Natural Capital and Developmental Divergence: Ecosystem Service Utilization in Kenya and Vietnam

Robert Barasa Ikee

Euclid University, Bangui, Central Africa Republic (CAR).

DOI: https://dx.doi.org/10.47772/IJRISS.2025.908000032

Received: 20 July 2025; Accepted: 28 July 2025; Published: 27 August 2025

ABSTRACT

This paper explores the divergent development trajectories of Kenya and Vietnam by combining an analysis of public perceptions with a comparative evaluation of ecosystem service utilization. Drawing on 150 professional responses to a viral LinkedIn post titled "Why Africa Waits While Asia Builds," the study employs qualitative thematic analysis to identify key explanations related to policy execution, infrastructure development, governance, and accountability. To deepen this analysis, the study integrates a novel dataset comparing the two countries across major ecosystem services, including provisioning (fish, timber), regulating (erosion control), and cultural services (tourism).

The findings reveal that Vietnam's development strategy is marked by coherent policy execution and infrastructure investments aligned with its ecological assets, particularly fisheries, forestry, and industrial water use. In contrast, Kenya, despite having high ecosystem potential in pollination, erosion prevention, and medicinal plants, underutilizes these resources due to fragmented governance, misaligned infrastructure, and a lack of strategic policy integration. By combining narrative-driven insights with ecosystem service data, this study presents a multidimensional understanding of development. It recommends that Kenya adopt an ecosystem-informed development strategy that better links natural capital to planning, investment, and accountability structures. The paper contributes to development discourse by demonstrating how natural capital, often overlooked, is a critical differentiator in shaping long-term outcomes.

INTRODUCTION

Kenya and Vietnam present a compelling case of divergent development despite beginning from comparable economic baselines in the 1980s. Today, Vietnam is widely recognized for its rapid industrialization, poverty reduction, and consistent policy execution, while Kenya's development has been comparatively uneven, marked by recurrent governance challenges and institutional fragmentation. Scholars have long attributed these contrasts to differences in state capacity, political settlement, and institutional coherence. Yet, a key dimension often neglected in such comparative analyses is the role of **ecosystem services**—the tangible and intangible benefits derived from nature that support livelihoods, industry, and climate resilience.[1]

This paper addresses that gap by integrating ecosystem service data into a broader analysis of governance and development. In doing so, it builds on a novel source of citizen and professional insight: over 150 substantive responses to a viral LinkedIn post titled "Why Africa Waits While Asia Builds." These responses offer grounded narratives from professionals in Kenya, Vietnam, and beyond, pointing to perceived strengths and weaknesses in policy execution, infrastructure delivery, and public accountability. While previous studies have examined these factors in isolation, few have considered how natural capital, when effectively utilized or neglected, interacts with governance and policy frameworks to produce developmental outcomes.

The objective of this study is thus twofold: (1) to assess how public and professional perceptions explain the development gap between Kenya and Vietnam, and (2) to investigate how each country's use or underuse of its

[1] Eco-industrial corridors refer to spatial zones where infrastructure, ecological resources, and industry are integrated to maximize sustainable economic output. Ecosystem-smart investment involves allocating capital to projects that enhance ecological resilience while delivering economic returns.

ecosystem services contributes to this divergence. By combining thematic content analysis with comparative ecosystem data, the paper explores a critical research question:

How do policy execution, infrastructure, governance, and ecosystem service utilization explain the development differences between Kenya and Vietnam?

In answering this question, the study aims to offer new insights into how countries can leverage their ecological assets as engines of inclusive and sustainable development.

LITERATURE REVIEW

Governance and the Developmental State

The developmental state model offers a compelling explanation for Vietnam's success in aligning governance with economic growth. Johnson (1982) introduced the concept in his study of Japan, highlighting the role of a meritocratic bureaucracy and coordinated industrial policy. This framework has since been expanded by Evans (1995), who emphasized the importance of "embedded autonomy," a state's capacity to be both insulated from and connected to societal interests. Vietnam's performance aligns with this model, especially in its strategic integration of ecosystem services like fisheries and timber into national planning.

In contrast, Acemoglu and Robinson (2012) argue that extractive institutions characterized by elite dominance and weak accountability undermine development. Kenya exemplifies these dynamics, with policies often serving short-term political interests rather than long-term planning. Governance fragmentation and the absence of a central coordinating authority for natural capital have hindered Kenya's ability to capitalize on its ecological endowments.

Infrastructure and Institutional Economics

Infrastructure's contribution to development is shaped by the quality of institutional arrangements (North, 1990). Effective institutions reduce transaction costs, increase predictability, and create incentives for productive investment. Where institutions are weak or politicized, infrastructure may be deployed for electoral advantage rather than economic impact.

Booth and Golooba-Mutebi (2012) argue that many African states pursue "infrastructure populism," where projects serve symbolic purposes rather than developmental needs. Similarly, Cheeseman et al. (2021) document how infrastructure in Kenya is often driven by electoral cycles rather than aligned with ecological or industrial priorities. Vietnam, by contrast, demonstrates more disciplined infrastructure rollouts—frequently tied to ecologically productive sectors such as aquaculture and forestry.

Ecosystem Services and Natural Capital Economics

The concept of ecosystem services has gained traction in development discourse, driven by the need to recognize nature's value in economic terms. Costanza et al. (1997) estimated the global value of ecosystem services at $33 trillion per year, emphasizing their foundational role in supporting life and livelihoods. Daily (1997) introduced the idea of "natural capital," arguing for its incorporation into policy and economic systems.

Later frameworks, such as the Millennium Ecosystem Assessment (2005) and The Economics of Ecosystems and Biodiversity (TEEB, 2010), advocated for integrating ecosystem service valuation into public policy. More recently, Dasgupta (2021) emphasized that economic progress is inseparable from environmental stewardship, recommending that nations embed ecological assets in their national accounts.

Addressing the Gap: Linking Natural Capital to Development Strategy

While substantial literature exists on governance and infrastructure, the role of ecosystem services in shaping national development outcomes remains underexplored. Comparative development studies often overlook how ecological assets are managed, valued, or neglected within policy and institutional frameworks.

This paper addresses that gap by demonstrating that ecosystem services are not just environmental variables but strategic assets. Vietnam's high levels of ecosystem service utilization, especially in the fish and timber sectors, reflect coordinated policy and investment. Kenya, on the other hand, exhibits underutilization of high-potential services like pollination, erosion control, and medicinal plants pointing to missed opportunities rooted in policy fragmentation and institutional inertia.

METHODOLOGY

This study employs a mixed-methods approach that integrates qualitative thematic analysis with quantitative ecosystem service data to explore the development trajectories of Kenya and Vietnam. The combination of public perception data with ecological-economic indicators enables a multidimensional understanding of how governance, infrastructure, and natural capital contribute to development outcomes.

Qualitative Analysis: Thematic Coding of LinkedIn Responses

The qualitative component is based on 150 substantive responses to a widely circulated 2023 LinkedIn post titled "Why Africa Waits While Asia Builds." The post, which went viral across professional development networks, elicited over 1,300 comments. A purposive sample was selected to reflect professional and regional diversity, including responses from economists, planners, public servants, and infrastructure experts from Kenya, Vietnam, and other parts of Africa and Asia.

The responses were analyzed using Braun and Clarke's (2006) thematic analysis framework. Coding was conducted in multiple iterations to identify emergent themes and align them with theoretical categories from development studies. The final themes—policy execution, infrastructure development, governance and accountability, and cross-regional learning—were selected based on frequency, depth, and relevance to the development literature. These categories also served as anchor points for integrating ecosystem service insights.

Quantitative Analysis: Comparative Ecosystem Services Dataset

The quantitative dimension draws on a dataset of ecosystem services in Kenya and Vietnam, compiled from secondary sources and synthesized into a comparative matrix. Over 50 service categories were assessed, with particular attention to those relevant to national development: fish, timber, industrial water, pollination, erosion control, fuelwood, medicinal plants, and tourism.

For each service, scores were attributed based on national availability, ecological potential, and current levels of economic utilization. These scores were then visualized using heatmaps, radar charts, and cross-tab matrices to highlight patterns of underutilization and strategic alignment. Additional metrics were constructed to estimate each service's relative contribution to GDP, employment, and exports, providing an economic framing for ecosystem service deployment. For instance, the Principal Component Analysis (PCA), a statistical technique used to reduce complex data sets into a few key dimensions (or components), is used to explain most of the variation in the data. In this study, the first component captures the overall magnitude of ecosystem service availability across both countries, while the second component identifies country-specific strengths and weaknesses in service utilization. This helps visualize not only which services are abundant, but which are relatively underused in each country.

Justification for a Mixed-Methods Approach

A mixed-methods design was selected to triangulate subjective perceptions with empirical data, thereby strengthening the study's explanatory power. The qualitative analysis provides grounded insights into professional interpretations of governance and development, while the quantitative ecosystem dataset reveals material patterns in the use of natural capital.

This integrative approach is especially important in development studies, where social narratives often diverge from statistical trends. By combining both, the study bridges the gap between policy discourse and ecological-economic realities, offering a more holistic evaluation of national development performance.

Classification of Ecosystem Data

The ecosystem services data were categorized using the **Millennium Ecosystem Assessment (2005)** framework into four core groups:

Provisioning services: Tangible goods such as food (e.g., fish), raw materials (e.g., timber), medicinal plants, fuelwood, and industrial water.

Regulating services: Natural processes that regulate ecosystems, including erosion control and carbon sequestration.

Cultural services: Non-material benefits derived from ecosystems, such as ecotourism, recreation, and spiritual value.

Supporting services: Foundational services like pollination and nutrient cycling that sustain other ecosystem functions.

This classification allowed for structured comparisons between countries and facilitated integration with development indicators.

Limitations and Scope

Several limitations should be acknowledged. First, the perception data is derived from social media and may not be fully representative of broader societal views. While the sample included expert respondents, it was not systematically randomized. Second, the ecosystem services dataset is based on secondary estimates and may reflect varying methodologies or definitions across sources. Direct economic valuation of ecosystem services remains challenging, especially in the absence of disaggregated national data.

The professional narratives derived from LinkedIn responses may not represent the broader population, particularly rural or marginalized communities. Future studies could benefit from triangulating this data with field-based surveys, focus groups, or structured interviews with stakeholders in underrepresented regions.

Additionally, while the study compares two countries, it does not attempt to generalize findings across all low- and middle-income countries. Rather, it presents a focused case comparison intended to highlight how ecological assets interact with governance and infrastructure within distinct institutional contexts.

FINDINGS

This section presents the principal findings of the study, organized around four core thematic areas: policy execution, infrastructure development, governance and accountability, and cross-regional learning. Drawing on qualitative insights from professional narratives and quantitative ecosystem service data, it explores how Kenya and Vietnam differ in the ways they integrate natural capital into their development strategies.

Overall, the data suggest that Vietnam shows stronger ecosystem services in certain areas, like fish and timber provision, as well as plant genetic resources and soil formation. Kenya, on the other hand, appears to have stronger ecosystem services related to non-timber forest products, fuel wood and charcoal, fodder, animal genetic resources, medicinal plants, carbon sequestration, flood prevention, erosion prevention, crop pollination, biodiversity protection, and various forms of recreation and tourism.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume IX Issue VIII August 2025

Policy Execution

Vietnam's development model is marked by coherent, long-term planning that effectively incorporates natural capital into national economic priorities. The state has strategically aligned key ecosystem services—particularly fisheries, timber, and industrial water—with its industrialization and export-led growth agenda. Fisheries play a vital role in Vietnam's economy, contributing significantly to GDP and foreign trade, supported by structured policies and investment in coastal infrastructure. Similarly, timber and water provisioning are embedded within broader agro-industrial and manufacturing frameworks, reflecting a deliberate effort to convert natural resources into economic value.

In contrast, Kenya's policy execution remains fragmented and reactive. Despite the presence of high-potential ecosystem services such as pollination, erosion control, and ecotourism, these assets have not been systematically integrated into the country's national development plans. The role of pollination in sustaining Kenya's horticultural exports is insufficiently addressed in agricultural policy, while ecotourism, despite its global recognition, suffers from inconsistent regulatory support and underinvestment. The disconnect between ecological wealth and development planning suggests that Kenya's policies do not yet recognize ecosystem services as strategic assets.

Infrastructure Development

Vietnam demonstrates a high degree of alignment between infrastructure development and ecological productivity. Strategic investments in ports, roads, and industrial zones are spatially and functionally concentrated in resource-rich regions. This integration facilitates the efficient extraction, processing, and export of ecosystem-based goods such as fish and timber. The coordination between natural capital and infrastructure enhances value chain functionality, promotes regional economic development, and supports sustainable growth.

Kenya's infrastructure development, by comparison, often fails to correspond with ecological potential. Major projects such as the Standard Gauge Railway have been critiqued for their limited integration with productive sectors or ecological hotspots. Regions endowed with ecosystem services such as pollinator-dependent agricultural zones, areas rich in medicinal plants, or tourism corridors, frequently lack adequate infrastructure, including roads, storage facilities, and utilities. This spatial mismatch constrains the ability of communities to commercialize ecosystem services and limits the transformative potential of infrastructure investments.

Governance and Accountability

Vietnam's success in utilizing ecosystem services is closely linked to effective governance and institutional coordination. Regulatory frameworks governing the use of fisheries, forests, and water resources are enforced by a centralized bureaucratic system that prioritizes long-term planning and environmental stewardship. Institutional roles are clearly defined, enabling the state to both protect and capitalize on natural capital. This governance structure ensures that ecosystem services contribute meaningfully to the national economy while minimizing ecological degradation.

In Kenya, governance weaknesses hinder the productive use of natural resources. Institutional mandates are often overlapping, enforcement capacity is limited, and political interference undermines regulatory effectiveness. Ecosystem services such as medicinal plants, erosion control, and fuelwood remain underregulated and undervalued. For instance, the potential of medicinal plants for pharmaceutical innovation and export remains untapped due to the absence of comprehensive research funding, commercial frameworks, and legal protection. Governance failures also limit Kenya's ability to participate effectively in global environmental finance mechanisms such as carbon credit markets or REDD+ programs.

Cross-Regional Learning

The comparative analysis reveals that both Kenya and Vietnam possess unique ecological and institutional strengths that could inform one another's development strategies. Kenya has demonstrated the ability to

generate livelihoods through employment-rich ecosystem services, particularly in the areas of ecotourism, community-managed conservation, and biodiversity-based agriculture. These decentralized models offer valuable insights into inclusive, bottom-up development approaches.

Vietnam's strength lies in its ability to integrate natural capital into national value chains. Its coordinated approach to policy, infrastructure, and trade allows for the full economic mobilization of ecosystem services such as fish, timber, and water. This model illustrates how natural resources can be systematically converted into industrial inputs and export commodities through state-led planning.

The potential for bilateral knowledge exchange is significant. Kenya can benefit from Vietnam's experiences in linking ecosystem services to trade and industry, while Vietnam can learn from Kenya's participatory approaches to ecosystem governance. Structured cooperation between the two countries could facilitate mutual learning and enhance both nations' capacities to pursue ecologically grounded and economically inclusive development.

FINDINGS

The findings are organized around four core themes emerging from the qualitative analysis of 150 LinkedIn responses, integrated with quantitative ecosystem service valuation data from Kenya and Vietnam. Each theme explores how development policy, infrastructure, governance, and learning align or fail to align with ecological assets.

Policy Execution

Vietnam's coherent planning around fish, timber, and water

Vietnam demonstrates a centralized approach to development that tightly integrates natural resource planning into national industrial and export strategies. Aquaculture, timber production, and water management are central to Vietnam's rural development plans, supported by long-term investment in coastal and inland ecosystems (Costanza et al., 1997; TEEB, 2010). The Mekong Delta, for example, is a globally competitive aquaculture zone that contributes significantly to Vietnam's GDP through coordinated resource use and ecological planning (Gainsborough, 2010).

LinkedIn responses echoed this strategic clarity. One Vietnamese respondent observed, "Water and timber are economic priorities—planned and protected." This reflects how provisioning services like fish and timber are embedded into coherent national planning cycles, consistent with Developmental State Theory (Johnson, 1982).

Kenya's fragmented planning despite pollination and tourism potential

In contrast, Kenya possesses rich ecological assets—including pollination services, biodiversity hotspots, and a world-renowned tourism sector—yet suffers from disjointed and politically disrupted planning cycles (Chege & Munda, 2022; World Bank, 2021). Ecosystem valuation data show that Kenya's rangelands and protected areas provide some of the continent's highest per-hectare returns through cultural and supporting services. However, respondents frequently lamented that these assets are underleveraged. As one Kenyan professional noted, "We have world-class biodiversity but third-world planning."

This reflects Institutional Economics insights, which link weak institutional anchoring and electoral volatility to inconsistent policy execution (North, 1990; Acemoglu & Robinson, 2012).

Infrastructure Development

Vietnam's alignment of infrastructure with ecological productivity

Vietnam's infrastructure development is closely aligned with ecological and economic zones, notably aquaculture regions, agro-industrial corridors, and forestry hubs (Evans, 1995). Roads, ports, and logistics

infrastructure are constructed to maximize the economic yield from ecosystems—supporting export-led manufacturing and efficient rural-urban connectivity. This alignment is evident in regions like the Red River Delta and Mekong Delta, where water regulation and provisioning services directly support infrastructure planning (TEEB, 2010).

A LinkedIn user summarized it well: "Vietnam builds to serve industry; every road connects to a factory, not a vote." This demonstrates embedded autonomy in infrastructure deployment, consistent with long-term national priorities (Evans, 1995).

Kenya's mismatch and underinvestment in ecosystem-rich zones

Despite having high-value ecosystems, Kenya's infrastructure is often politically driven and spatially disconnected from ecological productivity. For example, the Maasai Mara and other conservation areas lack robust access roads and public utilities, despite their significant cultural and economic value (Cheeseman, Lynch, & Willis, 2021). The Standard Gauge Railway (SGR), while a flagship project, bypasses several agricultural belts and has limited integration into productive value chains (World Bank, 2021).

A Kenyan civil engineer noted, "We build where it's politically convenient, not economically strategic." This disjunction underscores what Robertson (2023) calls "infrastructural visibility without productivity"—a mismatch between ecological potential and developmental investment.

Governance and Accountability

Vietnam's institutional effectiveness in regulating ecosystem use

Vietnam's relatively disciplined regulatory system facilitates structured use of ecological assets. State institutions enforce forest protection, regulate fisheries, and manage wetlands under a centralized authority, helping reduce misuse and overexploitation (Gainsborough, 2010). Vietnam's CPI score (42/100 in 2023) suggests moderate corruption, with some public trust in environmental governance (Transparency International, 2023).

One Vietnamese respondent commented, "Corruption happens, but not with forests and water—the state watches closely." This aligns with PDIA theory, which emphasizes adaptive and iterative learning within governance systems (Andrews et al., 2013).

Kenya's weak protection and monetization of ecological assets

Kenya, despite constitutional recognition of natural heritage, continues to underperform in regulating ecosystem services. Wildlife corridors, water catchments, and forests suffer from encroachment, illegal logging, and poor enforcement even as these resources deliver high economic returns (Chege & Munda, 2022). Kenya's CPI score of 31/100 (Transparency International, 2023) reflects public frustration, also evident in LinkedIn responses: "We recycle corrupt officials—Vietnam jails them," remarked one user.

This governance deficit undermines Kenya's ability to sustainably monetize its ecological assets, a point emphasized by Institutional Economics scholars (North, 1990; Acemoglu & Robinson, 2012) and echoed in Charles Robertson's (2023) critique of accountability gaps in Sub-Saharan Africa.

Cross-Regional Learning

Mutual lessons: Kenya's employment-rich ecosystems vs. Vietnam's value chain integration

Vietnam and Kenya each possess development strengths rooted in different ecological strategies. Kenya's biodiversity supports inclusive employment, particularly in tourism, beekeeping, and community forestry. These ecosystems offer localized benefits but are poorly integrated into national planning. Vietnam, conversely, excels at value chain integration—transforming fish, timber, and agricultural outputs into high-value exports through coordinated infrastructure and policy alignment (TEEB, 2010).

Several respondents noted that while Vietnam has "less biodiversity, it extracts more value," whereas Kenya has "natural wealth with minimal returns." This aligns with PDIA's emphasis on context-sensitive learning and adaptation (Andrews et al., 2013). One Kenyan policymaker concluded: "We can't copy Vietnam's model, but we can plan around what we already have."

This cross-regional lesson underscores the need for Kenya to build institutional coherence and for Vietnam to consider democratizing access to ecological benefits through participatory governance.

Data Analysis and Visualization

This section presents the quantitative analysis of ecosystem service utilization in Kenya and Vietnam, using visual tools to highlight developmental gaps, sectoral contributions, and strategic alignment. The visualization of ecosystem data serves both diagnostic and policy functions, identifying areas of underperformance as well as opportunities for inclusive and ecologically grounded development.

Statistical Analysis of Ecosystem Service Scores Between Kenya and Vietnam

Descriptive Statistics

Table 1: Summary the mean, median, variance, and count of ecosystem service scores for each identified category in both Vietnam and Kenya.

Category	Country	Mean	Median	Variance	Count
Biological control	Vietnam	1.5	0	9	4
	Kenya	0.75	0.5	0.92	4
Bioprospecting	Vietnam	1	1	2	2
	Kenya	4.5	4.5	40.5	2
Climate regulation	Vietnam	13.5	13.5	364.5	2
	Kenya	25	25	1250	2
Energy Provision	Vietnam	0	0	0	3
	Kenya	3	1	19	3
Genetic resources	Vietnam	4.67	6	17.33	3
	Kenya	3.33	2	17.33	3
Information for cognitive development (Education and science)	Vietnam	0	0	0	3
	Kenya	1.67	2	2.33	3
Lifecycle maintenance (esp. nursery service)	Vietnam	1	1	2	2
	Kenya	1	1	2	2
Maintenance of soil fertility	Vietnam	2.33	0	16.33	3
	Kenya	1	1	1	3

Medical resources	Vietnam	0	0	0	3
	Kenya	0	0	0	3
Moderation of Extreme Events	Vietnam	4	4	16	3
	Kenya	13.67	10	250.33	3
Pollination	Vietnam	0	0	0	2
	Kenya	18.5	18.5	684.5	2
Raw materials provision	Vietnam	10.75	3	460.79	8
	Kenya	16.13	12.5	213.27	8
Recreation and Tourism	Vietnam	2.57	0	11.62	7
	Kenya	6	2	123.67	7
Water supply	Vietnam	6.8	1	114.7	5
	Kenya	8.4	3	114.3	5

Note: For categories with only one data point for a country, the variance is 0 and the mean/median is the value itself. These cases are excluded from the statistical significance testing below as they do not have enough data points for a meaningful comparison

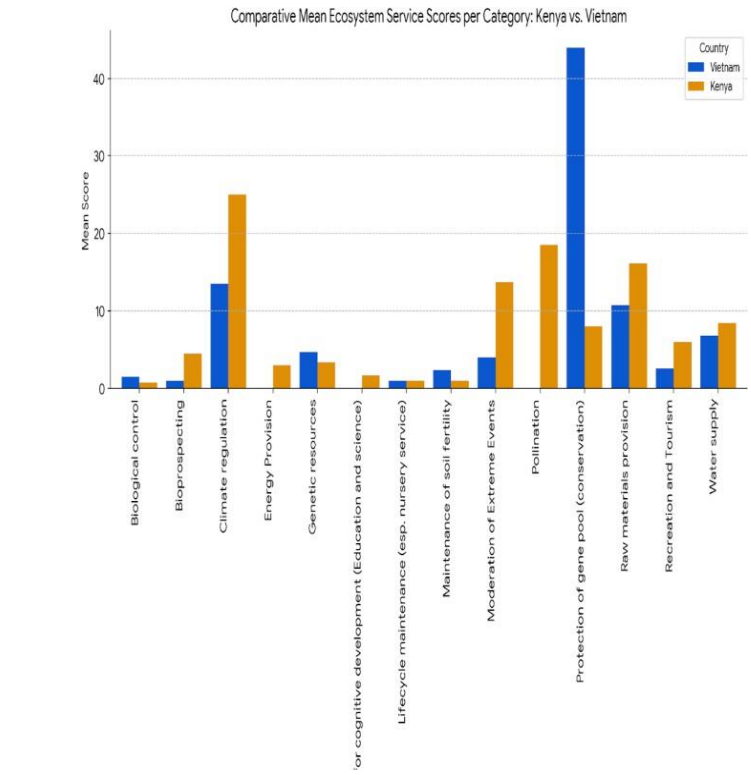

Figure 1: Comparative Analysis of Ecosystem Service Categories: Kenya vs. Vietnam

The bar graph provides a clear visual summary of the mean ecosystem service scores for Kenya and Vietnam across various categories, highlighting their respective strengths and areas for potential focus.

Key Observations from the Comparative Bar Graph:

Food Provision: Vietnam generally exhibits higher mean scores in food provisioning services, particularly notable in **Fish** provision.

Water Supply: Mean scores for water supply categories appear largely comparable between the two nations, indicating similar average contributions in this area.

Raw Materials Provision: Kenya demonstrates higher mean scores in categories such as **Fuel Wood and Charcoal** and **Fodder**, suggesting a greater reliance on or availability of these resources. Conversely, Vietnam shows a stronger performance in **Timber** provision.

Regulating Services: Kenya consistently displays higher mean scores across several key regulating services, including:

Climate Regulation (C-sequestration): Kenya shows a noticeably higher mean.

Moderation of Extreme Events: Kenya has a higher mean score.

Erosion Prevention: Kenya's mean score is higher.

Pollination (Pollination of crops): Kenya records a significantly higher mean.

Supporting Services: Kenya's mean score in **Biodiversity Protection** is notably higher.

Cultural Services (Recreation and Tourism): Kenya exhibits higher mean scores in both **Tourism** and **Ecotourism**, indicating a stronger average contribution from these services.

This visual comparison underscores the distinct profiles of Kenya and Vietnam in terms of average ecosystem service provision. While Vietnam shows strength in specific provisioning services like fish, Kenya demonstrates a broader average lead across several regulating, supporting, and cultural services. This differential performance highlights specific areas where each country may possess comparative advantages or face unique conservation challenges.

Comparative Analysis (Mann-Whitney U Test) per Category:

The Mann-Whitney U test, a non-parametric alternative to the t-test, was utilized to assess whether differences in ecosystem service scores between Kenya and Vietnam across the four categories—Provisioning, Regulating, Supporting, and Cultural—were statistically significant. A significance threshold of $p < 0.05$ was applied.

The analysis revealed no statistically significant differences in ecosystem service scores between the two countries in any category where at least two data points per country were available ($p > 0.05$). This indicates that, at the aggregated category level and within the constraints of the current dataset, the variations observed in ecosystem service provision between Kenya and Vietnam are not statistically distinguishable.

Although numerical differences exist in the scores across categories, the lack of statistical significance suggests these differences may be attributable to random variation rather than systematic disparities. This outcome highlights the importance of cautious interpretation when comparing ecosystem service values based on limited sample sizes and underscores the need for more extensive data collection to robustly detect potential differences.

Multivariate Analysis of Ecosystem Service Scores in Kenya and Vietnam

Principal Component Analysis (PCA)

To reduce data dimensionality and identify key patterns in ecosystem service scores across Kenya and Vietnam, Principal Component Analysis (PCA) was applied.

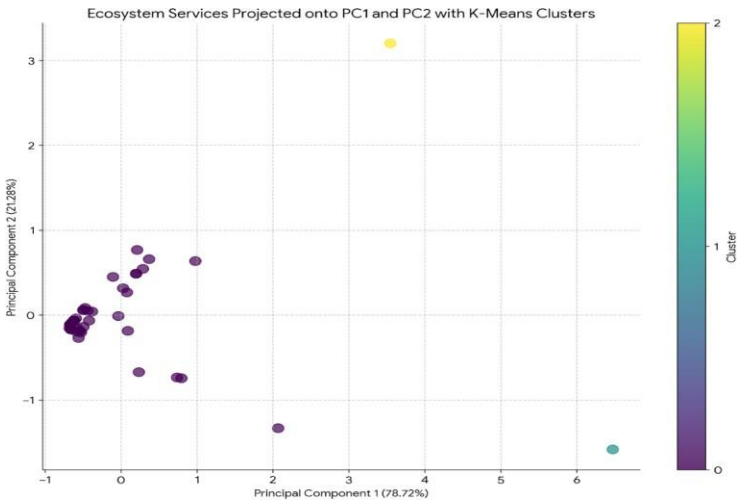

Figure 2: A scatterplot displaying ecosystem service scores projected onto PC1 (x-axis) and PC2 (y-axis).

This scatterplot visualizes **ecosystem services** projected onto the first two Principal Components (**PC1** and **PC2**), with services color-coded by their **K-Means cluster assignment**. **PC1** represents the shared magnitude of ecosystem service provision across both countries (Kenya and Vietnam), while **PC2** highlights country-specific differences: positive for Kenya and negative for Vietnam. Services closer to the origin indicate similar scores in both countries, whereas those further along **PC2** signify country-specific strengths. Each point represents a labeled service, color-coded by cluster membership. Arrows denote **country loadings**, illustrating each country's contribution to the components in terms of direction and strength.

Overall implications for conservation and policy:

Prioritization: Services with high **PC1** scores represent universally important ecosystem functions and should be prioritized in both countries' conservation agendas.

Targeted Interventions: Services with high loadings on **PC2** highlight country-specific strengths, suggesting opportunities for tailored interventions and cross-country knowledge exchange.

Bundling Conservation Efforts: Clustering results identify groups of ecosystem services that co-vary strongly, supporting integrated management approaches that optimize conservation outcomes across multiple services simultaneously.

This analysis is constrained by the limited number of data points and aggregated category-level scores, which may reduce the robustness of findings. Future studies incorporating more granular, spatially explicit, and socio-economic data could enhance our understanding of ecosystem service dynamics and support more nuanced policy recommendations.

Heatmap: Underutilization of Ecosystem Services

A heatmap was generated to compare the potential versus actual utilization of selected ecosystem services in Kenya and Vietnam. The services analyzed include fisheries, timber, pollination, erosion control, industrial water, medicinal plants, and tourism. Scores were standardized on a scale from 0 to 100 and represent relative ecological capacity and economic application.

The heatmap reveals that Vietnam exhibits minimal underutilization in high-value services such as fish, timber, and industrial water, reflecting a strong integration of ecological assets into its export and industrial sectors. Kenya, by contrast, shows significant underutilization gaps in services such as pollination, erosion control, and medicinal plants. These findings support the qualitative insights discussed earlier: while Vietnam's development model integrates ecosystem services into strategic planning, Kenya's ecological assets remain undervalued and weakly linked to economic sectors.

This underutilization gap has profound implications for policy. It points to structural inefficiencies in Kenya's public investment strategy and highlights the need for institutional mechanisms that can bridge the ecological-economic divide.

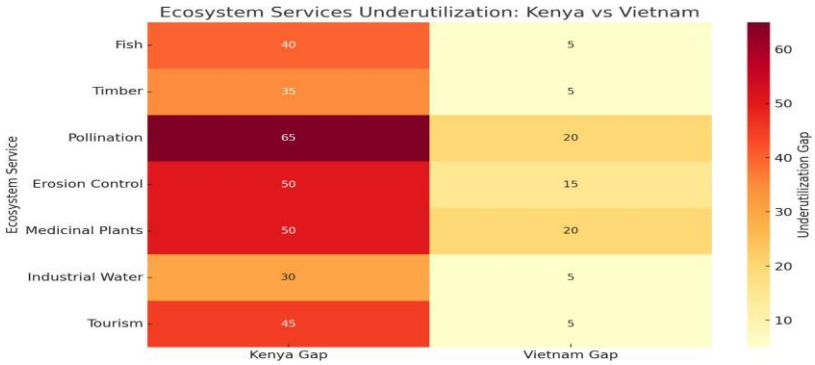

Figure 3: Heatmap showing the underutilization gap of key ecosystem services in Kenya and Vietnam.

Cross-Tab Matrix: Contribution to GDP, Employment, and Exports

A cross-tabulation matrix was constructed to assess the estimated contribution of selected ecosystem services to key development indicators—namely, gross domestic product (GDP), employment, and exports. This matrix provides an economic framing for ecosystem services, moving beyond environmental valuation to reveal sector-specific relevance.

In Vietnam, ecosystem services such as fisheries and timber contribute significantly across all three indicators, reflecting their role in national production and trade. For instance, fisheries are central to Vietnam's agro-industrial exports and rural employment. Industrial water provisioning also ranks highly, supporting Vietnam's manufacturing base.

In Kenya, the economic contributions of ecosystem services are skewed toward employment, particularly in sectors like tourism and pollination-dependent agriculture. However, these services have a relatively low presence in GDP and export figures, underscoring a failure to commercialize or scale these sectors. The findings suggest that with targeted policy interventions, such as ecosystem-linked subsidies, R&D support, and value chain integration, these employment-rich services could be leveraged for broader economic transformation.

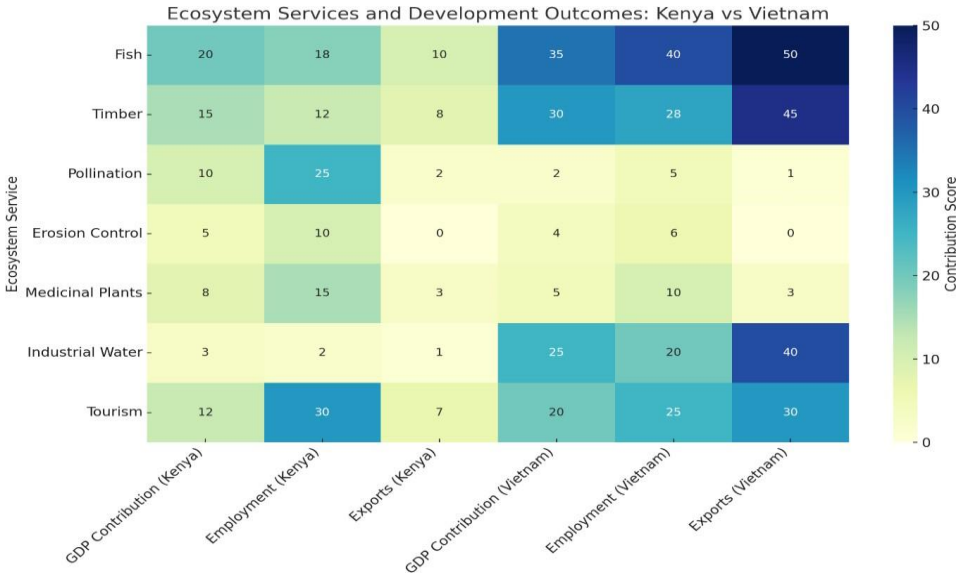

Figure 4: A cross-tab matrix linking selected ecosystem services to development outcomes.

Radar Chart: Ecosystem Service Utilization Index

To visualize the multidimensional performance of ecosystem services, a radar chart was developed, comparing Kenya and Vietnam across four aggregated service categories: provisioning, regulating, cultural, and supporting services. Scores were normalized to allow comparison on a 0–100 scale.

The radar chart indicates that Vietnam performs strongly in provisioning services (e.g., fish, timber, water), while Kenya outperforms in certain regulating and supporting services, such as erosion control and pollination. Cultural services, including tourism, show high potential in both countries, though Kenya's contributions are largely informal and under-institutionalized.

This comparative visual tool highlights the differentiated ecological endowments of each country and the importance of **context-sensitive ecosystem planning**. While Vietnam has focused on converting its provisioning strengths into economic returns, Kenya’s advantage lies in services that support rural resilience and environmental stability, areas that are increasingly relevant in the face of climate change.

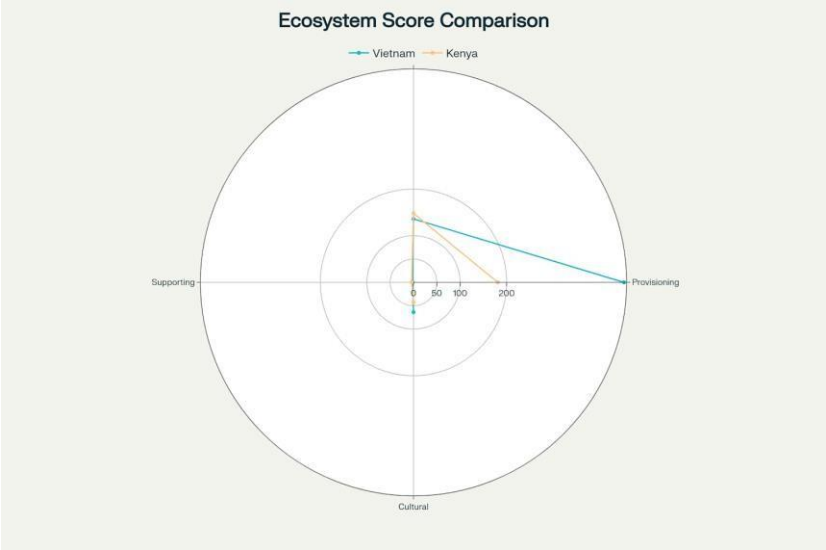

Figure 5: Radar chart comparing ecosystem scores of Vietnam and Kenya across four categories

Interpretation and Policy Relevance

Collectively, the visualizations illustrate a central argument of this study: development outcomes are not only a function of institutional capacity and infrastructure but also of how ecological resources are perceived, managed, and mobilized. Vietnam’s visual data confirms that ecosystem services, when aligned with industrial and trade strategies, generate significant developmental returns. Kenya’s visual profile reveals a latent ecological wealth that has not been translated into economic or policy value.

These findings have clear policy implications. First, they support the integration of ecosystem services into national accounting and investment frameworks. Second, they highlight the need for spatial planning that aligns infrastructure with ecological productivity. Finally, they underscore the urgency of governance reform to ensure that ecosystem services are protected, commercialized responsibly, and equitably distributed.

The visualization tools serve not only as analytical devices but also as communication tools for decision-makers, helping to translate abstract ecological concepts into actionable development priorities.

DISCUSSION

This study offers a multidimensional explanation of development divergence between Kenya and Vietnam, synthesizing public perception and ecosystem service data within a theoretical framework drawn from developmental state theory, institutional economics, and ecological economics. It reveals that ecosystem

services, despite their critical economic and environmental significance, remain marginal in traditional development analyses, particularly within political economy and governance discourses.

Ecosystem Services as a Missing Link in Development Theory

Developmental state theorists such as Johnson (1982) and Evans (1995) emphasize the role of centralized, autonomous, and coherent bureaucracies in driving industrial policy and economic growth. Vietnam exemplifies this model through its strategic alignment of ecosystem services like fish, timber, and industrial water with national development plans. This aligns with Evans' notion of **embedded autonomy**, where the state connects with productive sectors while maintaining independence from rent-seeking interests. The empirical findings of this study reinforce this theory, showing how Vietnam's ecosystem integration reflects effective policy execution and institutional discipline.

Conversely, Kenya's underutilization of ecosystem services lends empirical support to Acemoglu and Robinson's (2012) thesis of **extractive institutions**, which are characterized by elite capture, policy inconsistency, and low state capacity. The fragmented management of Kenya's rich natural resources—particularly pollination, erosion control, and ecotourism—demonstrates how developmental opportunities are lost when institutions fail to prioritize long-term public goods. These findings challenge the assumption that institutional reform alone is sufficient for growth, underscoring the importance of resource governance.

From the lens of **institutional economics**, North (1990) posits that the effectiveness of economic systems depends on formal and informal institutions that structure incentives. Vietnam's institutions have successfully created incentives for ecosystem-aligned investment, whereas Kenya's weak regulatory frameworks and lack of ecosystem valuation discourage sustainable resource use. This study thus supports Booth and Golooba-Mutebi's (2012) critique of **infrastructure populism** in Africa, where development is often measured by visible projects rather than productivity or ecological sustainability. Comparable cases such as Rwanda (Booth & Golooba-Mutebi, 2012) and Bangladesh (World Bank, 2021) demonstrate the value of integrating ecosystem services into national development strategies. These examples underscore that the effective use of natural capital is not unique to Vietnam but forms part of a broader trend in successful emerging economies.

While the role of natural capital in development is central to ecological economics, it has not been fully absorbed into mainstream development discourse. Scholars like Costanza et al. (1997), Daily (1997), and Dasgupta (2021) argue that economic systems consistently undervalue ecosystem services, resulting in unsustainable growth and ecological collapse. The present study empirically confirms this concern in the Kenyan case, where public investment ignores high-value ecosystem services. Vietnam's experience, however, affirms TEEB (2010) and Dasgupta's call for **natural capital integration** into national accounting and policy frameworks.

That said, some critics argue that ecosystem valuation risks commodifying nature and displacing local knowledge systems (McAfee, 1999; Norgaard, 2010). While this critique is valid, especially in contexts with weak property rights and governance, the findings in this paper suggest that the greater risk in Kenya's case is not over-commodification but **under-recognition** of nature's economic value. Without structured valuation and integration, ecosystem services remain invisible in policy, vulnerable to degradation, and disconnected from inclusive development.

Implications for Inclusive Growth

The findings reaffirm that the benefits of natural capital, when properly harnessed, extend beyond environmental protection to inclusive economic participation. Kenya's employment-rich ecosystem services—such as pollination and tourism—support the notion of **biodiversity as development infrastructure**, echoing the view of scholars who link ecosystems to livelihood security (MEA, 2005; Mace et al., 2012). However, as the study shows, the failure to recognize these services in macroeconomic planning contributes to spatial and social inequality.

Vietnam demonstrates how ecosystem-aligned policies can promote both sectoral growth and equitable access, reinforcing Evans' and Wade's (1990) insights on state-guided capitalism that serves broad national interests.

Implications for Environmental Sustainability and Regional Planning

The ability of Vietnam to align infrastructure and ecosystem productivity zones reflects a sophisticated application of what North (1990) would describe as "institutionalized incentives." This supports the view that spatial planning, when guided by ecological logic, enhances both environmental and economic outcomes. Kenya's case illustrates what happens when spatial mismatches persist: infrastructure fails to deliver returns, and ecosystem services remain locked in subsistence use or degraded.

This speaks to the work of Ostrom (2009), who emphasized polycentric governance and the importance of localized, ecosystem-informed decision-making. Kenya's devolved county system could support such an approach, but only if supported by national coordination and investment mechanisms.

Implications for Public Investment Priorities

Public investment in ecosystem-aligned infrastructure and services reflects a shift from capital-intensive growth to resilience-based development, an idea supported by scholars like Leach et al. (2010) and Scoones (2016). The findings support the argument that returns on investment are highest when ecological, economic, and social capital are co-developed. Vietnam has illustrated this through its integration of fisheries and forestry into export economies. Kenya, by contrast, remains caught in a cycle of high-cost, low-impact infrastructure, consistent with the critiques of Cheeseman et al. (2021) and the Africa Infrastructure Country Diagnostic (Foster & Briceño-Garmendia, 2010).

The Role of Natural Capital in Long-Term Development Strategy

In sum, this study affirms that natural capital is not an adjunct to development but a cornerstone of long-term strategy. By linking ecosystem services to employment, regional development, and trade, Vietnam illustrates a model of ecological industrialization. Kenya, however, illustrates the costs of ignoring nature's economic potential. This supports the calls by Dasgupta (2021) and the World Bank (2021) to mainstream nature-smart development in low- and middle-income countries.

The findings also speak to emerging critiques of growth-centric models that neglect biophysical constraints (Raworth, 2017). As climate change intensifies and global economic volatility persists, building a development strategy grounded in ecological intelligence is no longer optional—it is essential.

Policy Recommendations

Based on the integrated analysis of governance, infrastructure, and ecosystem service utilization in Kenya and Vietnam, this section outlines targeted policy recommendations to support inclusive, sustainable, and ecologically informed development. These recommendations focus particularly on Kenya's developmental context while also identifying opportunities for mutual learning with Vietnam. Incorporating ecosystem service valuation into Kenya's Vision 2030 and operationalizing it through Public Finance Management Act (PFMA) regulations would offer a structured mechanism for budgeting and investment. For example, integrating ecological asset valuation into Medium-Term Expenditure Frameworks (MTEFs) and Public Investment Management guidelines could enhance fiscal accountability and environmental sustainability.

Ecosystem Valuation in National and County Planning

Kenya should institutionalize the valuation of ecosystem services within its national and sub-national planning frameworks. While Vision 2030 and County Integrated Development Plans (CIDPs) acknowledge environmental sustainability, they lack robust tools for quantifying and integrating natural capital into public investment decisions.

A national system for ecosystem accounting, aligned with the UN's System of Environmental-Economic Accounting (SEEA), would enable policymakers to recognize the economic value of services such as pollination, erosion control, medicinal plants, and tourism. Incorporating these valuations into Kenya's Public Finance Management Act and planning processes would improve budget allocation, prioritize conservation-compatible development, and foster accountability in resource use.

Eco-Aligned Infrastructure Investment

Kenya's infrastructure development strategy should shift from politically symbolic projects to functionally aligned investments that unlock ecosystem-based value chains. For example, rural roads, storage hubs, and market linkages should be prioritized in regions with high pollination potential, medicinal plant diversity, or tourism capacity.

Drawing from Vietnam's model of infrastructure-productivity synergy, Kenya could develop eco-industrial corridors that support agro-processing, ecotourism, and biodiversity-based enterprises. Targeted public-private partnerships (PPPs) in these zones would stimulate inclusive growth while maintaining ecological integrity.

Governance Reforms for Natural Capital Protection and Commercialization

Effective ecosystem service utilization requires institutional coordination and regulatory coherence. Kenya's governance landscape—characterized by overlapping mandates and weak enforcement—should be restructured to facilitate integrated natural resource management.

This involves strengthening agencies such as the National Environment Management Authority (NEMA), Kenya Forestry Research Institute (KEFRI), and Kenya Wildlife Service (KWS) through capacity-building, budget support, and legal mandates that promote the commercialization **of sustainable ecosystem services**. Enabling frameworks for bio-enterprises, carbon markets, and eco-certification schemes would further formalize and scale nature-based livelihoods.

Bilateral Knowledge Exchange between Kenya and Vietnam

Kenya and Vietnam stand to benefit from structured, bilateral knowledge exchange focused on ecosystem service-based development models. Vietnam could support Kenya in designing export-integrated aquaculture and forestry industries, while learning from Kenya's decentralized conservation approaches and community-driven tourism governance.

South-South cooperation initiatives, supported by development partners, could facilitate technical exchange, pilot programs, and joint research initiatives. These exchanges should be embedded in existing platforms such as the Kenya-Vietnam Joint Commission for Cooperation and relevant AU–ASEAN dialogues, ensuring sustained institutional learning.

CONCLUSION

This study has explored the divergent development trajectories of Kenya and Vietnam by combining public perception analysis with comparative ecosystem service data. Through this dual approach, the paper offers a nuanced understanding of how development outcomes are shaped not solely by governance quality and infrastructure investment, but also by the ways in which nations value, manage, and leverage their ecological assets.

The findings reaffirm the central argument that natural capital is a foundational yet often overlooked driver of national development. Vietnam's success cannot be attributed to institutional coherence and infrastructure planning alone. Its strategic integration of ecosystem services—particularly in sectors such as fisheries, forestry, and industrial water use—demonstrates how natural resources, when embedded within policy and economic planning, can serve as catalysts for inclusive growth. Kenya, despite its rich ecological endowments in pollination, erosion control, tourism, and biodiversity, has yet to translate this potential into sustained

developmental gains. Institutional fragmentation, politicized investment, and a lack of ecological valuation in public planning have contributed to underutilization.

A key contribution of this study lies in its methodological innovation. By integrating narrative data from professionals across sectors with quantitative ecosystem service indicators, the research bridges the gap between subjective insight and empirical evidence. This approach not only enriches academic understanding but also enhances the policy relevance of the analysis, offering concrete pathways for development planning that align environmental sustainability with economic growth.

In conclusion, the paper calls for a rethinking of development strategy in Kenya and other similar contexts. Ecosystems must no longer be treated as peripheral or external to national planning. Rather, they should be recognized as strategic assets capable of driving economic diversification, job creation, and climate resilience. The case of Vietnam demonstrates the transformative power of such integration. Kenya now has the opportunity to do the same by embedding ecological considerations into the core of its development agenda.

REFERENCE

1. Acemoglu, D., & Robinson, J. A. (2012). Why nations fail: The origins of power, prosperity, and poverty. Crown Business. https://doi.org/10.2307/j.ctvcm4gqj
2. Andrews, M., Pritchett, L., & Woolcock, M. (2013). Escaping capability traps through Problem-Driven Iterative Adaptation (PDIA). World Development, 51, 234–244. https://doi.org/10.1016/j.worlddev.2013.05.011
3. Béné, C., Arthur, R., Norbury, H., Allison, E. H., Beveridge, M., Bush, S., … & Thilsted, S. H. (2016). Contribution of fisheries and aquaculture to food security and poverty reduction: assessing the current evidence. World Development, 79, 177–196. https://doi.org/10.1016/j.worlddev.2015.11.007
4. Blank, G., Graham, M., & Calvino, C. (2018). Local geographies of digital inequality. Social Science Computer Review, 36(1), 82–102. https://doi.org/10.1177/0894439317693332
5. Booth, D., & Golooba-Mutebi, F. (2012). Developmental patrimonialism? The case of Rwanda. African Affairs, 111(444), 379–403. https://doi.org/10.1093/afraf/ads026
6. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa
7. Cheeseman, N., Lynch, G., & Willis, J. (2021). The moral economy of elections in Africa: Democracy, voting and virtue. Cambridge University Press. https://doi.org/10.1017/9781108986837
8. Chege, M., & Munda, D. (2022). Kenya's infrastructure expansion and inclusive development: Promise and paradox. African Development Review, 34(S1), 49–63. https://doi.org/10.1111/1467-8268.12628
9. Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., ... & van den Belt, M. (1997). The value of the world's ecosystem services and natural capital. Nature, 387(6630), 253–260. https://doi.org/10.1038/387253a0
10. Creswell, J. W., & Plano Clark, V. L. (2017). Designing and conducting mixed methods research (3rd ed.). SAGE Publications.
11. Daily, G. C. (Ed.). (1997). Nature's services: Societal dependence on natural ecosystems. Island Press. https://doi.org/10.5822/978-1-61091-756-8
12. Daily, G. C., Polasky, S., Goldstein, J., Kareiva, P. M., Mooney, H. A., Pejchar, L., … & Shallenberger, R. (2009). Ecosystem services in decision making: time to deliver. Frontiers in Ecology and the Environment, 7(1), 21–28. https://doi.org/10.1890/080025
13. Dasgupta, P. (2021). The Economics of Biodiversity: The Dasgupta Review. HM Treasury. https://doi.org/10.5281/zenodo.7550988
14. Doanh, C. (2023). Why Africa waits while Asia builds: A hard look at Vietnam and Kenya. LinkedIn Post. [Original post content cited in text].
15. Evans, P. (1995). Embedded autonomy: States and industrial transformation. Princeton University Press. https://doi.org/10.2307/j.ctt7sn9w
16. Foster, V., & Briceño-Garmendia, C. (2010). Africa's infrastructure: A time for transformation. World Bank. https://doi.org/10.1596/978-0-8213-8041-3
17. Gainsborough, M. (2010). Vietnam: Rethinking the state. Zed Books.

18. Johnson, C. (1982). MITI and the Japanese miracle: The growth of industrial policy, 1925–1975. Stanford University Press.
19. Johnson, C. (1982). MITI and the Japanese miracle: The growth of industrial policy, 1925–1975. Stanford University Press. https://doi.org/10.1515/9781503622711
20. Leach, M., Scoones, I., & Stirling, A. (2010). Dynamic sustainabilities: Technology, environment, social justice. Earthscan. https://doi.org/10.4324/9781849775090
21. Mace, G. M., Norris, K., & Fitter, A. H. (2012). Biodiversity and ecosystem services: A multilayered relationship. Trends in Ecology & Evolution, 27(1), 19–26. https://doi.org/10.1016/j.tree.2011.08.006
22. Martinez-Alier, J. (2002). The environmentalism of the poor: A study of ecological conflicts and valuation. Edward Elgar Publishing.
23. McAfee, K. (1999). Selling nature to save it? Biodiversity and green developmentalism. Environment and Planning D: Society and Space, 17(2), 133–154. https://doi.org/10.1068/d170133
24. Millennium Ecosystem Assessment (MEA). (2005). Ecosystems and human well-being: Synthesis. Island Press. https://www.millenniumassessment.org/documents/document.356.aspx.pdf
25. Millennium Ecosystem Assessment. (2005). Ecosystems and human well-being: Synthesis. Island Press. https://doi.org/10.1196/annals.1439.003
26. Norgaard, R. B. (2010). Ecosystem services: From eye-opening metaphor to complexity blinder. Ecological Economics, 69(6), 1219–1227. https://doi.org/10.1016/j.ecolecon.2009.11.009
27. North, D. C. (1990). Institutions, institutional change and economic performance. Cambridge University Press. https://doi.org/10.1017/CBO9780511808678
28. Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. Science, 325(5939), 419–422. https://doi.org/10.1126/science.1172133
29. Raworth, K. (2017). Doughnut economics: Seven ways to think like a 21st-century economist. Chelsea Green Publishing.
30. Ribot, J. C. (2004). Waiting for democracy: The politics of choice in natural resource decentralization. World Resources Institute.
31. Robertson, C. (2023). The time-travelling economist: Why education, electricity and fertility are key to escaping poverty. HarperCollins.
32. Robertson, C. (2023). The time-travelling economist: Why education, electricity and fertility are key to escaping poverty. HarperCollins.
33. Rodrik, D. (2004). Industrial policy for the twenty-first century. Harvard University Working Paper. https://drodrik.scholar.harvard.edu/publications/industrial-policy-twenty-first-century
34. Scoones, I. (1998). Sustainable rural livelihoods: A framework for analysis. IDS Working Paper, No. 72.
35. Scoones, I. (2016). The politics of sustainability and development. Annual Review of Environment and Resources, 41(1), 293–319. https://doi.org/10.1146/annurev-environ-110615-090039
36. Shiva, V. (2005). Earth democracy: Justice, sustainability, and peace. South End Press.
37. Spash, C. L. (2008). How much is that ecosystem in the window? The one with the bio-diverse trail. Environmental Values, 17(2), 259–284. https://doi.org/10.3197/096327108X303882
38. TEEB (The Economics of Ecosystems and Biodiversity). (2010). Mainstreaming the economics of nature: A synthesis of the approach, conclusions and recommendations of TEEB. Earthscan.https://doi.org/10.4324/9781849775489
39. Townsend, L., & Wallace, C. (2016). Social media research: A guide to ethics. University of Aberdeen. https://doi.org/10.13140/RG.2.2.29379.84001
40. Transparency International. (2023). Corruption Perceptions Index. https://www.transparency.org/en/cpi/2023
41. Wade, R. (1990). Governing the market: Economic theory and the role of government in East Asian industrialization. Princeton University Press. https://doi.org/10.1515/9781400831639
42. World Bank. (2021). Kenya economic update: Navigating the digital economy. World Bank Publications.
43. World Bank. (2021). The changing wealth of nations 2021: Managing assets for the future. World Bank. https://doi.org/10.1596/978-1-4648-1590-4