative decoupling between agricultural income growth and land use [8]. Compared with provinces where agricultural growth remains input-driven, Phu Tho demonstrates a more advanced model of rural economic upgrading linked to institutional programs such as OCOP. This pattern of income improvement through resource-based livelihood upgrading is consistent with previous community-level evidence from Vietnam, where green growth pathways are closely linked to ecosystem services and

household adaptive strategies rather than purely industrial expansion [20, 21]. At the subnational level, economic transformation in Phu Tho reflects a form of relative decoupling, in which income gains coexist with controlled resource use—an outcome frequently observed in local livelihood-based green growth models in Vietnam [13, 22].

Table 3. Key indicators of agriculture and craft villages in Phu Tho Province in 2024

Indicators	Value
Tea cultivation area (ha)	15,700
Fresh tea leaf output (tons)	180,000
Large-scale processing facilities (number)	59
Small-scale processing facilities (number)	1,280
Pomelo cultivation area (ha)	5,593
Fresh pomelo output (tons)	52,000
Rice output (tons)	319,000
Number of recognized craft villages	75

Sources: Phu Tho Provincial Statistics Office [19]

Tourism has emerged as a complementary pillar of inclusive economic transformation, strengthening linkages between services, agriculture, and cultural industries. Leveraging Xuan Son National Park and the Hung Kings Temple Historical Site, Phu Tho has positioned ecotourism and heritage tourism as engines of local growth. As shown in Table 4, tourism revenue reached VND 4.13 trillion in 2024, representing a 22% increase compared to 2023, while average annual tourist arrivals during 2011–2024 stood at approximately 7 million visits. Investment in tourism infrastructure amounted to VND 5.8 trillion by 2020 and is projected to increase to VND 13 trillion by 2030, indicating sustained policy commitment and investor confidence.

Importantly, tourism development in Phu Tho is not pursued as an enclave sector. Instead, it is explicitly linked to agricultural products and craft villages through themed tourism routes and OCOP-based experiences. This integrated approach enhances local

value capture, expands non-farm employment opportunities, and reduces rural income vulnerability. Such cross-sectoral integration is increasingly recognized in the literature as a key mechanism for inclusive green growth at the subnational level [3, 8].

Table 4. Tourism and investment indicators in Phu Tho Province

Indicators	Value
Average annual number of tourist arrivals (2011–2024, million visits)	7.0
Tourism revenue in 2024 (VND trillion)	4.13
Revenue growth (2024 compared to 2023, %)	22
Total investment up to 2020 (VND trillion)	5.8
Planned investment up to 2030 (VND trillion)	13

Sources: Phu Tho Provincial People's Committee [23]

From a theoretical perspective, the observed structural transformation in Phu Tho Province aligns with the green growth literature emphasizing diversification rather than sectoral substitution [3]. Unlike conventional industrialization pathways that prioritize rapid manufacturing expansion, Phu Tho's growth trajectory reflects a hybrid model in which high-value agriculture, craft-based rural industries, and tourism expand alongside industrial development. This pattern supports the notion of "inclusive structural change," whereby economic upgrading is accompanied by income opportunities for smallholders and rural communities [8]. Compared to provinces with growth driven predominantly by heavy industry, Phu Tho demonstrates a more balanced transformation consistent with green growth principles at the subnational level.

4.2. Environmental performance and decoupling dynamics

Beyond economic restructuring, assessing the environmental performance of key sectors—particularly agriculture—is essential for evaluating the effectiveness of green growth strategies at the provincial level. As agriculture remains an important component of the local economy in Phu Tho Province, improvements in environmental sustainability within this sector play a crucial role in determining whether economic growth can be achieved while reducing pressure on natural resources.

Sustainable agriculture and environmental performance

Environmental sustainability in agriculture constitutes a core pillar of green growth. In Phu Tho Province, agricultural development has gradually shifted from an expansion-oriented model toward a more resource-efficient and environmentally sustainable approach. This transition reflects the combined influence of Vietnam's National Green Growth Strategy and provincial initiatives aimed at promoting ecological agriculture, sustainable land management, and climate-resilient production systems.

A key policy instrument supporting this transition is the provincial land-use planning framework for the period 2021–2030. The plan covers approximately 297,000 hectares of agricultural land and integrates environmental objectives—including soil conservation, efficient irrigation, and reduced chemical inputs—into broader socio-economic development strategies [23] Rather than expanding cultivated land areas, the province prioritizes improving productivity through spatial optimization, agro-ecological zoning, and crop specialization. Such measures aim to enhance land-use efficiency while limiting land degradation and reducing pressures on surrounding ecosystems. This policy orientation is consistent with OECD green growth principles, which emphasize improvements in resource productivity rather than extensive expansion of production systems [3].

In addition to land-use planning, the province has promoted the development of environmentally friendly agricultural value chains through the One Commune One Product (OCOP) program. By 2022, Phu Tho had certified 139 OCOP products, achieving 61% of its 2025 target. Many of these products are associated with sustainable production practices such as organic fertilization, integrated pest management, and reduced pesticide use. These practices contribute not only to higher product quality and market competitiveness but also to reduced environmental pressures associated with intensive agriculture.

Environmental improvements are further supported by the adoption of circular agriculture practices, particularly in tea cultivation and pomelo production—two flagship agricultural sectors in the province. Agricultural residues such as tea branches and fruit-processing by-products are increasingly reused as organic fertilizers or compost. This recycling process reduces agricultural waste and decreases reliance on chemical fertilizers while simultaneously improving soil health and nutrient cycling. Such circular approaches are increasingly recognized as important mechanisms for improving environmental

performance within agricultural systems. Another important dimension of environmental sustainability is water resource management. Investments in irrigation modernization and climate-resilient agricultural infrastructure have improved water-use efficiency and reduced vulnerability to climate variability. According to provincial reports, irrigation upgrading programs have enhanced water management capacity, allowing farmers to maintain stable crop yields while reducing water losses. These interventions are consistent with international green growth frameworks that emphasize resource-use efficiency as a central indicator of environmental sustainability [3, 8]. The combined effects of these policy initiatives are reflected in several indicators of sustainable agricultural development in the province. As summarized in Table 5, the integration of land-use planning and sustainable agricultural programs has generated measurable economic and social outcomes.

Table 5. Indicators of sustainable agriculture and land-use planning in 2024

Indicator	Value
Agricultural land under planning (ha)	297,000
OCOP-certified products (number)	139
OCOP target achievement rate (%)	61
Value of OCOP products (VND billion)	355.8
Jobs created through the OCOP program (persons)	4,000
Average monthly income (VND million)	5.5
Growth rate of the agriculture–forestry–fisheries sector (%)	3.28

Sources: Phu Tho Provincial People's Committee [23]

The OCOP program alone generated approximately VND 355.8 billion in revenue and created around 4,000 rural jobs, with an average monthly income of VND 5.5 million. Importantly, these outcomes were achieved alongside a compound annual growth rate (CAGR) of 3.28% in the agriculture–forestry–fisheries sector during 2021–2023, without a corresponding expansion in agricultural land area. This pattern suggests that productivity gains and value-added agricultural production are increasingly driving sectoral growth.

From a decoupling perspective, these results provide preliminary evidence of relative decoupling between agricultural economic growth and land use. Productivity improvements are primarily driven by agro-ecological zoning, region-specific crop specialization, and circular agricultural practices such as residue composting and organic fertilization. These developments indicate that economic gains in the agricultural sector can be achieved without increasing the overall scale of land exploitation.

However, as noted by Haberl [24], relative decoupling—where environmental pressures grow more slowly than economic output—does not necessarily imply an absolute reduction in resource use or environmental impacts. In the case of Phu Tho Province, continued reliance on irrigation upgrades and certain input-intensive practices suggests that environmental improvements remain partly dependent on technological and institutional support. Consequently, further progress toward absolute decoupling will require stronger environmental monitoring systems, expanded adoption of organic agriculture, and deeper integration of circular economy principles into agricultural production.

The experience of Phu Tho Province illustrates how provincial-level policies can operationalize national green growth objectives within the agricultural sector. Through integrated land-use planning, sustainable value-chain development, and improved resource management, the province has begun to establish the foundations for a more environmentally sustainable agricultural system while maintaining stable economic growth.

Industrial greening and eco-industrial parks

Industrial development represents a more complex arena for assessing decoupling dynamics, given its higher resource intensity and environmental footprint. Phu Tho's strategy focuses on greening industrial production through the development of eco-industrial parks (EIPs), aligning with international models that promote closed-loop material and energy flows [3]. As shown in Table 6, the province currently manages four major industrial parks—Thuy Van, Trung Ha, Phu Ha, and Cam Khe—hosting a total of 202 industrial projects, including 98 FDI projects. The Phu Ha Industrial Park, covering 356 ha and attracting over VND 25.6 trillion in investment, serves as a flagship example. Environmental measures include mandatory energy audits, ISO 50001 certification, centralized wastewater treatment, and infrastructure designed to support resource sharing and biodiversity corridors.

Table 6. Indicators of industrial parks in Phu Tho Province

Indicator	Value
Number of industrial parks (Number)	4
Total number of industrial projects (Number)	202
Number of FDI projects (Number)	98
Area of Phu Ha Industrial Park (ha)	356
Total investment capital (VND billion)	25,579

Sources: Phu Tho Provincial People's Committee [23]

These initiatives reflect a shift from conventional industrial expansion toward managed industrial growth with reduced environmental intensity. Compared with industrial zones in provinces where environmental controls remain fragmented, Phu Tho's EIP model demonstrates stronger institutional alignment with national green growth objectives [25, 26]. Nevertheless, from a decoupling standpoint, industrial output growth continues to be accompanied by rising absolute energy demand, suggesting that environmental performance improvements primarily reflect efficiency gains rather than structural transformation. This pattern is consistent with the broader literature, which finds that efficiency-oriented industrial greening often yields relative, but not absolute, decoupling unless combined with demand-side and structural changes [24].

Renewable energy deployment and energy efficiency

Energy transition constitutes the most quantifiable dimension of environmental performance in Phu Tho, providing clear metrics for assessing decoupling dynamics. The province's implementation of the National Green Growth Strategy and Power Development Plan VIII emphasizes renewable energy deployment and industrial energy efficiency [27]. As reported in Table 7, Phu Tho has developed a waste-to-energy facility with a total designed capacity of 18 MW, of which 9 MW was operational by 2023, with full capacity expected by 2026. This facility plays a dual role in electricity generation and solid waste management, directly supporting circular economy objectives. In parallel, rooftop solar installations in Phu Ha Industrial Park reached 450 kW in 2023, contributing to national targets for distributed renewable energy adoption [28].

Table 7. Renewable energy and energy efficiency indicators in Phu Tho Province in 2023

Indicator	Value
Total waste-to-energy capacity (MW)	18
Operational capacity (MW)	9
Rooftop solar power capacity (kW)	450
Number of enterprises completing energy audits	20
Total electricity savings (million kWh)	83.78
Electricity savings in the industrial sector (million kWh)	48.97
Improvement in energy efficiency (%)	2.21

Source: Ministry of Industry and Trade [27] and Vietnam National Energy Efficiency Center [28]

Energy efficiency gains are particularly notable. Since 2018, more than 20 enterprises have completed energy audits and adopted ISO 50001 energy management systems. As a result, total electricity savings reached 83.78 million kWh in 2023, with 48.97 million kWh saved within the industrial sector alone, improving overall provincial energy efficiency by 2.21%. These outcomes align with OECD green growth indicators, which identify energy productivity as a core measure of environmental performance [3]. The observed improvements in energy efficiency align with earlier findings that local environmental governance in Vietnam often advances through incremental institutional learning and practice-based adoption, rather than radical technological shifts [29].

Despite these gains, the evidence suggests that Phu Tho remains in a transitional phase of decoupling. Energy savings have moderated the growth of energy intensity, but rising industrial output continues to exert upward pressure on total energy demand. This finding reinforces Haberl [24] argument that technological efficiency improvements, while necessary, are insufficient to achieve absolute decoupling without deeper changes in production structures and consumption patterns.

Implications for subnational decoupling dynamics

Taken together, the evidence indicates that Phu Tho has achieved meaningful improvements in environmental performance across agriculture, industry, and energy systems. These improvements reflect a coordinated policy effort to reduce resource intensity and environmental pressures while sustaining economic growth. However, the observed decoupling remains predominantly relative rather than absolute.

In theoretical terms, Phu Tho exemplifies a managed subnational transition toward green growth, where institutional coordination, targeted investments, and efficiency-oriented policies generate incremental environmental gains. This trajectory aligns with findings in the global decoupling literature, which suggest that subnational units in developing economies often progress through stages of relative decoupling before more transformative shifts become feasible [24, 8]. As such, Phu Tho's experience provides valuable empirical evidence on the opportunities and limits of environmental decoupling at the provincial level within emerging economies.

The combination of industrial expansion, energy efficiency gains, and renewable energy deployment in Phu Tho Province provides empirical evidence of relative decoupling between economic growth and environmental pressure. While industrial output and tourism revenues increased substantially, electricity savings of 83.78 million kWh and improvements in energy efficiency indicate that resource use intensity has declined. This finding is consistent with the relative decoupling pathway described by Haberl [24] which is commonly observed in developing economies undergoing early-stage green transitions. However, the evidence does not yet support absolute decoupling, underscoring the continued importance of policy-driven efficiency gains and institutional coordination.

4.3. Social inclusion and institutional capacity

Social inclusion and institutional capacity are critical enabling conditions for translating green growth strategies into tangible and equitable development outcomes at the subnational level. In Phu Tho Province, the implementation of Vietnam's National Green Growth Strategy has been accompanied by deliberate efforts to integrate livelihood improvement, community participation, and institutional coordination into sectoral development policies. This section evaluates the social outcomes of these interventions and assesses the role of institutional capacity in sustaining inclusive green growth.

Inclusive livelihoods through ecotourism and the OCOP program

Phu Tho Province has strategically leveraged its cultural heritage and ecological assets—most notably the Hung Kings Temple Historical Site and Xuan Son National Park—to promote ecotourism as an inclusive development pathway. Tourism revenue reached VND 4.1 trillion in 2024, representing a 22% increase compared to the previous year [23]. Unlike conventional tourism-led growth, this expansion has been explicitly linked to rural livelihood strategies through the integration of the One Commune One Product (OCOP) program.

By embedding OCOP-certified agricultural and handicraft products into thematic tourism routes, the province has created direct market access for small-scale producers and cooperatives. Agritourism experiences centered on Doan Hung pomelo, Long Coc green tea, and traditional fishing practices along the Da and Lo rivers illustrate how tourism development has been aligned with local production systems rather than displacing them. This approach enhances value capture at the community level and reduces reliance on intermediaries, thereby supporting inclusive income generation consistent with World Bank recommendations on community-based tourism and rural value chains. The integration of OCOP-linked ecotourism illustrates how green growth policies can enhance social inclusion by embedding local knowledge, cultural practices, and community participation into market-oriented development—an approach strongly supported by prior empirical studies in Vietnamese coastal and rural contexts [21, 22].

Measurable social and distributional outcomes

The social impacts of Phu Tho's green growth implementation are summarized in Table 8, which consolidates key indicators across income, employment-related benefits, and resource-use efficiency. One notable outcome is the increase in farmers' income associated with climate-smart infrastructure investments. World Bank–financed irrigation upgrading projects have generated an average income gain of USD 586.6 per hectare per year, reflecting improved water-use efficiency and enhanced crop productivity. This outcome demonstrates how environmental investments can yield direct distributional benefits when embedded within inclusive agricultural policies.

Tourism growth has further reinforced these gains. The 22% year-on-year increase in tourism revenue in 2024 underscores the role of ecotourism as a driver of local employment and service-sector opportunities, particularly for women and informal workers in rural

areas. At the same time, improvements in energy efficiency—evidenced by total electricity savings of 83.78 million kWh, including 48.97 million kWh from industrial parks—contribute indirectly to social inclusion by reducing production costs and strengthening the long-term competitiveness of local [28].

Table 8. Key impact indicators in Phu Tho Province

Indicator	Value
Additional income of farmers (USD/ha)	586.6
Tourism revenue (2024)	4.1
Year-on-year tourism revenue growth (%)	22
Total electricity savings (million kWh)	83.78
Electricity savings from industrial parks (million kWh)	48.97

Source: Phu Tho Provincial People's Committee[24]; Vietnam National Energy Efficiency Center [29]

Institutional capacity and multi-level governance

Underlying these outcomes is a strengthening of institutional capacity at the provincial level. Phu Tho's green growth initiatives are characterized by coordinated action among provincial authorities, line departments, enterprises, cooperatives, and international development partners. The integration of national programs—such as OCOP, energy efficiency standards, and irrigation modernization—into provincial planning frameworks reflects effective vertical policy alignment, a key feature of successful multi-level governance [3].

Moreover, the province's reliance on standardized monitoring indicators and secondary data sources demonstrates that robust policy evaluation does not necessarily require large-scale primary surveys. Instead, triangulation of administrative data, sectoral statistics, and policy reports has enabled evidence-based decision-making and accountability. This approach aligns with the growing literature emphasizing the role of institutional learning and adaptive governance in subnational sustainability transitions [12]. These findings reinforce the argument that subnational green growth outcomes depend less on formal policy design than on local institutional capacity, trust, and

community–state interaction, as evidenced in previous studies on wetland management and protected areas in Vietnam [29].

Implications for inclusive green growth

Overall, Phu Tho's experience illustrates that social inclusion is not an automatic outcome of green growth but the result of deliberate institutional design. By linking environmental investments with livelihood-oriented programs and by strengthening coordination across governance levels, the province has enhanced the inclusiveness and durability of its green growth pathway. These findings contribute to the broader green growth literature by highlighting the central role of institutional capacity in mediating the social outcomes of subnational sustainability transitions.

These social outcomes highlight the central role of institutional capacity in mediating the inclusiveness of green growth at the provincial level. Rather than relying solely on market mechanisms, Phu Tho's experience illustrates how coordinated policy instruments—such as the OCOP program, irrigation investments, and energy efficiency standards—can translate environmental objectives into tangible livelihood benefits. This supports the multi-level governance argument that subnational governments act as critical intermediaries between national strategies and local outcomes [3]. The findings therefore extend the green growth literature by demonstrating that inclusive outcomes depend not only on sectoral choices but also on institutional coherence and implementation capacity.

4.4. Synthesis: subnational green growth pathways

Taken together, the evidence suggests that Phu Tho has made credible progress in operationalizing Vietnam's National Green Growth Strategy at the provincial level. Economic restructuring toward services and high-value agriculture has been accompanied by improvements in energy efficiency and rural incomes, indicating a pathway toward relative decoupling. However, structural dependence on industrial expansion and infrastructure investment persists.

From a theoretical standpoint, Phu Tho exemplifies a managed transition model of subnational green growth, where coordinated policies and targeted investments generate incremental sustainability gains rather than transformative shifts. This finding resonates with the broader decoupling literature, which highlights the difficulty of achieving absolute decoupling in developing-country contexts, especially below the national scale [24]. By empirically linking policy design, institutional capacity, and observable outcomes,

the Phu Tho case contributes to green growth scholarship by illustrating both the potential and the limits of provincial-level implementation. It underscores that subnational green growth is feasible and measurable, but inherently constrained by multi-level governance structures and financial readiness.

5. Conclusion

This study demonstrates that Phu Tho Province represents a promising and illustrative case of localizing Vietnam's national green growth strategy. Through an integrated approach combining policy adjustment, institutional innovation, and multi-stakeholder engagement, the province has achieved tangible progress across all three pillars of sustainability: economic, environmental, and social. Key outcomes include increased farm household incomes, expanded ecotourism revenues, improved energy efficiency, and diversification of green employment opportunities.

Empirical evidence suggests that strategic investments in digital agriculture, renewable energy, and eco-industrial parks—when complemented by targeted capacity-building initiatives and access to blended finance—can effectively translate national green growth objectives into concrete local action. Nevertheless, persistent challenges related to green finance availability, institutional coordination, and technical capacity highlight the urgent need for context-specific reforms.

To sustain this momentum, Phu Tho should institutionalize green growth governance frameworks, scale up successful pilot models, and deepen partnerships with international technical and financial support networks. If effectively implemented, these measures position Phu Tho to become a replicable model for inclusive and climate-resilient development in Vietnam and other comparable developing-country contexts.

Theoretical Contributions and Implications

Beyond its policy relevance, this study contributes to the green growth literature by providing empirical evidence on how national green growth strategies are operationalized at the subnational level within a developing economy context. The findings demonstrate that, at the provincial scale, green growth tends to follow a pathway of relative decoupling, where economic expansion—driven by agriculture upgrading, ecotourism, and industrial diversification—is accompanied by improvements in energy efficiency and resource productivity, but not yet by absolute reductions in environmental pressures. This

observation supports recent theoretical arguments that decoupling outcomes are highly contingent on institutional capacity, technological maturity, and sectoral structure [24].

Furthermore, the Phu Tho case underscores the importance of multi-level governance in shaping green growth trajectories. The alignment between national strategies, provincial planning instruments, and sector-specific implementation mechanisms illustrates how subnational governments function as critical intermediaries translating national policy objectives into context-specific development outcomes. This finding extends existing green growth frameworks, which have predominantly focused on national or urban scales, by highlighting the analytical value of provincial-level assessment.

Finally, the study contributes to emerging debates on green finance readiness by showing that institutional preparedness and governance coordination are as important as financial availability in enabling green investments. The evidence suggests that without targeted capacity-building and integrated financial instruments, the scalability of green growth initiatives remains constrained, even in provinces with strong policy commitment. Taken together, these insights reinforce the need for theory-informed, implementation-focused analyses to advance understanding of green growth dynamics beyond the national level.

The findings contribute to the green growth literature by demonstrating that, at the subnational level, economic–environmental decoupling is not a purely technological process but a governance- and community-mediated outcome. Evidence from Phu Tho confirms that inclusive institutions, ecosystem-based livelihoods, and culturally embedded production systems play a decisive role in shaping green growth trajectories, echoing earlier community-centered sustainability research in Vietnam [21, 22].

Future research could extend this study in three directions. First, longitudinal and panel data analyses would enable stronger causal inference regarding the long-term decoupling effects of provincial green growth policies. Second, comparative studies across provinces with different institutional capacities could further illuminate the role of governance quality in shaping implementation outcomes. Finally, integrating firm-level or household-level primary data would complement secondary data approaches and provide deeper insights into distributional impacts and green finance readiness at the micro level.

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