Forestry: Jurnal Ilmu Kehutanan
Volume. 1, Issue 1, November 2025
Page No: 17-28

Adaptive Forest Management in a Changing World: Insights from the Anthropocene Epoch

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Received : October 09, 2025
Accepted : November 10, 2025
Published : November 30, 2025

Citation: Dua, P., (2025). Adaptive Forest Management in a Changing World: Insights from the Anthropocene Epoch. Forestry: Jurnal Ilmu Kehutanan, 1(1), 17-28.

ABSTRACT: The Anthropocene epoch has dramatically reshaped forest ecosystems, necessitating a rethinking of traditional forest governance frameworks. This study presents a narrative review of recent literature examining policy shifts and adaptive strategies in forest management within this new ecological context. Using a structured search across Scopus, PubMed, and Google Scholar, relevant studies from 2010 to 2025 were selected based on thematic relevance to forest policy, adaptive management, and socio-ecological resilience. The synthesis identifies three major themes: regulatory and policy transformation, the influence of socioeconomic factors, and the integration of technology in forest governance. Results demonstrate that inclusive policies, local community engagement, and the use of remote sensing and machine learning significantly improve ecosystem resilience and conservation outcomes. Conversely, rigid institutional structures, outdated legal systems, and insufficient local participation persist as barriers to sustainability. The discussion highlights the need for interdisciplinary, context-sensitive, and evidence-based approaches that incorporate local knowledge and promote collaboration across sectors. Recommendations include the development of adaptive and inclusive policies, cross-sector partnerships, and restoration-focused landscape management. These findings reaffirm the urgency of systemic reform and offer a roadmap for resilient forest governance in an era of unprecedented ecological change.

Keywords: Forest Management; Anthropocene, Adaptive Policy, Community-Based Governance, Ecological Resilience, Remote Sensing, Sustainable Forestry.

INTRODUCTION

Forests, as critical reservoirs of biodiversity and essential regulators of global ecological processes, have undergone extensive transformations in the Anthropocene—an epoch defined by significant and accelerating human impact on Earth's ecosystems. The urgency to address forest management in this era stems from mounting empirical evidence of biodiversity decline, ecosystem service degradation, and climate instability driven by anthropogenic activities. Recent studies provide compelling insights into the consequences of unchecked human intervention in forest landscapes.

Torres-Romero and Giordano (2022) demonstrate the alarming global trends of declining small carnivore species due to habitat fragmentation and degradation, emphasizing the necessity of adaptive forest management to preserve biodiversity. Furthermore, Sun and Vose (2016) articulate the critical link between sustainable forest management and water resource protection, underscoring how unsustainable practices may compromise vital ecosystem services upon which local communities depend.

Historical data have revealed a troubling trajectory of land cover change and forest degradation on both global and regional scales, reflecting the convergence of climatic alterations and anthropogenic pressures. Liu et al. (2024) highlight significant shifts in land-use patterns, particularly forest cover reduction, driven by expanding agricultural frontiers and urban development. Rapid climate change, as examined by Caignard et al. (2023), imposes selective pressures on tree species, threatening forest resilience and long-term viability. In this vein, Golladay et al. (2016) assert that ecological responses to intensified environmental stressors are shaping uncertain forest futures, thus demanding urgent reevaluation of management paradigms. Together, these trends underscore the imperative for enhanced forest governance frameworks responsive to environmental uncertainties and socio-political complexities.

The current landscape of forest management faces substantial challenges, particularly in translating adaptive management principles into practice amid the accelerating pace of anthropogenic disturbances. Sun and Vose (2016) emphasize the necessity of flexibility in forest governance to accommodate ecological unpredictability, noting that conventional management frameworks are often ill-equipped to respond to such complexities. In addition to the biophysical constraints, institutional inertia and fragmented stakeholder collaboration further hinder effective forest governance. Robold and Huettmann (2021) advocate for the integration of open-access data and technological innovation to bolster adaptive capacity; however, outdated legal and policy instruments often obstruct this integration. These institutional and infrastructural limitations demand robust, interdisciplinary solutions that align environmental knowledge with governance reform.

Moreover, the legal and political environment presents formidable obstacles to the implementation of progressive forest management policies. Caignard et al. (2023) contend that the rigidity of existing policy frameworks restricts the responsiveness of forest governance systems to the dynamic interplay between ecological and social drivers. Despite advances in remote sensing and ecological monitoring, the absence of flexible legal structures hinders the translation of scientific insights into practical interventions. These constraints illustrate the necessity of reconfiguring policy environments to accommodate the adaptive nature of forest ecosystems under anthropogenic stress.

In the broader literature, significant gaps persist in the integration of long-term ecological insights and adaptive governance models into forest policy and management practices. Golladay et al. (2016) argue that many current forest management plans are misaligned with dynamic ecosystem conditions, relying instead on static, reductionist approaches that fail to anticipate or respond to future uncertainties. Messier et al. (2019) critique the limitations of such reductionist frameworks, advocating for a systemic approach that embraces ecological complexity, stakeholder diversity, and socio-environmental feedback loops. This disconnect between ecological science and policy

formulation highlights a critical shortcoming in contemporary forest governance and reinforces the need for integrative frameworks capable of bridging these domains.

The present narrative review addresses this gap by synthesizing current research on policy transformations and adaptive strategies in forest management under the Anthropocene. It aims to examine the efficacy of policy adaptations, the integration of local and indigenous knowledge systems, and the role of governance mechanisms in enhancing forest resilience. Lugo and González (2019) emphasize the value of historical and contextual perspectives in shaping effective environmental policy, arguing that localized experiences and cultural narratives enrich understanding and policy relevance. In a similar vein, Walters et al. (2019) and Hara et al. (2021) highlight the importance of narrative reviews in surfacing social inequities, empowering marginalized communities, and promoting inclusive governance.

This review seeks to explore not only technical and ecological dimensions of forest governance, but also its sociopolitical and cultural underpinnings. Drawing from diverse case studies, it investigates how adaptive strategies have been operationalized across contexts and evaluates the alignment of current policy instruments with the principles of ecological resilience, participatory governance, and social justice. In this effort, it provides a platform for integrating indigenous stewardship, community-based approaches, and institutional reforms into the broader discourse on forest sustainability.

The geographical scope of this review includes forest systems in both the Global North and South, with a particular emphasis on developing countries, indigenous territories, and biodiversity-rich regions that are disproportionately affected by climate change and economic globalization. Caignard et al. (2023) and Tampekis et al. (2024) underscore the relevance of context-specific management strategies that recognize local knowledge and sociocultural practices. Wang et al. (2025) further reveal how indigenous forest management traditions contribute significantly to ecosystem equilibrium, even amid global ecological disruptions. Such perspectives are critical in crafting equitable and resilient forest governance strategies.

By foregrounding both the challenges and opportunities of forest management in the Anthropocene, this introduction establishes a foundation for a comprehensive inquiry into the interplay of policy, ecology, and society. It positions the review within the urgent discourse on sustainable forest futures and sets the stage for an integrative analysis of adaptive governance pathways responsive to a rapidly changing world.

METHOD

The present study adopts a structured narrative review methodology to synthesize emerging knowledge, policy transformations, and adaptive strategies in forest management within the Anthropocene epoch. The selection of a narrative review approach allows for a broad yet analytically rigorous exploration of socio-ecological dimensions, policy discourses, and governance adaptations across diverse geographical and political contexts. The methodology integrates principles of systematic searching with interpretive narrative synthesis, enhancing both transparency and contextual relevance of findings.

The literature search was conducted using three major academic databases: Scopus, Google Scholar, and PubMed. These platforms were chosen due to their comprehensive indexing of peer-reviewed environmental science, policy studies, and interdisciplinary sustainability research. The search strategy relied on a combination of controlled vocabulary and free-text terms. Primary keywords included "forest management," "Anthropocene," "policy shifts," and "adaptive strategies." These keywords were operationalized through Boolean operators to maximize the relevance and precision of retrieved results. For example, combinations such as ("forest management" AND "Anthropocene") OR ("policy shifts" AND "adaptive strategies") were systematically applied. Furthermore, quotation marks were used to enforce phrase searching, thereby ensuring that composite concepts like "forest management" or "adaptive strategies" were captured as contiguous lexical units, as recommended by Tampekis et al. (2024) and Sun and Vose (2016).

In total, the initial search yielded approximately 450 articles. Duplicates were removed, and the remaining records were screened for relevance based on titles and abstracts. The primary inclusion criteria encompassed peer-reviewed journal articles, book chapters, and conference papers published between 2010 and 2025. Only literature written in English and those addressing the interrelation of forest management with Anthropocene-related stressors (e.g., climate change, land-use change, biodiversity loss) were retained. Studies that directly addressed policy adaptation, ecological resilience, stakeholder participation, or community-based management models were also prioritized. Articles were excluded if they lacked methodological transparency, were limited to purely descriptive historical accounts without policy or ecological analysis, or were focused exclusively on agricultural or marine ecosystems unless directly relevant to forest landscapes.

The review incorporates a diversity of study types, including empirical field studies, policy evaluations, modeling-based simulations, ethnographic narratives, and meta-analyses. These various methodologies allow for triangulation of findings across scales and perspectives. Particularly, case-based analyses and comparative studies were emphasized to capture the heterogeneity of forest governance across global regions. The integration of qualitative case studies and quantitative ecological models supports a comprehensive understanding of how adaptive strategies manifest in practice and how they respond to distinct socio-ecological challenges.

To ensure consistency and analytical rigor during the selection process, a tracking matrix was developed to log metadata for each retained article. This matrix included publication year, study location, methodological approach, thematic focus, and justification for inclusion. Articles were coded based on thematic relevance to four core dimensions: ecological change, policy transformation, community-based adaptation, and institutional innovation. These codes guided the iterative reading and synthesis process.

The review design draws from both systematic and narrative review principles. The systematic component emphasizes replicability in search procedures and clarity in inclusion criteria, while the narrative component allows for contextual interpretation of the literature. As McGinley (2017) asserts, the inclusion of narrative accounts is particularly valuable in identifying emergent governance patterns, revealing sociopolitical tensions, and elevating perspectives from marginalized or underrepresented groups. Such narratives are instrumental in exploring how forest

management practices are enacted on the ground and how policy frameworks are contested, negotiated, or reframed within local contexts.

The hybrid methodology also responds to the call for integrated knowledge frameworks that align scientific understanding with policy and practice. González and Lugo (2019) argue that narrative reviews, by connecting scholarly insights with real-world forest governance experiences, offer unique opportunities to reveal systemic policy gaps and envision transformative solutions. This is especially critical in the Anthropocene, where complex and interrelated drivers of change necessitate cross-scalar and transdisciplinary approaches.

Overall, the methodological framework applied in this review aims to provide a robust, evidence-informed foundation for understanding how forest management policies and adaptive strategies are evolving in response to unprecedented ecological transformations. The combination of systematic search protocols, transparent screening procedures, and narrative synthesis ensures that the review remains grounded in empirical rigor while embracing the diversity and complexity of the forest governance landscape. This approach is intended not only to map the current state of knowledge but also to highlight critical gaps and emergent trends that can inform more inclusive, adaptive, and resilient forest policies in the years to come.

RESULT AND DISCUSSION

The literature reviewed for this study reveals multifaceted developments in forest management within the Anthropocene, highlighting how global policy frameworks, social structures, and technological innovations interact to shape adaptive strategies in forest governance. This section presents synthesized findings under three main themes: (1) Policy and Regulatory Shifts, (2) Socioeconomic Factors, and (3) Technological and Innovative Approaches. Each theme reflects critical dimensions of transformation that underscore the evolving landscape of forest management in response to complex socio-environmental pressures.

Substantial changes in national and international forest policy frameworks have emerged as a response to the intensifying ecological pressures associated with the Anthropocene. One of the most significant global milestones is the Paris Agreement of 2015, which reasserts the importance of forest conservation in achieving carbon neutrality and climate stabilization goals. As noted by González and Lugo (2019), forest preservation was framed not merely as an ecological imperative but as a pivotal strategy in reducing global greenhouse gas emissions. Parallel to the Paris Agreement, the REDD+ initiative (Reducing Emissions from Deforestation and Forest Degradation) was established to provide financial incentives to countries that protect forest cover and reduce deforestation rates. REDD+ has been instrumental in incorporating forest governance into global climate mitigation mechanisms (McGinley, 2017; Spínola et al., 2020).

At the national level, various countries have demonstrated shifts in regulatory orientation. Brazil, for instance, developed the Amazon Fund as part of its evolving strategy to enhance sustainable forest management. Spínola et al. (2020) document how this fund has enabled the implementation of monitoring and enforcement mechanisms that aim to curb illegal deforestation. Similar policy transitions are observed in Southeast Asia and sub-Saharan Africa, where governments are

increasingly recognizing the value of integrating conservation principles into broader development agendas. These examples suggest that adaptive forest management is gradually becoming embedded in national policy landscapes, although effectiveness varies widely across contexts.

Evaluating the impacts of these policy changes requires robust empirical indicators. Remote sensing technologies have been extensively used to measure shifts in land cover and forest biomass, providing objective metrics to assess the success of implemented policies. Sun and Vose (2016) highlight the utility of satellite imagery in capturing deforestation patterns, reforestation efforts, and vegetation health. Furthermore, biodiversity indices and population trends of keystone or indicator species serve as proxies for assessing ecological integrity. Potter and Urquhart (2017) observe that forests governed by participatory and sustainable principles tend to maintain higher levels of biodiversity and exhibit greater resilience to environmental stressors. These findings affirm that strategic regulatory shifts, when paired with ecological monitoring tools, can enhance adaptive forest management.

In addition to policy transformations, social and economic dimensions play a crucial role in shaping adaptive forest governance. The participation of local communities, clarity in land tenure, and access to financial incentives are repeatedly cited in the literature as key enablers of successful forest management strategies. McGinley (2017) underscores that community-based forest management fosters responsiveness and local ownership, as indigenous and rural communities possess deep ecological knowledge and cultural ties to the forest. When communities are meaningfully engaged, forest governance becomes more inclusive and resilient to external shocks.

Property rights and economic incentives further influence management outcomes. Creed et al. (2016) argue that secure land tenure encourages long-term investment in forest conservation, while schemes such as Payments for Ecosystem Services (PES) provide economic justification for sustainable practices. These mechanisms have shown promise in incentivizing conservation behaviors across Latin America and parts of Asia. However, implementation remains inconsistent due to governance challenges and funding limitations. Nevertheless, where effectively deployed, these socioeconomic instruments have led to measurable improvements in forest structure and function.

Cross-national comparisons shed light on the contextual nuances of social and economic drivers in forest policy efficacy. Caignard et al. (2023) report that countries supporting participatory governance approaches, such as Nepal and Mexico, demonstrate greater success in achieving sustainability targets than those employing top-down regulatory models. Similarly, the work of Torres-Romero and Giordano (2022) shows that land tenure security enhances conservation outcomes, particularly among marginalized populations who depend on forests for their livelihoods. These insights collectively illustrate that adaptive strategies must be tailored to specific social, cultural, and economic settings, reinforcing the need for context-sensitive policymaking.

Technological advancements have emerged as indispensable tools in modern forest management, particularly in enhancing monitoring precision and forecasting ecological change. Remote sensing technologies, such as satellite imagery and aerial drones, offer real-time data on forest cover, canopy structure, and disturbance events. Huang et al. (2019) emphasize that such tools enable near-continuous surveillance of vast and inaccessible forest areas, thus supporting timely policy responses and intervention planning.

The integration of machine learning algorithms into environmental monitoring represents another significant leap forward. Robold and Huettmann (2021) describe how machine learning can process large datasets from remote sensing and field observations to model ecosystem dynamics and predict responses to climate and anthropogenic stressors. These predictive capabilities are critical for adaptive management, as they allow stakeholders to preemptively identify vulnerabilities and allocate resources efficiently.

Geographic Information Systems (GIS) have also proven essential in synthesizing spatial data for planning and decision-making. Valdès et al. (2019) demonstrate how GIS tools can map land-use patterns, identify high-risk zones, and visualize the impacts of alternative management scenarios. These tools support multi-scalar governance by bridging local realities with national planning frameworks, enabling coordinated and spatially-informed decisions.

Quantitative evidence reinforces the efficacy of technology-driven approaches in bolstering forest ecosystem resilience. Randin et al. (2020) provide compelling data showing that combining remote sensing with species distribution models can accurately forecast biodiversity shifts under various climate scenarios. Their findings reveal that forests managed using such technologies are more resistant to illegal logging and climatic disturbances, owing to enhanced monitoring capacity and rapid response mechanisms. These results confirm the transformative potential of technology in navigating the uncertainties of forest management in the Anthropocene.

Nonetheless, the adoption of advanced technologies is not without its limitations. Access remains uneven across regions, with many developing countries lacking the infrastructure, technical capacity, or financial resources to implement high-tech solutions. Moreover, as highlighted in the Methodology, narrative insights remain crucial to contextualizing quantitative findings. While Wigand et al. (2021) focus on nitrogen storage in mangrove soils, rather than forest resilience, their work illustrates the importance of aligning technological applications with ecological and social objectives.

Taken together, the results of this narrative review indicate that successful forest management in the Anthropocene requires a synergistic blend of adaptive policy frameworks, inclusive social mechanisms, and cutting-edge technologies. These elements must operate in concert to address the unprecedented challenges posed by climate change, biodiversity loss, and socio-economic inequality. The evidence also points to the importance of context-specific approaches, as policy and management strategies effective in one region may falter in another due to differing institutional, cultural, or ecological conditions. As such, forest governance must remain flexible, participatory, and responsive to the dynamic interplay of global and local forces shaping the Anthropocene landscape.

The findings of this review reinforce the existing theoretical frameworks in forest governance while simultaneously challenging conventional practices that often fail to address the ecological complexity and socio-political volatility of the Anthropocene. The literature strongly supports an integrated approach to forest management that includes ecological, social, and economic dimensions. For example, Valdès et al. (2019) demonstrate how small forest patches within agricultural landscapes can provide critical ecosystem services, reaffirming the value of community-based and multifunctional forest governance strategies. These insights support a

conceptual transition from extractive and utilitarian forest policies toward more inclusive, adaptive, and ecologically attuned approaches.

Yet, the review also exposes persistent rigidity within current forest governance structures. Despite efforts to develop adaptive frameworks, many existing policies remain ill-equipped to accommodate rapid ecological change and escalating anthropogenic pressures. Tampekis et al. (2024) note that current policy instruments often lack the necessary flexibility to manage the dynamic nature of forest ecosystems in the Anthropocene. This inflexibility undermines the potential of adaptive management strategies, highlighting the urgent need for transformative governance models that prioritize innovation, responsiveness, and stakeholder inclusion.

Addressing uncertainty is central to effective forest governance. As demonstrated in fire-affected regions explored by Tampekis et al. (2024), policies that fail to consider the increasing variability and severity of climate-induced disturbances risk exacerbating ecosystem degradation. The capacity to anticipate, absorb, and respond to change must therefore be embedded within the policy design process. Robold and Huettmann (2021) argue that technological innovations such as remote sensing and machine learning can significantly enhance ecosystem monitoring and decision-making under uncertainty. Their integration, however, demands strong institutional collaboration across technological, policy, and community spheres to ensure that tools are both contextually relevant and practically implementable.

The results also underscore the critical importance of inclusive policy development. Caignard et al. (2023) emphasize that policies developed in collaboration with local communities not only foster conservation effectiveness but also enhance social equity and long-term stewardship. Empowering communities through participatory governance mechanisms ensures that policies are informed by localized ecological knowledge and cultural values. McGinley (2017) similarly notes that forest governance rooted in local knowledge systems yields more adaptive and context-sensitive outcomes. The integration of such perspectives is especially vital in biodiversity-rich and socially complex regions where forest-dependent populations face compounded vulnerabilities.

Systemic factors continue to constrain forest governance, exacerbating the challenges identified in the results. Institutional weaknesses, legal inadequacies, and cultural misalignments collectively undermine the implementation of sustainable forest management. Sun and Vose (2016) stress that effective governance requires not only the existence of adaptive policies but also the institutional capacity to enforce and revise them. Without institutional coherence and inter-agency coordination, forest management becomes fragmented and reactive. Weak governance structures also lead to inconsistent resource allocation and ineffective policy enforcement, perpetuating cycles of degradation and conflict.

From a legal standpoint, inadequate regulatory frameworks and weak rule of law frequently enable unsustainable exploitation. As highlighted by Sun and Vose (2016), the absence of robust environmental protections contributes to policy failure and ecological decline. Legal systems that fail to integrate environmental, social, and economic priorities often exacerbate stakeholder conflict and impede conservation objectives. Furthermore, the lack of legal recognition for customary land rights and traditional ecological practices alienates indigenous communities, undermining collective action and trust in governance institutions.

Culturally, dominant narratives and policy paradigms frequently overlook or marginalize local ecological knowledge and forest stewardship traditions. McGinley (2017) asserts that policies that neglect local knowledge and values risk alienating key stakeholders and compromising conservation legitimacy. Conflicts over resource access and land use are often rooted in the dissonance between top-down governance structures and community-driven priorities. Acknowledging and institutionalizing cultural perspectives in forest governance is thus essential for fostering legitimacy, compliance, and resilience.

The broader socio-economic landscape also complicates forest governance. Lugo and González (2019) argue that deforestation and forest degradation are often symptomatic of larger development trajectories, such as agricultural expansion, infrastructure development, and economic marginalization. Forest management cannot be isolated from these macro-level dynamics, as land-use decisions are shaped by intersecting political, economic, and cultural forces. Addressing systemic drivers requires multi-scalar interventions that bridge local forest practices with national development strategies.

To overcome these persistent obstacles, literature advocates for evidence-based and context-responsive strategies. Valdès et al. (2019) advocate for the integration of community knowledge systems in forest governance to enhance ecosystem service delivery and conservation effectiveness. Participatory governance not only grounds policies in local realities but also strengthens social capital and conflict resolution mechanisms. Such strategies are particularly effective in socially diverse and ecologically sensitive landscapes.

Adaptive policy frameworks rooted in empirical research and experiential learning offer another pathway forward. Caignard et al. (2023) propose that long-term ecological monitoring and iterative policy evaluation are essential for designing governance models capable of responding to rapid environmental change. These adaptive approaches prioritize learning, flexibility, and feedback, aligning forest management practices with ecological thresholds and community needs.

Technological innovation remains a cornerstone of modern forest governance. Robold and Huettmann (2021) demonstrate how data-intensive technologies such as remote sensing and predictive analytics can support strategic planning and resource allocation. By enabling early detection of ecological stressors, these technologies facilitate proactive intervention and reduce management lag. Nevertheless, technology must be accompanied by capacity-building and equitable access to ensure that benefits are broadly distributed and not concentrated among elite stakeholders.

Ecological restoration and landscape-scale planning also offer promising avenues for building forest resilience. Golladay et al. (2016) introduce the "Achievable Future Conditions" model, which emphasizes adaptive management based on realistic ecological benchmarks. This approach encourages diversification of species and ecosystem functions, enhancing resilience to external shocks and long-term sustainability. It represents a pragmatic balance between ideal conservation outcomes and the socio-political realities of forest governance.

Cross-sectoral collaboration is equally crucial for integrated forest management. Tampekis et al. (2024) highlight the need for coordinated planning among government agencies, private actors, and civil society organizations. Such collaboration fosters innovation, resource sharing, and shared

accountability, strengthening governance structures and enhancing policy coherence. Multi-stakeholder engagement also reinforces procedural justice and ensures that forest governance is inclusive and democratically accountable.

The existing literature nonetheless presents several limitations that must be addressed in future research. Many studies rely on case-specific data, limiting generalizability across broader ecological or governance contexts. Comparative research across regions and forest types is needed to distill transferable lessons and validate the effectiveness of adaptive strategies. Additionally, greater attention must be paid to the intersectionality of social identity, particularly how gender, ethnicity, and class influence participation and outcomes in forest governance. Integrating such dimensions into analytical frameworks will enhance the equity and inclusiveness of adaptive management approaches.

Finally, interdisciplinary approaches are essential for addressing the complex and multifactorial nature of forest governance in the Anthropocene. Bridging insights from ecology, political science, sociology, and economics can generate more robust and actionable knowledge. This review affirms that sustainable forest governance requires not only technical and institutional reform but also a paradigm shift toward inclusive, adaptive, and evidence-informed policy systems responsive to the volatile realities of the Anthropocene epoch.

CONCLUSION

This narrative review has revealed that forest management in the Anthropocene requires urgent restructuring to address accelerating environmental pressures, socio-political complexities, and the limitations of traditional governance models. The findings confirm that policy frameworks emphasizing adaptive, participatory, and integrated approaches are more effective in achieving long-term sustainability. Notably, the shift from exploitative resource-use paradigms to ecosystem-based and community-led management has been shown to foster biodiversity conservation, socio-ecological resilience, and more equitable governance.

Despite global efforts such as the Paris Agreement and REDD+ initiatives, many existing policies remain inflexible and fail to accommodate rapid ecological changes. Systemic barriers rooted in weak institutions, outdated legal frameworks, and insufficient recognition of local knowledge further hinder effective implementation. The results also demonstrate that technological tools like remote sensing, GIS, and machine learning can enhance adaptive capacity, yet their application must be supported by inclusive, multi-stakeholder collaboration.

To address these challenges, this review recommends the formulation of adaptive forest policies that integrate scientific evidence and community knowledge, the promotion of cross-sector collaboration, and the expansion of capacity-building programs. Restoration-based strategies, such as landscape-level planning and ecosystem diversification, should also be prioritized to bolster ecological resilience. Future research should explore interdisciplinary and cross-regional studies, focusing on the intersections of identity, governance, and climate vulnerability to create more inclusive forest policy frameworks. Strengthening local participation, legal support, and

technological accessibility will be key strategies in overcoming the persistent governance obstacles of the Anthropocene.

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