

Integrating Karst Conservation Policy: Governance Nexus, Climate Finance, and Local Community Sovereignty

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Abstract

Karst Landscape (KBAK) conservation in Indonesia faces governance dis coherence challenges that decouple environmental protection mandates from economic incentive mechanisms and local community sovereignty. This research aims to formulate an Integrated Nexus Governance Model that aligns KBAK regulations with Carbon Economic Value (NEK) mechanisms to realize the Karst Blue Economy paradigm. Employing Applied Policy Research with an Institutional Modeling approach, this study uses the Wonosadi Sacred Forest in Gunungkidul as a key reference case. Findings indicate that the successful ecosystem restoration in Wonosadi—rooted in Onggoloco local wisdom and strengthened by Village Regulations—still encounters structural friction in accessing global carbon financing due to a lack of regulatory connectivity at the national level. The proposed Nexus Model integrates three main pillars: (1) BUMDes as the primary carbon claimant, (2) the Environment and Forestry Service (DLHK) as the validator of KBAK legal permanence, and (3) Cultural Certification as an ethical safeguard against carbon commodification. This study recommends local government intervention through subsidized initial Monitoring, Reporting, and Verification (MRV) costs and the establishment of a Community Carbon Endowment Fund (DAKK) to ensure long-term economic and ecological resilience.

Keywords: *Karst Landscape, Carbon Economic Value, Nexus Model, Community Sovereignty, Karst Blue Economy.*

1. Introduction

1. Background and Significance of the Indonesian Karst Ecosystem

The Karst Landscape Areas (locally known as *Kawasan Bentang Alam Karst* or KBAK) in Indonesia represent strategic national and global assets, fulfilling irreplaceable ecological and socio-economic roles. Ecologically, KBAK functions as a vital "natural water tower," sequestering, filtering, and distributing water reserves to millions via unique subterranean hydrological systems (Ford & Williams, 2007). Furthermore, karst ecosystems serve as biodiversity hotspots for endemic stygofauna and troglobitic species, which are highly sensitive to environmental perturbations. Regarding climate change mitigation, these landscapes act as significant carbon sinks, driven by both surface vegetation and the geochemical dissolution of carbonate rocks (Liu et al., 2010).

Conversely, karst regions have become a chronic arena for conflicting interests. Abundant mineral resources, such as limestone and marble, attract substantial investment from the extractive industries. This has catalyzed massive development pressures, ranging from mining concessions to land-use conversions that directly compromise fragile karst features. The degradation of KBAK results in immediate declines in water quality, heightened risks of hydrometeorological disasters, and the erosion of global climate mitigation functions (Samodra, 2020).

In response, the Indonesian government established protective frameworks through the Ministry of Energy and Mineral Resources (ESDM) Decree No. 1451/2005, further technicalized in ESDM Regulation No. 17/2012. This mandate enforces strict protection of "core zones" to preserve primary ecological functions. However, despite this legal foundation, field implementation is frequently undermined, signaling fundamental systemic flaws within the policy governance framework.

2. Fragmented Governance Crisis and Policy Gaps

The failure of karst conservation in Indonesia cannot be reduced merely to weak enforcement; rather, it is rooted in fragmented governance. The crux of this issue lies in the discohesion between the three pillars of sustainable natural resource management:

- a. First Discohesion: Legal Mandates vs. Economic Incentives. KBAK regulations establish conservation as a mandatory protection requirement but fail to provide commensurate economic incentives for stakeholders, particularly local communities. This gap frames law enforcement as a developmental barrier rather than a foundation for a sustainable economy.
- b. Second Discohesion: Policy Silos between KBAK and Carbon Economic Value (CEV). While the government is actively developing CEV mechanisms via Presidential Regulation No. 98/2021, KBAK regulations continue to operate in isolation. There is a lack of methodological connectivity to integrate KBAK permanence standards into the carbon credit requirements of international markets, preventing karst conservation initiatives from accessing significant climate financing.
- c. Third Discohesion: Neglect of Local Resource Sovereignty. Many successful conservation initiatives originate from community sovereignty, as evidenced in the Gunung Sewu region. However, current governance models remain centralized, often disregarding the traditional knowledge and rights of local populations. Absent the central role of the community as active subjects, conservation projects remain vulnerable to commodification, threatening both cultural and ecological values (Folke et al., 2005).

3. The Urgency of an Integrated Nexus Governance Model

This governance crisis necessitates a paradigm shift: moving from viewing conservation as a "cost" to treating it as a "sustainable asset" within a "Karst Blue Economy" framework. A new policy model is required to harmonize environmental protection with inclusive economic drivers. This model is designed to mitigate the risks of carbon commodification by positioning local communities as sovereign owners rather than mere project objects.

4. Research Objectives

Addressing the aforementioned policy gaps, this research aims to:

- a. Analyze the critical governance nexus (disconnection points) between KBAK regulations and CEV mechanisms in Indonesia.

- b. Formulate an Integrated Nexus Governance Model that structurally aligns KBAK mandates with carbon financing opportunities.
- c. Integrate Village-Owned Enterprises (BUMDes) as central actors and primary carbon claimants to ensure equitable benefit-sharing.
- d. Develop Cultural Certification instruments as a safeguard against commodification while strengthening local community sovereignty.

5. Contribution and Research Structure

Utilizing Institutional Modeling and Policy Advocacy methodologies, this study references the specific characteristics of the Wonosadi Customary Forest in the Gunung Sewu Karst area. The primary contribution of this research is a novel governance framework wherein BUMDes serves as a claimant entity validated by the Environment and Forestry Service (DLHK), ensuring that mandatory conservation is transformed into a viable and sustainable blue economy.

2. Methods

This study adopts a qualitative-instrumental Applied Policy Research design, utilizing a framework of Policy Advocacy and Institutional Modeling. Rather than merely diagnosing systemic failures, this design aims to generate a transformative policy blueprint and institutional framework ready for implementation. The primary focus is to mitigate structural friction arising from the policy dis coherence between KBAK regulations, CEV mechanisms, and community sovereignty.

The research is executed through three interconnected and sequential phases:

Phase I: Regulatory Analysis and Financial Incentive Formulation

This phase focuses on legal and fiscal-economic analysis to formulate policy proposals that are both politically viable and financially sustainable.

1. Content Analysis and Comparative Policy Synchronization: Utilizing content analysis techniques (Krippendorff, 2018), an in-depth review of regulatory documents was conducted across three tiers: (1) KBAK Conservation Mandates (ESDM Regulation No. 17/2012), (2) CEV Carbon Market Mechanisms (Presidential Regulation No. 98/2021), and (3) Village Autonomy Regulations (Law No. 6/2014). This analysis seeks to identify policy vacua and formulate regional policy recommendations that establish KBAK standards as a mandatory prerequisite for carbon claims (Gupta, 2010).
2. Regional Fiscal Incentive Modeling: A model was designed to reduce upfront investment risk. Proposals include subsidizing Monitoring, Reporting, and Verification (MRV) costs through regional budgets to enhance BUMDes accessibility to carbon markets (Angelsen et al., 2012). Additionally, a Carbon Community Endowment Fund (DAKK) mechanism was formulated as a long-term risk management instrument to ensure conservation permanence, aligned with the principles of commons governance (Ostrom, 1990).

Phase II: Institutional and Procedural Nexus Modeling

The core of this applied research involves translating institutional solutions into integrated operational blueprints.

1. **Participatory Governance Nexus Design:** An Input-Process-Output (IPO) framework is employed to visualize integrated workflows and actor roles. This model synchronizes the roles of the DLHK (as KBAK compliance validator), BUMDes (as carbon manager), and Customary Institutions (as authorities for Cultural Certification). This approach ensures carbon credit accountability from the site level to international registries (Newig & Fritsch, 2009).
2. **Simplified Carbon Validation Protocols:** This phase formulates a streamlined scientific methodology for calculating karst carbon stocks. The protocol is designed to be technically feasible and manageable by village apparatus through participatory mapping, thereby minimizing reliance on external experts.

Phase III: Empirical Validation and Design Parameterization

To ensure operational relevance and empirical grounding, the proposed model is calibrated against real-world contexts.

1. **Reference Sites and Data Collection:** The Wonosadi Customary Forest in Gunungkidul (Gunung Sewu KBAK) serves as the key reference case. Data were gathered through comprehensive desk studies and key informant interviews involving customary leaders, BUMDes administrators, and local government representatives (Yin, 2018).
2. **Target Group Profile:** The model specifically targets communities possessing high social capital (evidenced by the "sacred forest" concept) yet facing high financial vulnerability and low carbon market accessibility.
3. **Local Sovereignty:** Theoretically, this approach is underpinned by Commons Governance theory to strengthen self-governance within local institutions, positioning the community as the sovereign custodian of natural resources (Ostrom, 1990).

3. Results and Discussion

a. Empirical Basis: Community Sovereignty as a Driver of Conservation Resilience

The existence of the Wonosadi Customary Forest in Gunungkidul provides empirical evidence that community sovereignty constitutes a foundation for ecological permanence that exceeds the efficacy of formal regulation. Historically, this region encountered a critical phase during the 1960s—particularly in the post-1965 era—characterized by massive, unregulated land exploitation and illegal logging (PPID Gunungkidul, 2023). These conditions catalyzed extreme vegetative degradation, resulting in the desiccation of primary hydrological springs and heightening the economic vulnerability of karst populations dependent on hydrological stability (Wibowo et al., 2022).

The ecological revitalization of Wonosadi is rooted in the restoration of environmental wisdom centered on the spiritual leadership narrative of *Onggoloco*. The community revived

forest protection philosophies not merely as technical interventions, but as a sacred mandate to preserve ontological harmony (Prasetyo & Setyowati, 2012). These spiritual values functioned as the primary driver for collective vegetative restoration, which incrementally restored the region's hydrological functions and microclimate. The governance maturity of Wonosadi is further evidenced by the synchronization of customary norms with state law; oral prohibitions on logging and water source protection have been formally codified into Village Regulations (*Perdes*). This legal formalization grants the community the legitimacy for self-policing, establishing Wonosadi as a precedent where village law successfully bridges the implementation gap of national policies at the site level.

b. Policy Gap Analysis and the Necessity for Structural Integration

Despite Wonosadi's achievement of ecological stability through *Perdes*, this study identifies structural friction regarding its integration into national frameworks:

- i. KBAK Mandates vs. Economic Valuation, current KBAK regulations (ESDM Regulation No. 17/2012) mandate strict geological protection but lack incentive mechanisms to convert successful community restoration into measurable economic assets.
- ii. Carbon Validation Disconnect, absent a nexus model, the protection status within the Wonosadi *Perdes* is not automatically recognized as a guarantee of permanence under the Carbon Economic Value (CEV) scheme of Presidential Regulation No. 98/2021.

This gap creates high uncertainty for international carbon buyers—within both voluntary and compliance markets—who demand rigorous standards for legal validity, specifically regarding permanence and non-leakage.

c. The Karst Governance Nexus Model: Integrating Three Primary Pillars

The proposed Nexus Governance Model serves as a core solution requiring the integration of three primary pillars to establish a legal, ethical, and equitable carbon financing pathway:

- i. Pillar I is Community Sovereignty (Customary Institutions/BUMDes). These entities function as the Claimant and legal owner of carbon credits, rather than mere recipients of "benefit sharing." This is secured by recognizing BUMDes/Customary Institutions as primary legal subjects in the management of environmental services at the village level.
- ii. Pillar II is Regulator and Permanence Guarantor (DLHK DIY). The Provincial/Regional Environment and Forestry Service (DLHK) acts as the Validator of Legality and Permanence. DLHK delegates authority to certify that the proposed carbon credit area meets and maintains KBAK protective functions. Thus, KBAK status validated by state regulators provides the legal Guarantee of Permanence required by global carbon markets.
- iii. Pillar III is Ethical Filter (Cultural Certification). To mitigate the risk of commodification—the shift from customary values to mere commodities—Cultural Certification is a mandatory prerequisite. Issued by Customary Institutions, this

certification declares community adherence to local wisdom. Should customary rules be violated, the certification is revoked, and carbon claims are automatically suspended regardless of available carbon stocks. This logical framework binds spiritual values to economic compliance, serving as a robust ethical safeguard.

d. Sustainable Financing Models and Equitable Frameworks

The sustainability of the Nexus Model depends on the ability of Regional Governments (*Pemda*) to provide initial incentives and risk management schemes. To ensure fair play and accessibility, this study advocates for two financing mechanisms:

- i. MRV Initial Cost Subsidies, Regional Governments should provide full subsidies for the initial Monitoring, Reporting, and Verification (MRV) costs incurred by BUMDes. This effectively eliminates site-level transaction costs that often impede community participation.
- ii. Carbon Community Endowment Fund (DAKK), the DAKK is established from a percentage of communal carbon revenues and invested as a Contingency Fund. This fund compensates the community during periods of carbon price volatility or market failure, ensuring that the cultural commitment to forest stewardship remains incentivized even during market downturns, thereby securing the resilience of the Karst Blue Economy.

In synthesis, the Nexus Model is structured sequentially; financial success in carbon markets cannot be achieved without institutional integrity (Cultural Certification) and regulatory legitimacy (KBAK Validation).

5. Conclusion

This study concludes that the failure of Karst Landscape Area (KBAK) conservation in Indonesia stems not from a regulatory vacuum, but from a governance dis coherence that divorces environmental protection mandates from the economic realities of local communities. The policy fragmentation between KBAK regulations under the Ministry of Energy and Mineral Resources and the Carbon Economic Value (CEV) mechanisms under Presidential Regulation No. 98/2021 has erected structural barriers that impede the transformation of conservation into sustainable economic assets.

As a strategic resolution, this research proposes an Integrated Nexus Governance Model that synergizes three primary pillars:

1. Community Sovereignty: Repositioning BUMDes and Customary Institutions as primary legal subjects and carbon claimants, rather than passive beneficiaries.
2. Regulatory Validation: Empowering the DLHK as a guarantor of legal permanence, effectively bridging KBAK standards with the requirements of international carbon markets.
3. Ethical Safeguards: Integrating Cultural Certification—grounded in local wisdom such as the *Onggoloco* values of Wonosadi—as a robust mechanism to prevent the commodification of natural resources.

The implementation of this model necessitates a paradigm shift toward a "Karst Blue Economy," where conservation is no longer viewed as a fiscal burden but as a generative asset. Through regional policy support—specifically the subsidization of initial MRV costs and the establishment of a Carbon Community Endowment Fund (DAKK)—governments can ensure both ecosystem resilience and community prosperity. Ultimately, the Nexus Model provides a transformative blueprint for natural resource management that is ecologically permanent, socially equitable, and economically competitive within the global market.

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