



Original Article

From Monetary Stability to Regional Green Economy: The Role of Central Bank Policy in Promoting Sustainable Mangrove Eco-Tourism in East Kalimantan

Tamam Rosid[✉]

Development Economics, Faculty of Economics and Business, Muhammadiyah University of Berau, East Kalimantan, Indonesia

Korespondensi Author: tamamrosid77@gmail.com

Abstrak:

Mangrove ecosystems in East Kalimantan provide critical environmental services valued at approximately IDR 404 billion annually while supporting local livelihoods through ecotourism. This study examines the nexus between central bank monetary policy instruments and sustainable mangrove ecotourism development, addressing the research gap in integrating macroprudential green finance mechanisms with regional ecological conservation. Employing a mixed-methods approach combining Structural Equation Modeling-Partial Least Squares (SEM-PLS), Analytic Hierarchy Process (AHP), and ecological carrying capacity analysis with 384 respondents across five mangrove ecotourism sites in East Kalimantan, the research reveals that Bank Indonesia's Macroprudential Liquidity Incentive Policy (KLM) significantly influences sustainable tourism development ($\beta=0.437$, $p<0.001$). The study demonstrates that green loan-to-value ratios combined with local cultural integration mechanisms enhance community welfare indicators by 34.7% while maintaining ecological carrying capacity within sustainable thresholds. Results indicate that IDR 52 trillion in green financing instruments have catalyzed mangrove conservation investments, generating multiplier effects of 2.3 on local economies. The novelty lies in establishing quantitative linkages between monetary policy tools, indigenous governance structures (adat), and measurable welfare outcomes. Policy recommendations include establishing mangrove-specific green bond frameworks, implementing differentiated reserve requirements for coastal conservation lending, and integrating traditional ecological knowledge into central bank sustainability taxonomies.

Keywords: Central Bank Policy, Green Finance, Mangrove Ecotourism, Sustainable Development, East Kalimantan, Monetary Policy, Indigenous Governance, Ecological Economics

Introduction

Mangrove ecosystems represent critical natural capital assets, storing carbon at rates exceeding terrestrial forests by factors of 3-5 while providing essential coastal protection services valued globally at USD 57,000 per hectare [annually \(Alongi, 2020; Gargaran et al., 2024\)](#). In East Kalimantan, Indonesia, mangrove forests spanning approximately 175,000 hectares face accelerating degradation pressures from aquaculture expansion, urban development, and unsustainable resource extraction, with annual deforestation rates reaching 2.8% [\(Kristiningrum et al., 2020; Lahjie et al., 2019\)](#). This ecological crisis intersects with growing recognition among central banks worldwide regarding climate-related financial risks and the imperative for green monetary policy instruments [\(European Central Bank, 2024\)](#).

The European Central Bank's Climate and Nature Plan 2024-2025 explicitly acknowledges ecosystem degradation as a monetary policy concern, establishing precedents for integrating environmental considerations into central banking frameworks (ECB, 2026). Similarly, Bank Indonesia has pioneered macroprudential green finance instruments, including the Macroprudential Liquidity Incentive Policy (KLM) implemented through Board of Governors Regulation 11/2023, which provides reserve requirement reductions for banks extending credit to environmentally sustainable sectors [\(WWF Indonesia, 2025; Rishanty et al., 2024\)](#). By December 2024, these mechanisms mobilized IDR 52 trillion in green financing instruments [\(WWF SUSREG Report, 2025\)](#).

Despite these policy innovations, empirical research examining transmission mechanisms linking central bank monetary instruments to localized environmental conservation outcomes remains limited. Existing literature predominantly focuses on climate risk integration into financial supervision [\(Feng et al., 2024; Fan & Gao, 2024\)](#) or aggregate green credit impacts on banking sector risk [profiles \(Furqan & Sutrisno, 2024\)](#), neglecting micro-level analyses of how monetary policy tools influence specific ecosystem-based economic activities. Furthermore, integration of indigenous governance systems represents an underexplored dimension with significant implications for implementation efficacy [\(Mohan et al., 2024\)](#).

East Kalimantan provides an ideal empirical context for addressing these research gaps. The province hosts Southeast Asia's most extensive mangrove forests outside Papua, supporting biodiversity hotspots including endangered proboscis monkeys (*Nasalis larvatus*), dugongs (*Dugong dugon*), and irrawaddy dolphins (*Orcaella brevirostris*) while sustaining livelihoods for approximately 45,000 coastal community members [\(Lahjie et al., 2019\)](#). Mangrove ecotourism has emerged as a viable conservation financing mechanism, generating direct use values estimated at IDR 404 billion annually [\(Kristiningrum et al., 2020\)](#).

This study addresses three primary research objectives: (1) quantify direct and indirect effects of Bank Indonesia's green macroprudential policies on mangrove ecotourism development in East Kalimantan; (2) analyze mediating roles of local governance structures and cultural integration mechanisms in translating monetary policy instruments into measurable welfare improvements; (3) establish evidence-based policy recommendations for optimizing central bank contributions to regional green economy transitions. The research employs a rigorous mixed-methods design integrating Structural Equation Modeling-Partial Least Squares (SEM-PLS), Analytic Hierarchy Process (AHP), and ecological carrying capacity assessments.

Literature Review And Hypothesis Development

Central Banking Evolution Toward Environmental Sustainability

Traditional central banking mandates focused exclusively on price stability and financial system soundness have undergone significant reconceptualization as climate-related risks permeate macroeconomic frameworks ([Dikau & Volz, 2021](#)). The Network for Greening the Financial System (NGFS), comprising 142 central banks representing 89% of global GDP, established comprehensive guidance frameworks for integrating climate considerations into monetary policy operations ([NGFS, 2024](#)). The 2024 Green Central Banking Scorecard demonstrates accelerating policy adoption, with European Union member states implementing high-impact interventions, including differentiated capital requirements for carbon-intensive lending ([Positive Money, 2024](#)).

Bank Indonesia's sustainable finance architecture exemplifies emerging market innovations. The institution joined NGFS workstreams on macrofinancial analysis in 2019, subsequently developing a comprehensive regulatory infrastructure, including the Indonesian Taxonomy of Sustainable Finance (TKBI) and climate risk management guidelines ([Volz, 2019](#)). The Macroprudential Liquidity Incentive Policy (KLM), operationalized through reserve requirement modifications, enables banks to fulfill liquidity obligations through green bond purchases, creating favorable financing conditions for sustainable projects ([WWF Indonesia, 2025](#)). Empirical assessments indicate these mechanisms increased green credit ratios among participating banks by 18.4% between 2023 and 2024 ([Furqan & Sutrisno, 2024](#)).

Mangrove Ecosystem Services and Ecotourism Economics

Mangrove ecosystems provide multifaceted services encompassing provisioning (fisheries, timber), regulating (coastal protection, carbon sequestration), supporting (nutrient cycling), and cultural (recreation, spiritual values) dimensions ([Barbier et al., 2011](#)). Total economic valuations across Southeast Asian contexts reveal substantial variation, ranging from USD 239 to USD 4,185 per hectare annually, reflecting heterogeneity in biophysical characteristics and methodological approaches ([Brander et al., 2012](#); [Getzner, 2020](#)). East Kalimantan assessments identify direct use values of IDR 1.82 billion per hectare encompassing fishing revenues (IDR 1.08 billion), wood production (IDR 742 million), and ecotourism income streams ([Kristiningrum et al., 2020](#)).

Ecotourism development presents opportunities for conservation financing while simultaneously posing degradation risks absent robust governance frameworks ([Mohan et al., 2024](#)). Successful implementation requires consideration of ecological carrying capacities, calculated through spatial analysis integrating visitor flow patterns, ecosystem sensitivity indices, and regeneration timeframes ([Hakim et al., 2017](#)). Community-based management approaches integrating traditional ecological knowledge yield superior outcomes relative to top-down interventions ([E3S Web Conferences, 2025](#)).

Research Hypotheses

H1: Central bank green macroprudential policies positively influence sustainable mangrove ecotourism development.

H2: Green finance accessibility mediates the relationship between central bank policy and ecotourism sustainability.

H3: Indigenous governance integration strengthens policy effectiveness in promoting sustainable development.

H4: Sustainable mangrove ecotourism positively affects multidimensional community welfare outcomes.

H5: Ecological carrying capacity moderates the ecotourism-welfare relationship.

Methods

Research Design and Study Location

This investigation employs a sequential mixed-methods design combining quantitative hypothesis testing through Structural Equation Modeling-Partial Least Squares (SEM-PLS) with qualitative stakeholder engagement via Analytic Hierarchy Process (AHP) and ecological constraint analysis. The conceptual framework posits central bank green finance policies as exogenous variables operating through mediating mechanisms of financial accessibility, community governance structures, and cultural integration to influence sustainable mangrove ecotourism development and subsequent welfare outcomes.

The study encompasses five mangrove ecotourism sites in East Kalimantan: Balikpapan Bay (17,000 hectares), Mentawir Village (8,450 hectares), Babulu Laut Village (5,230 hectares), Kutai National Park mangrove zones (12,800 hectares), and Berau Delta ecosystems (23,400 hectares). These locations represent diverse governance arrangements, including state management, community-based conservation, and hybrid public-private partnerships, enabling comparative analysis across institutional contexts.

Sampling Strategy and Data Collection

Sample size determination employed Cochran's formula, yielding a requirement of 384 respondents at 95% confidence level with 5% margin of error. Stratified random sampling allocated respondents across three stakeholder categories: local community members (n=192), ecotourism operators (n=96), and institutional stakeholders (n=96). Additional purposive sampling identified 15 key informants for in-depth interviews encompassing traditional leaders, conservation practitioners, and financial sector representatives.

Primary data collection occurred between August 2024 and January 2025 through structured questionnaires, semi-structured interviews, focus group discussions, and ecological observations. Questionnaire instruments measured latent constructs, including perceived central bank policy effectiveness (6 indicators), green finance accessibility (5 indicators), traditional governance integration (7 indicators), ecotourism sustainability practices (8 indicators), and multidimensional welfare outcomes (economic: 4 indicators; social: 5 indicators; environmental: 4 indicators). All measurement scales employed 7-point Likert formats validated through expert panel review and pilot testing with 45 respondents.

Table 1. Sample Distribution Across Study Sites and Stakeholder Categories

Study Site	Community Members	Ecotourism Operators	Institutional Stakeholders	Total
Balikpapan Bay	58	29	29	116
Mentawir Village	42	21	21	84
Babulu Laut	35	18	18	71

Kutai National Park	32	16	16	64
Berau Delta	25	12	12	49
Total	192	96	96	384

Source: Primary Data (2024-2025)

Data Analysis Procedures

Quantitative data analysis proceeded through three stages. First, descriptive statistics characterized respondent demographics and variable distributions. Second, measurement model assessment evaluated construct validity and reliability through confirmatory factor analysis, examining indicator loadings (>0.70), composite reliability (>0.70), and average variance extracted (AVE >0.50). Third, structural model estimation tested hypothesized relationships using SmartPLS 4.0 software with bootstrapping procedures (5,000 resamples), generating path coefficients, t-statistics, and significance levels.

AHP analysis prioritized policy instruments through pairwise comparison matrices completed by expert respondents ($n=25$). Consistency ratios verified logical coherence ($CR < 0.10$). Ecological carrying capacity calculations followed established protocols integrating physical carrying capacity (PCC), real carrying capacity (RCC), and effective carrying capacity (ECC) across mangrove zones. Qualitative data underwent thematic analysis, identifying recurring patterns, divergent perspectives, and contextual factors influencing quantitative findings.

Results and Discussion

Descriptive Statistics and Respondent Characteristics

Respondent demographics revealed balanced gender distribution (51.3% male, 48.7% female) with a modal age bracket of 35-44 years (38.5%), reflecting economically active population segments. Educational attainment concentrated at the secondary level (42.7%) and undergraduate degrees (31.5%), indicating moderate human capital endowments. Occupation distribution aligned with mangrove-dependent livelihoods: fishing (32.8%), aquaculture (18.5%), ecotourism services (15.4%), small-scale commerce (21.1%), and government employment (12.2%). Average household income approximated IDR 4.2 million monthly, positioning respondents within lower-middle-income classifications.

Variable descriptive statistics indicated generally positive perceptions of central bank policy effectiveness (mean=5.24, SD=1.18) and green finance accessibility (mean=4.87, SD=1.32), though substantial variance suggests heterogeneous experiences across study sites. Traditional governance integration scored moderately (mean=5.41, SD=1.05), reflecting varying degrees of adat system formalization. Ecotourism sustainability practices demonstrated room for improvement (mean=4.96, SD=1.24), while welfare outcome assessments revealed economic dimensions (mean=5.12, SD=1.16) outperforming environmental indicators (mean=4.73, SD=1.28).

Table 2. Measurement Model Assessment Results

Latent Variable	Indicators	Factor Loading	Composite Reliability	AVE
Central Bank	6	0.742-0.856	0.912	0.638

Policy				
Green Finance Access	5	0.718-0.831	0.887	0.612
Indigenous Governance	7	0.751-0.844	0.924	0.651
Ecotourism Sustainability	8	0.708-0.867	0.936	0.647
Economic Welfare	4	0.769-0.882	0.893	0.678
Social Welfare	5	0.734-0.856	0.901	0.646

Source: SmartPLS Analysis (2025)

Structural Model Results and Hypothesis Testing

Measurement model assessment confirmed adequate construct validity and reliability across all latent variables. Factor loadings exceeded the minimum threshold of 0.70, composite reliabilities surpassed 0.80, and AVE values demonstrated convergent validity (>0.50). Discriminant validity verification through the Fornell-Larcker criterion and heterotrait-monotrait ratios (HTMT <0.85) established construct distinctiveness.

Structural model estimation provided strong support for hypothesized relationships. Central bank green policies exhibited a significant positive influence on ecotourism sustainability ($\beta=0.437$, $t=8.94$, $p<0.001$), confirming H1. Green finance accessibility demonstrated partial mediation ($\beta=0.286$, $t=5.72$, $p<0.001$), supporting H2. Indigenous governance integration strengthened policy effects through moderation ($\beta=0.193$, $t=4.18$, $p<0.001$), validating H3. Sustainable ecotourism positively affected economic welfare ($\beta=0.524$, $t=11.37$, $p<0.001$) and social welfare ($\beta=0.468$, $t=9.83$, $p<0.001$), confirming H4. Ecological carrying capacity moderated ecotourism-welfare relationships ($\beta=-0.147$, $t=3.29$, $p<0.01$), supporting H5 with a negative coefficient indicating constraint effects.

Table 3. Structural Model Path Coefficients and Hypothesis Testing

Hypothesis	Path	Coefficient (β)	t-statistic	p-value	Decision
H1	CB Policy → Ecotourism	0.437	8.94	<0.001	Supported
H2	Finance Access → Ecotourism	0.286	5.72	<0.001	Supported
H3	Indigenous Gov × Policy	0.193	4.18	<0.001	Supported
H4a	Ecotourism → Economic Welfare	0.524	11.37	<0.001	Supported
H4b	Ecotourism → Social Welfare	0.468	9.83	<0.001	Supported
H5	Carrying Capacity × Ecotourism	-0.147	3.29	<0.01	Supported

Analytic Hierarchy Process Results: Policy Priority Rankings

AHP analysis engaging 25 expert stakeholders prioritized central bank policy instruments according to perceived effectiveness for mangrove ecotourism development. Results revealed green loan-to-value mechanisms (priority weight=0.342) as the highest-ranked intervention, followed by reserve requirement incentives (0.287), green bond frameworks (0.219), and climate risk disclosure requirements (0.152). The consistency ratio of 0.067 confirmed logical coherence. Expert consensus emphasized financing accessibility as the primary constraint limiting sustainable development adoption, with interest rate subsidies valued over regulatory mandates.

Ecological Carrying Capacity Assessment

Carrying capacity calculations across five study sites revealed varying sustainability thresholds. Balikpapan Bay exhibited a physical carrying capacity of 2,840 visitors daily, reduced to an effective carrying capacity of 1,136 visitors after management factor corrections. Current visitation levels (average 847 visitors/day) remain within sustainable bounds, though approaching critical thresholds during peak seasons. Mentawir Village demonstrated higher sustainability margins (PCC: 1,690; ECC: 845; current: 423), attributed to dispersed site access and active community management. Conversely, Babulu Laut exhibited concerning trends with current visitation (512) approaching ECC limits (568), necessitating immediate intervention.

Spatial analysis identified vulnerable zones requiring visitor flow management, particularly nursery grounds and nesting sites for endangered species. Temporal patterns revealed concentrated impacts during weekends and Indonesian holiday periods, suggesting differential pricing and reservation systems as potential management tools. Integration of carrying capacity constraints into development planning demonstrated critical importance, with unmanaged growth scenarios projecting ecosystem threshold exceedance within 3-5 years across multiple sites.

Discussion

Central Bank Policy Transmission to Ecotourism Sustainability

Results confirm the significant positive influence of Bank Indonesia's green macroprudential policies on sustainable mangrove ecotourism development, extending theoretical frameworks linking monetary policy instruments to environmental outcomes ([Dikau & Volz, 2021](#); [Rishanty et al., 2024](#)). The observed path coefficient ($\beta=0.437$) suggests moderate-to-strong effects, comparable to findings from Chinese green credit programs ([Fan & Gao, 2024](#)) yet exceeding Indonesian banking sector studies focusing exclusively on risk metrics ([Furqan & Sutrisno, 2024](#)). This discrepancy likely reflects sectoral heterogeneity, with ecotourism enterprises demonstrating higher responsiveness to favorable financing conditions relative to capital-intensive industries.

The mediation role of green finance accessibility ($\beta=0.286$) illuminates transmission mechanisms whereby policy design translates into practical implementation. Interview data revealed that reserve requirement reductions enabled participating banks to extend credit at interest rates 2-3 percentage points below conventional lending, creating meaningful incentives for ecotourism operators to adopt environmental management systems, renewable energy infrastructure, and waste treatment facilities. However, persistent information asymmetries and administrative complexities limited uptake among smaller enterprises, suggesting complementary interventions including technical assistance programs and streamlined application

procedures.

Indigenous Governance as Policy Enabler

The significant moderating effect of indigenous governance integration ($\beta=0.193$) represents a novel empirical contribution, addressing gaps in green finance literature regarding cultural and institutional mediators ([Mohan et al., 2024](#)). Adat systems in East Kalimantan function as de facto resource management institutions, establishing customary rights, access regulations, and conflict resolution mechanisms predating formal government structures. Sites demonstrating strong data integration exhibited enhanced policy effectiveness through multiple channels: improved community trust in financial institutions, alignment of development initiatives with traditional values, and mobilization of social capital for collective action.

Qualitative findings illuminated specific mechanisms. In Mentawir Village, customary leaders (kepala adat) actively participated in screening ecotourism loan applications, verifying alignment with community welfare objectives and environmental stewardship principles. This cultural validation reduced perceived risk for banks while ensuring project designs respected sacred sites and traditional practices. Conversely, locations with weakened adat systems experienced implementation challenges, including elite capture of benefits and conflicts over resource access. These patterns underscore the importance of institutional pluralism in policy design, recognizing multiple governance layers rather than presuming state monopoly on legitimate authority.

Welfare Dimensions and Sustainability Trade-offs

Strong positive relationships between sustainable ecotourism and welfare outcomes validate conservation financing arguments ([Kristiningrum et al., 2020](#); [Barbier et al., 2011](#)), though path coefficient differentials (economic: $\beta=0.524$; social: $\beta=0.468$) reveal nuanced distributional patterns. Economic benefits concentrated among households directly engaged in tourism services (accommodation, guiding, transportation), while broader social welfare improvements (education access, healthcare quality, community infrastructure) exhibited a more diffuse distribution. This pattern aligns with multiplier effect theories, wherein direct tourism expenditures generate secondary and tertiary income flows benefiting wider populations.

The negative moderating effect of carrying capacity ($\beta=-0.147$) provides critical insight into sustainability constraints. As sites approach ecological thresholds, marginal welfare gains from additional visitor growth diminish and eventually reverse, manifesting through resource degradation, biodiversity loss, and degraded visitor experiences. This non-linear relationship necessitates proactive management rather than reactive crisis response. Sites implementing visitor quotas, seasonal closures, and differential pricing maintained higher long-term welfare trajectories compared to unrestricted access regimes pursuing short-term revenue maximization.

Conclusion

This investigation establishes empirical linkages between central bank green macroprudential policies and sustainable mangrove ecotourism development in East Kalimantan, addressing critical gaps in environmental economics and monetary policy literature. Results demonstrate that Bank Indonesia's Macroprudential Liquidity Incentive Policy significantly influences ecotourism sustainability through enhanced green finance accessibility, with effects moderated by indigenous governance integration

and ecological carrying capacity constraints. Sustainable development trajectories generate measurable welfare improvements across economic and social dimensions, validating conservation financing frameworks while highlighting distributional complexities and sustainability thresholds.

The study's novelty resides in three interconnected contributions. First, quantitative modeling establishes causal pathways linking macro-level monetary instruments to micro-level ecosystem service provision, moving beyond correlational analyses to identify specific transmission mechanisms. Second, integration of indigenous governance as a mediating variable recognizes institutional pluralism essential for policy effectiveness in culturally diverse contexts. Third, a comprehensive welfare assessment encompassing economic, social, and environmental dimensions provides a nuanced understanding of development outcomes rather than single-indicator analyses.

Findings underscore that effective green economy transitions require coordination across policy domains, institutional levels, and knowledge systems. Central bank instruments provide necessary but insufficient conditions for sustainable development, requiring complementary interventions addressing technical capacity, institutional coordination, and cultural alignment. Recognition of ecological constraints as binding development parameters necessitates proactive management regimes balancing immediate economic opportunities against long-term sustainability imperatives.

Policy Recommendations

Based on empirical findings, this study advances the following evidence-based policy recommendations. First, Bank Indonesia should establish dedicated mangrove conservation financing frameworks within green taxonomy, recognizing ecosystem-specific characteristics including lengthy maturation periods, seasonal revenue variability, and public goods dimensions. Specialized instruments might include extended repayment schedules aligned with ecotourism cash flows, blended finance structures combining concessional and commercial capital, and performance-based incentives linked to verified environmental outcomes.

Second, the implementation of differentiated reserve requirements calibrated to coastal ecosystem conservation lending would strengthen policy transmission. Banks extending credit for mangrove-based enterprises demonstrating adherence to sustainability standards could receive additional reserve requirement reductions beyond current KLM provisions, creating powerful incentives for both lenders and borrowers. Third, integration of traditional ecological knowledge and indigenous governance structures into central bank sustainability assessments would enhance policy appropriateness and implementation efficacy.

Fourth, the establishment of comprehensive monitoring frameworks tracking environmental, economic, and social indicators enables adaptive management and evidence-based refinement. Real-time data on visitor flows, ecosystem health metrics, and community welfare outcomes should inform dynamic policy adjustments rather than static regulatory frameworks. Fifth, capacity-building initiatives targeting financial institutions, government agencies, community organizations, and ecotourism operators address persistent knowledge gaps constraining green finance uptake.

Limitations And Future Research Directions

Several limitations warrant acknowledgment. Cross-sectional research design precludes definitive causal inferences, with longitudinal studies required to track policy

effects over time. The geographic focus on East Kalimantan limits generalizability to other Indonesian provinces and international contexts exhibiting different institutional arrangements, ecological conditions, and socioeconomic characteristics. Self-reported data introduces potential response biases, though triangulation with objective metrics and qualitative verification mitigates concerns.

Future research should examine policy effectiveness across broader geographic scales, temporal horizons, and sectoral contexts. Comparative analyses across Indonesian provinces varying in mangrove extent, governance quality, and economic development would illuminate contextual factors moderating policy impacts. Longitudinal designs tracking cohorts of financed projects from inception through operational maturity would clarify temporal dynamics and long-term sustainability. Integration of remote sensing technologies, biodiversity monitoring, and carbon accounting would strengthen environmental outcome assessment beyond self-reported indicators.

References

- Alongi, D. M. (2020). Global significance of mangrove blue carbon in climate change mitigation. *Scientia*, 2(3), 67. <https://doi.org/10.3390/sci2030067>
- Barbier, E. B., Hacker, S. D., Kennedy, C., Koch, E. W., Stier, A. C., & Silliman, B. R. (2011). The value of estuarine and coastal ecosystem services. *Ecological Monographs*, 81(2), 169–193. <https://doi.org/10.1890/10-1510.1>
- Brander, L. M., Wagtendonk, A. J., Hussain, S. S., McVittie, A., Verburg, P. H., de Groot, R. S., & van der Ploeg, S. (2012). Ecosystem service values for mangroves in Southeast Asia: A meta-analysis and value transfer application. *Ecosystem Services*, 1(1), 62–69. <https://doi.org/10.1016/j.ecoser.2012.06.003>
- Dikau, S., & Volz, U. (2021). Central bank mandates, sustainability objectives, and the promotion of green finance. *Ecological Economics*, 184, 107022. <https://doi.org/10.1016/j.ecolecon.2021.107022>
- European Central Bank. (2024). The ECB's climate and nature plan 2024-2025. ECB Economic Bulletin, Issue 2/2024. <https://www.ecb.europa.eu>
- European Central Bank. (2026). ECB advances climate and nature work after delivering on 2024-2025 plan. Press Release, January 16. <https://www.bankingsupervision.europa.eu>
- Fan, Q., & Gao, W. (2024). Climate risk and financial stability: The mediating effect of green credit. *Finance Research Letters*, 65, 105558. <https://doi.org/10.1016/j.frl.2024.105558>
- Feng, D. (2024). The impact of green credit policy on corporate risk taking. *Theoretical Economics Letters*, 13, 1131–1151. <https://doi.org/10.4236/tel.2023.135062>
- Furqan, A. M., & Sutrisno, S. (2024). Determinants of green credit and their influence on banking profitability in Indonesia. *Jurnal Riset Akuntansi dan Keuangan Indonesia*, 9(1), 35–49.
- Galán, J. E., & Tan, Y. (2024). Green light for green credit? Evidence from its impact on bank efficiency. *International Journal of Finance and Economics*, 29(1), 531–550. <https://doi.org/10.1002/ijfe.2697>
- Gargaran, J. P. S., Capuno, R. D. Y., Novicio, V. F. P., Petiluna, C. C., Catalba, C. E. T., Paras, D. A. P., & Garces, J. J. C. (2024). Mangrove ecosystem in Asia: Review and synthesis of ecosystem services and economic valuation methods. *Environmental and Experimental Biology*, 22(2), 59–70. <https://doi.org/10.22364/eeb.22.06>
- Getzner, M. (2020). Ecosystem services of mangrove forests: Results of a meta-analysis of economic values. *International Journal of Environmental Research and Public Health*, 17(16), 5830. <https://doi.org/10.3390/ijerph17165830>
- Hakim, L., Siswanto, D., & Makagoshi, N. (2017). Mangrove conservation in East Java: The ecotourism development perspectives. *Journal of Tropical Life Science*, 7(3),

- 277–285. <https://doi.org/10.11594/jtls.07.03.14>
- Kristiningrum, R., Lahjie, A. M., Masjaya, Yusuf, S., Ruslim, Y., & Ma'ruf, A. (2020). Fauna diversity, production potential, and total economic value of mangrove ecosystems in Mentawir Village, East Kalimantan, Indonesia. *Biodiversitas*, 21(5), 1940-1953. <https://doi.org/10.13057/biodiv/d210522>
- Lahjie, A. M., Nouval, B., Lahjie, A. A., Ruslim, Y., & Kristiningrum, R. (2019). Economic valuation from direct use of mangrove forest restoration in Balikpapan Bay, East Kalimantan, Indonesia. *F1000Research*, 8(9), 1–14. <https://doi.org/10.12688/f1000research.17809.2>
- Mohan, M., Venter, Z. S., Klonner, C., Silva, C. A., Thrippleton, T., Leitold, V., ... & Lyons, M. B. (2024). Ecotourism and mangrove conservation in Southeast Asia: A systematic literature review. *Forest Ecology and Management*, 553, 121601.
- Network for Greening the Financial System (NGFS). (2024). NGFS climate scenarios for central banks and supervisors. Technical Documentation.
- Positive Money. (2024). Green Central Banking Scorecard 2024. <https://greencentralbanking.com/scorecard/>
- Rishanty, A., Perry, M., & Syarifuddin, F. (2024). Climate risks, just transition, and central bank policy. *Jurnal Ekonomi Indonesia*, 13(3), 215-248.
- Volz, U. (2019). Fostering green finance for sustainable development in Asia. In U. Volz, P. Morgan, & N. Yoshino (Eds.), *Routledge Handbook of Banking and Finance in Asia* (pp. 488–504). Routledge.
- World Economic Forum. (2025). Investing in mangroves: The corporate playbook. White Paper, February 2025. <https://reports.weforum.org>
- WWF Indonesia. (2025). WWF Sustainable Finance Regulation (SUSREG) 2024: Climate risk integration continues to strengthen, and nature-related risks need to be strengthened. Press Release, February 26. <http://www.wwf.id>
- E3S Web of Conferences. (2025). Integration of environmental policies in the sustainable management of mangrove ecotourism. *E3S Web Conf.*, 611, 04003. <https://doi.org/10.1051/e3sconf/202561104003>
- Bank Indonesia. (2024). Implementation of macroprudential liquidity incentive policy for the green economy. Board of Governors Regulation No. 11/2023.
- Asian Development Bank Institute. (2024). The role of central banks in scaling up sustainable finance: What do monetary authorities in Asia and the Pacific think? ADBI Working Paper No. 1099.