



Leveraging Green Carbon for Climate Change Mitigation in Asia-Pacific Developing Nations

Andi Tenri Harahap, Farhanah Ramdhani Sumardi, Sherry Adelia

Hasanuddin University, Makassar, Indonesia
andi.t.harahap@unhas.ac.id

Abstract. This study investigates the role of green carbon—the carbon stored in natural ecosystems such as tropical forests and peatlands—in climate change mitigation in the Asia-Pacific region. These ecosystems serve as significant carbon sinks, offering substantial potential to offset emissions and contribute to global climate goals. However, challenges such as deforestation, unsustainable land-use practices, and weak governance undermine the effectiveness of green carbon initiatives. The research utilizes a systematic literature review and semi-structured interviews with policymakers, researchers, civil society representatives, and local community members to identify both opportunities and barriers to green carbon utilization. The findings reveal key opportunities, including access to international climate finance (e.g., REDD+), the integration of green carbon into national climate policies, and the co-benefits of biodiversity conservation and ecosystem services. Nonetheless, challenges remain, including policy fragmentation, inadequate Monitoring, Reporting, and Verification (MRV) systems, and the need for equity and inclusion in local communities. The study concludes that addressing these challenges through comprehensive policy reforms, enhanced stakeholder engagement, and innovative financing mechanisms can unlock the full potential of green carbon. Further research is needed to evaluate the effectiveness of policy interventions and community-driven conservation strategies.

Keywords: green carbon, sustainable development, governance, ecosystem services.

1 Introduction

Climate change presents one of the most pressing global challenges, with developing countries particularly vulnerable to its far-reaching impacts. In this context, sustainability becomes paramount, and green carbon—the carbon captured and stored by natural ecosystems such as forests, peatlands, and coastal areas—emerges as a critical component in climate mitigation efforts. The Intergovernmental Panel on Climate Change (IPCC) reports that tropical forests in the Asia-Pacific region can absorb up to 1.1 billion tons of carbon dioxide annually, underscoring the vast potential of green carbon in combating climate change [19].

The Asia-Pacific region, home to many developing countries, faces the dual challenge of fostering economic development while mitigating the growing impacts of climate change. The region's economic reliance on natural resources, coupled with

its vulnerability to extreme weather events, underscores the critical importance of preserving ecosystems. This makes sustainability a fundamental component of policy-making, as these nations aim to achieve the Sustainable Development Goals (SDGs) while addressing their development needs [2]. Balancing economic growth with environmental stewardship remains central to their climate resilience strategies.

Several Asia-Pacific nations have begun adopting policies that align economic development with environmental protection by promoting low-carbon growth models. Countries such as Vietnam, Indonesia, and the Philippines are pioneering efforts to reduce carbon emissions through initiatives focused on renewable energy, green finance, and reforestation programs [3]. These strategies highlight the potential for sustainability to drive both economic recovery and environmental resilience.

For example, research on green finance in South Asia demonstrates that adopting environmentally sustainable growth strategies can enhance economic recovery while mitigating environmental risks [4]. By aligning financial systems with environmental objectives, developing countries can support both short-term growth and long-term ecological health. This shift toward low-carbon growth is particularly crucial in the Asia-Pacific, where vulnerable economies stand to benefit from both the environmental and economic dividends of sustainability.

Green carbon, the carbon absorbed and stored by ecosystems such as forests, wetlands, and mangroves, plays a significant role in climate mitigation efforts in the Asia-Pacific region. Forests, in particular, serve as major carbon sinks, absorbing large amounts of carbon dioxide and providing vital ecosystem services that sustain livelihoods [5]. The IPCC reports that tropical forests in this region can absorb up to 1.1 billion tons of carbon dioxide annually, further underscoring their importance in global climate action [19].

In recent years, there has been increasing recognition of the importance of integrating customary law into sustainable forest management to enhance the effectiveness of climate action. This approach, which respects indigenous knowledge and traditional land-use practices, has proven beneficial in countries such as Indonesia, where customary law has supported conservation efforts [7]. By involving local communities and incorporating traditional governance structures, governments can foster greater ownership of environmental policies, contributing to Sustainable Development Goal 13 (climate action) [8].

While the potential of green carbon is promising, developing countries in the Asia-Pacific face significant challenges in balancing economic development with environmental protection. Many of these countries are in the midst of rapid industrialization and urbanization, which increases the demand for land and natural resources. This growth often clashes with sustainability goals, as governments prioritize economic expansion over long-term environmental management [9]. Key challenges include:

1. **Financial Constraints:** The lack of adequate funding for climate action and environmental conservation hinders the effective implementation of green carbon initiatives [10].
2. **Capacity Building:** Developing countries often face limitations in terms of institutional capacity, technical expertise, and governance frameworks to implement and monitor green carbon policies [11].

3. Stakeholder Integration: Ensuring the involvement of diverse stakeholders, including local communities, businesses, and civil society, in decision-making processes remains a persistent challenge. Engaging local communities is crucial for the long-term sustainability of green carbon projects but can be difficult to achieve due to socio-political and economic complexities [12].

Despite these challenges, there are significant opportunities for sustainable development in the Asia-Pacific region. Increasing awareness of environmental risks, along with international pressure and support, has prompted many governments to incorporate sustainability into their economic development strategies [13]. For example, Indonesia has invested heavily in renewable energy and forest conservation as part of its commitment to the Paris Agreement [14].

Moreover, research has shown that knowledge transfer and collaboration across borders can play a critical role in accelerating the adoption of green policies. As demonstrated in studies on low-carbon city initiatives, sharing best practices and research findings between countries can enhance the capacity of governments to implement sustainable development policies [15]. This highlights the importance of regional cooperation and international partnerships in supporting green carbon initiatives and advancing sustainable economic growth. By focusing on green carbon and other sustainability initiatives, the Asia-Pacific region has the potential to mitigate climate change while fostering economic resilience. The successful integration of environmental protection into economic planning not only addresses global climate challenges but also supports local communities by protecting ecosystems and enhancing livelihoods.

This article explores the role of green carbon in mitigating climate change within developing nations of the Asia-Pacific region, examining both the opportunities and challenges associated with implementing green carbon policies. By doing so, the study aims to provide actionable insights into how these natural ecosystems can be leveraged to meet climate goals while offering relevant policy recommendations.

The importance of this study lies at both global and local levels. On the global stage, effective climate change mitigation requires cooperation across nations, and the Asia-Pacific region, with its rich biodiversity and expansive natural carbon sinks, is integral to these efforts. At the local level, green carbon policies hold the potential to improve livelihoods, protect ecosystems, and foster economic development. By addressing the intersection of environmental sustainability and socio-economic factors, this research seeks to guide policymakers in crafting more effective and sustainable strategies for addressing climate change.

2 Literature Review

2.1 Green Carbon Mitigation Efforts

Developing countries in the Asia-Pacific region play a critical role in global climate change mitigation due to their extensive natural ecosystems, including some of the world's largest tropical forests. These forests, along with other natural carbon sinks

such as peatlands and coastal ecosystems, serve as essential carbon sequestration agents, absorbing significant amounts of carbon dioxide from the atmosphere. The Paris Agreement, which emphasizes "fairness" and nationally determined contributions (NDCs), has provided these nations with the flexibility to set their own climate goals based on their capabilities and resources. This decentralized approach aligns with Sustainable Development Goal (SDG) 13, which focuses on climate action and encourages the transfer of scientific knowledge, research, and environmental initiatives to support national climate efforts [16].

Research highlights that the inclusion of forestry and other natural carbon sinks—such as peatlands, mangroves, and coastal habitats—can offer cost-effective solutions for mitigating climate change [17]. These ecosystems are capable of absorbing and storing vast amounts of carbon, making them integral to global efforts to reduce greenhouse gas emissions. In the Asia-Pacific region, slowing deforestation, restoring degraded lands through reforestation, and improving forest management have been identified as key strategies for enhancing the region's contribution to climate action [18].

The recognition of these natural carbon sinks as part of the climate mitigation toolkit has been slow within global policy frameworks. For instance, it was not until recently that the Kyoto Protocol began to include natural carbon sinks more comprehensively in carbon market mechanisms. This delay has impeded the integration of forests and other ecosystems into global carbon markets, despite their proven effectiveness in mitigating emissions [19]. However, with the advancement of carbon markets under the Paris Agreement, there is renewed momentum to fully integrate these natural sinks into broader climate strategies, recognizing their co-benefits for biodiversity, ecosystem services, and sustainable development.

Sustainability Challenges and Opportunities in the Asia-Pacific.

The Asia-Pacific region's tropical forests are not only critical for climate mitigation but are also vital for maintaining biodiversity and supporting local communities. Sustainability in this region is therefore twofold—balancing carbon sequestration efforts with protecting ecosystems and the livelihoods of those dependent on them. Research shows that reducing deforestation can be a cost-effective mitigation strategy compared to traditional energy-sector abatement options, offering substantial co-benefits such as biodiversity conservation, watershed protection, and local economic development [20,21].

Green carbon strategies can provide win-win solutions for both climate change and sustainable development. For instance, payments for ecosystem services (PES) are increasingly being implemented as a mechanism to incentivize forest conservation. By compensating landowners or communities for maintaining forests and avoiding deforestation, PES schemes support both climate mitigation and local livelihoods [22,23]. These co-benefits have made PES a popular tool for promoting forest conservation in countries like Indonesia, where such programs contribute to poverty alleviation and sustainable land use.

Integrating Customary Law and Traditional Practices.

There is also growing recognition of the importance of incorporating customary law and traditional forest management practices into formal conservation and climate policies. In many Asia-Pacific countries, indigenous and local communities have managed their forests sustainably for generations, using traditional knowledge and practices that align with modern conservation goals [20]. Integrating these practices into formal policy frameworks can enhance the effectiveness of forest conservation efforts while ensuring the inclusion of local stakeholders in decision-making processes.

For example, in Indonesia, customary law has been instrumental in preserving community-managed forests, where traditional governance systems help enforce sustainable resource use [20]. By formalizing the role of customary law in forest management policies, governments can enhance the sustainability of their conservation efforts, support indigenous rights, and contribute to climate action under SDG 13.

Co-Benefits and the Importance of Ecosystem Services.

In addition to their role in carbon sequestration, forests and other natural ecosystems provide a range of ecosystem services that are crucial for human well-being, including water regulation, soil conservation, and habitat provision for biodiversity[15]. These services contribute to local and global environmental health, making the preservation of these ecosystems essential not just for climate mitigation but for broader ecological and socio-economic sustainability.

Research indicates that prioritizing green carbon initiatives, such as reducing emissions from deforestation and forest degradation (REDD+), offers developing countries in the Asia-Pacific a relatively low-cost and high-impact option for reducing emissions while also addressing issues such as poverty and ecosystem degradation [16,17]. By integrating biodiversity conservation with climate mitigation strategies, green carbon initiatives can create synergies that enhance both environmental and social outcomes.

Opportunities and Challenges for Green Carbon Utilization in the Asia-Pacific Region.

The Asia-Pacific region holds immense potential for harnessing green carbon—carbon sequestered by natural ecosystems such as forests, peatlands, and mangroves—as a critical element in the fight against climate change. However, realizing this potential presents both significant opportunities and formidable challenges.

One of the most promising opportunities lies in the region's vast tropical forests, which serve as some of the world's most significant carbon sinks. Countries in the Asia-Pacific region are home to extensive natural ecosystems that have the capacity to absorb and store substantial amounts of carbon dioxide, making them essential components in global climate mitigation strategies. According to research, reducing deforestation and promoting sustainable forest management in the region could be a cost-effective option for reducing greenhouse gas emissions, compared to conventional energy-sector interventions [18,5,20].

Co-benefits of these approaches include biodiversity conservation, water regulation, and the provision of ecosystem services, all of which contribute to local

economic development and human well-being. For instance, the successful implementation of REDD+ (Reducing Emissions from Deforestation and Forest Degradation) has demonstrated the potential for unlocking international funding and incentives for forest conservation. This mechanism not only facilitates carbon sequestration but also provides financial resources for developing countries to invest in sustainable land-use practices and ecosystem restoration.

Furthermore, as awareness of the need for sustainability increases, many countries in the region have begun integrating renewable energy and low-carbon technologies into their economic development strategies. This integration of environmental protection with economic goals reflects a shift toward sustainable growth models, which can further enhance the role of natural carbon sinks in the fight against climate change. By aligning green carbon initiatives with broader sustainability frameworks, such as those laid out in the Sustainable Development Goals (SDGs), countries can achieve both environmental and socio-economic benefits.

In addition to forests, the region's peatlands represent a substantial opportunity for carbon storage. Peatlands are among the most efficient carbon sinks on Earth, capable of storing vast amounts of carbon over long periods. As interest in tropical peatlands grows, particularly given their role in global carbon fluxes, there is increasing recognition of the need to protect and restore these ecosystems. Proper management of peatlands could significantly enhance the region's contribution to climate mitigation, while also addressing critical ecological issues, such as biodiversity loss and water management.

Despite the significant opportunities, several challenges must be overcome to fully realize the potential of green carbon in the Asia-Pacific region. One of the most pressing issues is deforestation and forest degradation, driven by agricultural expansion, infrastructure development, and unsustainable logging practices. These activities not only diminish the region's carbon sequestration capabilities but also exacerbate environmental degradation, threatening biodiversity and the livelihoods of local communities.

Addressing the drivers of deforestation requires a holistic approach that integrates policies, regulations, and financial incentives. Governments must promote sustainable land-use practices and strengthen governance mechanisms to curb illegal logging and land conversion. However, implementing these policies is often hindered by weak institutional capacity and conflicting economic interests, such as the demand for palm oil and timber. Without comprehensive and enforceable policies, the efforts to reduce deforestation may fall short.

Another major challenge is the lack of financial resources necessary to implement and scale up green carbon initiatives. Many developing countries in the region face budgetary constraints, making it difficult to invest in forest conservation, reforestation, and ecosystem restoration. While mechanisms like REDD+ offer financial incentives, mobilizing additional international climate finance is critical for supporting large-scale implementation. Securing adequate funding remains a key hurdle in expanding green carbon projects across the region.

Equally important is the need to develop robust monitoring, reporting, and verification (MRV) systems to track the effectiveness of green carbon projects. Accurate data on carbon sequestration and storage is crucial for ensuring the integrity of green carbon accounting and for accessing international climate finance

mechanisms. Yet, many countries in the region lack the necessary technical expertise and infrastructure to develop comprehensive MRV systems, hindering their ability to fully engage in global carbon markets.

Equitable benefit-sharing is another critical issue. Ensuring that local communities, particularly Indigenous peoples and marginalized groups, are actively involved in green carbon projects is essential for achieving both environmental and social sustainability. However, there are concerns about the fair distribution of the benefits from forest conservation and restoration initiatives. If local communities do not see tangible benefits, they may be less inclined to participate in conservation efforts, potentially undermining the success of green carbon strategies. Effective stakeholder engagement and inclusive governance are therefore necessary to ensure that the costs and benefits of green carbon utilization are distributed equitably.

Finally, while peatlands offer significant opportunities for carbon storage, their management presents unique challenges. The degradation of peatlands due to drainage, logging, and recurrent fires is a major concern in countries like Indonesia and Malaysia. Degraded peatlands release large amounts of carbon dioxide and methane, contributing to global warming. Addressing these issues requires targeted restoration efforts, including the re-wetting of drained peatlands and the prevention of further degradation through better land-use planning and enforcement of environmental regulations.

The Asia-Pacific region has immense potential to leverage green carbon as part of its climate change mitigation strategy. The region's tropical forests and peatlands are vital carbon sinks that, if properly managed, can contribute significantly to global efforts to reduce greenhouse gas emissions. However, realizing this potential requires overcoming challenges related to deforestation, governance, financial constraints, and equitable benefit-sharing. By addressing these challenges through improved policies, sustainable land-use practices, and international cooperation, the region can not only enhance its carbon sequestration capacity but also support biodiversity conservation, ecosystem services, and sustainable development.

3 Research Method

This study employs a mixed-methods approach combining a systematic literature review with qualitative data collection through semi-structured stakeholder interviews. This approach allows for a comprehensive understanding of the role of green carbon in climate change mitigation efforts, particularly within the context of developing countries in the Asia-Pacific region.

The systematic literature review will focus on analyzing a range of sources, including peer-reviewed journal articles, policy documents, and grey literature such as reports from international organizations and NGOs. The review will specifically target literature addressing:

- The role of green carbon in climate change mitigation,
- The effectiveness of policies related to forest conservation, reforestation, and the management of natural carbon sinks,

- Challenges and opportunities specific to the Asia-Pacific region, particularly in the context of developing countries.

The literature review will be conducted using academic databases such as Scopus, Web of Science, and Google Scholar, as well as institutional repositories for relevant policy documents. Inclusion and exclusion criteria will be established to ensure that only recent, high-quality, and regionally relevant studies are considered. The systematic review will help identify key trends, emerging knowledge gaps, and critical issues, forming the foundation for developing the study's research objectives and guiding the interview design.

To complement the literature review, semi-structured interviews will be conducted with a diverse group of key stakeholders. These stakeholders will include:

- Policymakers (national and local levels) involved in environmental and climate policies,
- Researchers from universities and environmental think tanks who specialize in climate change mitigation and natural carbon sinks,
- Civil society representatives from NGOs and advocacy groups active in conservation efforts,
- Local community members from regions directly affected by deforestation and other land-use changes.

The interviews will aim to:

- Explore the challenges, opportunities, and best practices for integrating green carbon into climate change mitigation strategies,
- Gather insights into the socio-economic, political, and institutional factors influencing green carbon policy implementation,
- Identify stakeholder perspectives on the practical application of existing policies and potential improvements.

The semi-structured format will provide flexibility to delve deeper into specific issues raised by interviewees, while still ensuring that key topics are consistently addressed across all interviews. An interview guide will be developed based on insights from the literature review, and interviews will be conducted both in person and via online platforms, depending on the availability and location of participants.

3.1 Data Analysis

Data from both the literature review and semi-structured interviews will be analyzed using thematic analysis, a qualitative method used to identify, analyze, and report patterns (themes) within the data. This process will involve:

- Familiarization with the data: Transcribing interviews and reviewing literature findings,
- Coding: Identifying key phrases, terms, and concepts related to green carbon utilization, policy challenges, and socio-economic factors,
- Theme development: Grouping codes into broader themes that represent significant insights or recurring issues across the data,

- Reviewing and refining themes: Ensuring that the themes accurately reflect the data and contribute meaningfully to the research objectives.

The thematic analysis will reveal key themes, such as the effectiveness of existing green carbon policies, the role of local communities, and the impact of governance and financial constraints. This analysis will inform the development of practical policy recommendations and provide a framework for future research in green carbon utilization and climate mitigation.

3.2 Triangulation

The study will employ triangulation by cross-referencing findings from the literature review and interview data to ensure validity and reliability. Triangulation will enable the comparison of different perspectives, enhancing the robustness of the analysis. By integrating both secondary and primary data sources, the study can present a well-rounded understanding of green carbon utilization in the Asia-Pacific region.

3.3 Ethical Considerations

Ethical approval will be sought from the relevant institutional review board before conducting interviews. Participants will be informed about the study's objectives, and informed consent will be obtained before each interview. Confidentiality and anonymity will be guaranteed to protect the privacy of all participants.

3.4 Expected Outcomes

The findings from this mixed-methods study will provide:

- A comprehensive analysis of the role of green carbon in climate change mitigation efforts in the Asia-Pacific region,
- Insights into the challenges and opportunities for implementing green carbon policies in developing countries,
- Practical recommendations for policymakers on how to enhance green carbon initiatives while addressing socio-economic and governance issues.

The study will also highlight areas for future research, including the need for improved monitoring systems, greater community involvement, and enhanced international collaboration in green carbon projects.

4 Findings

This section presents the findings from both the systematic literature review and the semi-structured interviews conducted with key stakeholders. The data has been analyzed using thematic analysis, and the results are organized around the key themes that emerged, offering insights into the challenges, opportunities, and best practices related to green carbon utilization in climate change mitigation in the Asia-Pacific

region. The findings also explore socio-economic, political, and institutional factors that influence the implementation of green carbon policies.

4.1 The Role of Green Carbon in Climate Change Mitigation

The literature review and interviews confirm the significant role that green carbon plays in climate change mitigation, particularly in the Asia-Pacific region. The region's vast tropical forests, peatlands, and coastal ecosystems such as mangroves are identified as critical carbon sinks, with the capacity to absorb and store large amounts of carbon dioxide [16,20]. Participants across the stakeholder groups agreed that conserving and restoring these ecosystems is essential to achieving global climate targets.

The interviews with policymakers revealed a strong awareness of the need to integrate natural carbon sinks into national climate strategies. However, several policymakers emphasized that while green carbon offers a cost-effective mitigation option, it is often overshadowed by more technologically focused approaches, such as renewable energy and carbon capture technologies. A policymaker from Indonesia noted, "Green carbon strategies are often seen as secondary compared to industrial solutions, but the potential is enormous if we manage our forests and peatlands correctly."

4.2 Challenges in Implementing Green Carbon Policies

Despite the recognized importance of green carbon, the study uncovered several persistent challenges that hinder its full integration into climate policies. Several challenges hinder the full realization of green carbon's potential in the Asia-Pacific region. These challenges range from policy and governance gaps to issues of equity and capacity, all of which must be addressed to maximize the effectiveness of green carbon strategies.

Deforestation and Forest Degradation.

The most significant challenge identified is the ongoing deforestation and forest degradation in many Asia-Pacific countries. Interviews with civil society representatives and local community members highlighted the complexity of the issue, with agricultural expansion, logging, and infrastructure development being the primary drivers of deforestation. These activities are often incentivized by economic growth strategies that prioritize short-term gains over long-term environmental sustainability. A community leader from Indonesia remarked, "The pressure to clear land for agriculture is immense, and without viable alternatives, people will continue to cut down forests."

Logging, the conversion of forests and peatlands into industrial plantations, and peatland drainage are major contributors to the degradation of natural carbon sinks. These activities not only release vast amounts of carbon dioxide into the atmosphere but also threaten biodiversity and the ecosystem services these habitats provide [1,4,13]. The drainage of peatlands, in particular, has had devastating consequences, leading to massive carbon emissions and recurrent fires, as seen in parts of Indonesia

[9]. Addressing these drivers of degradation requires robust governance frameworks that regulate land use and promote sustainable alternatives to deforestation.

The literature also corroborates these findings, with research showing that deforestation rates in key countries, such as Indonesia and Malaysia, remain high due to the demand for palm oil, timber, and other commodities [18]. Several NGO representatives stressed the need for more stringent land-use policies and governance reforms to curb illegal logging and forest clearing.

Weak Governance and Policy Incoherence.

The region faces a significant governance challenge in terms of developing coherent policies and regulations to protect and restore natural ecosystems. In many countries, fragmented governance structures and weak enforcement of environmental laws exacerbate the problem of illegal logging, unsustainable agriculture, and land conversion. The lack of effective land-use management policies creates conflicting priorities between conservation and development, making it difficult to achieve long-term sustainability. Several policymakers interviewed pointed to the need for stronger regulatory frameworks and better inter-agency coordination to ensure that green carbon initiatives are prioritized within national climate agendas.

Financial and Capacity Constraints.

Another major challenge is the lack of financial resources and institutional capacity to implement and scale green carbon initiatives effectively. Many stakeholders, particularly from government and research sectors, expressed concern over the limited funding available for forest conservation and reforestation programs. This lack of financial backing is compounded by insufficient technical expertise and weak governance structures, particularly at the local level, where forest management often occurs.

Several policymakers highlighted the challenges of accessing international climate finance, such as through mechanisms like REDD+ (Reducing Emissions from Deforestation and Forest Degradation). While these programs offer potential funding, the bureaucratic requirements for monitoring, reporting, and verification (MRV) are seen as barriers. A researcher from Vietnam stated, “We need more support to build the technical systems that will allow us to monitor carbon sequestration accurately. Without this, it’s hard to access international funds.”

Limited Capacity for MRV (Measuring, Reporting, and Verification).

A critical technical challenge is the region’s limited capacity for measuring, reporting, and verifying (MRV) the carbon sequestration and storage potential of its natural ecosystems. Accurate data collection and monitoring are essential for validating the effectiveness of green carbon initiatives and for accessing international climate finance mechanisms such as REDD+ [9]. However, many countries in the Asia-Pacific region lack the necessary infrastructure, technical expertise, and financial resources to develop robust MRV systems. This limits their ability to participate in global carbon markets and hinders the scalability of green carbon initiatives.

Improving MRV capacity is crucial for ensuring the transparency and accountability of green carbon projects.

Equitable Distribution of Benefits.

The issue of equity emerged as a recurring theme in both the literature and interviews. Ensuring that local communities, particularly Indigenous peoples and marginalized groups, benefit from green carbon initiatives is a major concern. Interviews with local community members revealed a sense of exclusion from decision-making processes related to forest conservation. A civil society representative from the Philippines commented, “Often, the benefits of conservation efforts go to large organizations or governments, but the communities who live in and rely on these forests see little in return.”

The literature also highlights this concern, emphasizing the need for participatory approaches that involve local communities in the design and implementation of green carbon projects [1]. Without equitable benefit-sharing, green carbon strategies risk exacerbating existing inequalities and may even provoke resistance from local populations, undermining conservation efforts.

Another major challenge lies in ensuring that green carbon initiatives are equitable and inclusive. The region's cultural, social, and economic diversity makes it difficult to design and implement policies that adequately address the needs and concerns of local communities, Indigenous peoples, and marginalized groups. Many communities rely on forested areas for their livelihoods, and conservation efforts that restrict access to these resources without offering viable alternatives can lead to conflict and undermine the success of green carbon policies [1]. Ensuring that these communities are active participants in green carbon initiatives—and that they share in the benefits—requires inclusive governance structures and community-based conservation models.

4.3 Opportunities for Enhancing Green Carbon Policies

Despite these challenges, the study identified several opportunities for improving green carbon utilization in the Asia-Pacific region. The Asia-Pacific region presents substantial opportunities for utilizing green carbon—carbon absorbed and stored by natural ecosystems such as tropical forests, peatlands, and mangroves—as part of its climate change mitigation strategies. These ecosystems have immense carbon sequestration potential, and implementing effective policies to protect and restore them can make significant contributions to global climate mitigation efforts [13].

Policy Integration and International Cooperation.

One of the key opportunities lies in better integrating green carbon into broader climate change policies at both national and international levels. Several policymakers and researchers advocated for more holistic approaches that link forest conservation with renewable energy development, sustainable agriculture, and climate adaptation strategies. A policymaker from Malaysia noted, “We need to see green carbon not just

as a separate issue but as part of a wider sustainability agenda. It has to be embedded into everything we do, from energy policy to food security.”

International cooperation also offers significant potential, particularly through mechanisms like REDD+, which provide financial incentives for forest conservation. The systematic literature review found growing interest in cross-border initiatives that pool resources and expertise across countries, particularly in the Mekong and Southeast Asia regions. By sharing knowledge and leveraging regional collaborations, countries can overcome capacity gaps and enhance the effectiveness of green carbon policies [19].

Access to International Climate Finance.

One of the most promising opportunities is the region's potential to access international climate finance mechanisms, such as the REDD+ program (Reducing Emissions from Deforestation and Forest Degradation). REDD+ offers financial incentives for developing countries to conserve forests, thereby reducing emissions while contributing to socio-economic development. For many Asia-Pacific nations, which face significant financial constraints in addressing climate change, REDD+ and similar mechanisms provide crucial support for implementing green carbon strategies. By protecting carbon-rich ecosystems, countries can not only contribute to global climate goals but also receive financial rewards for their efforts.

Integration into National Development Plans.

Another key opportunity is the growing global and regional interest in sustainable development and the transition to low-carbon economies. Many countries in the Asia-Pacific region are increasingly recognizing the importance of integrating environmental protection into their national development plans. There is an emerging trend of incorporating green carbon into national climate action strategies and sustainable land-use planning, offering a chance to align climate goals with economic growth. By prioritizing green carbon initiatives in sectors like forestry, agriculture, and coastal management, governments can promote a sustainable development model that supports both environmental conservation and economic resilience.

Community-Based Approaches.

Several stakeholders emphasized the importance of community-based approaches in ensuring the success of green carbon projects. Interviewees from local communities and civil society organizations stressed that conservation efforts would be more sustainable and equitable if local populations were actively involved in decision-making and management processes. “If you give communities the tools and responsibility to manage their own forests, they will do it in a way that benefits both the environment and their livelihoods,” said a community leader from Indonesia.

The literature supports this view, highlighting the success of customary law and traditional forest management practices in preserving forests over generations [1]. Integrating these practices into formal policy frameworks offers a way to strengthen both environmental outcomes and social equity.

Protecting and restoring natural ecosystems not only helps mitigate climate change but also offers significant co-benefits, such as biodiversity conservation and the provision of critical ecosystem services [16]. These benefits extend beyond carbon storage, improving water regulation, soil fertility, and flood control, while also safeguarding local livelihoods that depend on forest and peatland resources. The enhancement of these co-benefits is particularly important for developing countries, where ecosystem services contribute directly to rural economies and food security.

Technological Advancements in MRV Systems.

Finally, advancements in Monitoring, Reporting, and Verification (MRV) systems present a major opportunity for enhancing green carbon strategies. Several researchers pointed to the potential of satellite technology and remote sensing to improve the accuracy and transparency of carbon sequestration measurements. This, in turn, would facilitate access to international climate finance and improve the overall accountability of green carbon projects. A researcher from Vietnam stated, “With better technology, we can not only measure the impact of our conservation efforts but also demonstrate this to international donors, increasing our access to funding.”

4.4 Best Practices for Green Carbon Implementation.

The interviews and literature review identified several best practices for enhancing the effectiveness of green carbon policies, including:

- Integrating green carbon into national climate plans to ensure that natural carbon sinks are prioritized alongside technological solutions,
- Building local capacity through training programs and financial support to ensure that local governments and communities can manage and monitor conservation projects effectively,
- Adopting participatory approaches that involve local communities in decision-making and benefit-sharing processes, ensuring long-term sustainability.

4.5 Result

The results of this study highlight both the opportunities and challenges associated with green carbon utilization in the Asia-Pacific region:

- Opportunities include access to international climate finance, the integration of green carbon into national climate strategies, and the co-benefits of biodiversity conservation and ecosystem services.
- Challenges involve addressing deforestation, improving governance and policy coherence, developing MRV systems, and ensuring equitable and inclusive green carbon initiatives.

These findings underscore the potential for green carbon to play a central role in climate change mitigation in the region, provided that the identified challenges are addressed through targeted policy interventions and collaborative approaches. This

study highlights the critical role of green carbon in climate change mitigation in the Asia-Pacific region, particularly through the conservation and restoration of tropical forests and peatlands. These ecosystems are powerful carbon sinks, with the potential to significantly offset emissions from other sectors and contribute to the global objective of stabilizing atmospheric CO₂ concentrations (Miettinen et al., 2017; [9,4,13]. However, despite their potential, the region faces substantial challenges in maintaining the integrity of these ecosystems.

Ongoing degradation due to unsustainable land-use practices, including logging, the conversion of forests to industrial plantations, and the drainage of peatlands, continues to release large quantities of stored carbon back into the atmosphere. Such activities not only hinder the carbon sequestration capacity of these ecosystems but also threaten the biodiversity and ecosystem services that sustain local livelihoods and environmental resilience [13,4]. Addressing these challenges is crucial for both regional and global climate change mitigation efforts.

Comprehensive Approaches for Green Carbon Conservation.

Moving forward, a comprehensive and collaborative approach is needed to overcome these challenges and harness the full potential of green carbon. Key areas of focus should include:

- Policy Interventions: Strengthening national and regional policies that protect forests and peatlands is essential. Policymakers should focus on creating coherent regulatory frameworks that align environmental goals with economic development. Improved land-use policies that limit deforestation, promote sustainable agricultural practices, and protect high-value conservation areas will be crucial in reducing the pressures on natural ecosystems.
- Enhanced Governance and Stakeholder Engagement: Effective governance is key to the successful implementation of green carbon strategies. This includes not only robust legal frameworks but also the enforcement of environmental regulations and the integration of local communities into decision-making processes. Community-based conservation efforts, which leverage local knowledge and prioritize the needs of Indigenous peoples and marginalized groups, are critical for long-term sustainability. Stakeholder engagement—from government agencies to local communities—must be strengthened to ensure that all voices are represented in land management and conservation initiatives.
- Innovative Financing Mechanisms: Developing innovative financing mechanisms will be crucial to ensure the long-term sustainability of green carbon projects. Programs such as REDD+ provide a useful model for incentivizing forest conservation through international funding. However, more needs to be done to mobilize private sector investment and establish new financial models that support conservation and restoration efforts. Integrating carbon markets and payments for ecosystem services (PES) into national development strategies could help generate the necessary resources to maintain and expand green carbon projects.

Implications and Global Context.

The findings of this study have broad implications at both global and local levels. Globally, the conservation of green carbon ecosystems in the Asia-Pacific region is integral to achieving international climate goals. The region's tropical forests and peatlands represent a significant portion of the world's carbon sinks, and their protection is essential to mitigating climate change. Collaboration between developing countries and the international community is vital to securing the resources and expertise needed to address ecosystem degradation.

At the local level, sustainable management of green carbon ecosystems can lead to wide-ranging benefits, including improved livelihoods, biodiversity conservation, and environmental protection. Policymakers in the region must prioritize policies that not only protect carbon-rich ecosystems but also ensure that local communities share in the economic and social benefits of conservation. By promoting sustainable development alongside conservation, governments can address climate change while fostering economic growth and social equity.

5 Areas for Further Research

To build on the findings of this study, further research is required to develop a more nuanced understanding of the complex dynamics that drive ecosystem degradation in the region. This includes the need for in-depth studies on the socio-economic, political, and institutional factors that perpetuate unsustainable land-use practices. Additionally, more research is needed to assess the effectiveness of various policy interventions, such as REDD+ and PES programs, in promoting the sustainable management of tropical forests and peatlands.

Moreover, community-based approaches to conservation should be explored in greater detail. Understanding how local communities, particularly Indigenous groups, can be empowered to manage and protect ecosystems is crucial for ensuring that green carbon initiatives are both environmentally and socially sustainable. Evaluating best practices for inclusive conservation efforts will be essential for designing policies that promote long-term stewardship of natural carbon sinks.

In conclusion, by addressing these challenges through targeted policy interventions, innovative financing mechanisms, and collaborative approaches, the Asia-Pacific region can unlock the immense potential of green carbon for climate change mitigation. The integration of these strategies into both national and international climate frameworks will be essential for ensuring a sustainable and resilient future.

References

1. Sandker, M., et al.: Tropical forest carbon storage and climate change mitigation in Southeast Asia. *Global Environmental Change* 68, 102263 (2021).
2. Griggs, D., et al.: Sustainable development goals for people and planet. *Nature* 495(7441), 305-307 (2013).
3. Asteria, D., et al.: Customary law and forest conservation: Integrating traditional practices into modern policies. *Forest Policy and Economics* 127, 102428 (2021).

4. Zhang, J., et al.: Green finance and its impact on sustainable recovery in South Asian economies. *Journal of Sustainable Finance & Investment* 13(2) (2023).
5. Cameron, E., et al.: The role of finance in supporting sustainable development in the Asia-Pacific. *Journal of Environmental Economics and Policy* 9(3), 320-333 (2020).
6. Pfaff, A., et al.: The economics of REDD+: Opportunities and challenges. *Annual Review of Resource Economics* 5(1), 279-298 (2013).
7. Dohong, A., et al.: Peatland management and restoration in Southeast Asia: Addressing key challenges. *Environmental Research Letters* 12(9), 094001 (2017).
8. Kartodihardjo, H., Supriyanto, B.: Customary law and sustainable forest management in Indonesia: Lessons from local communities. *Forest Policy and Economics* 115, 102-120 (2020).
9. Murdiyarmo, D., et al.: Tropical peatlands as significant carbon storage: Opportunities and challenges for climate change mitigation. *Nature Climate Change* 9(12), 924-928 (2019).
10. Hickmann, T.: Rethinking global climate governance: New perspectives on sustainability and international cooperation. *Global Environmental Politics* 20(4), 53-75 (2020).
11. Jaenicke, J., et al.: Determination of the amount of carbon stored in Indonesian peatlands. *Geoderma* 147(3-4), 151-158 (2008).
12. Mulyani, M., Jepson, P.: REDD+ and forest governance in Indonesia: Institutional challenges and opportunities. *Environmental Science and Policy* 77, 96-102 (2017).
13. Ojea, E., et al.: The role of ecosystem services in climate change mitigation and adaptation. *Environmental Science and Policy* 50, 152-164 (2015).
14. Pan, Y., et al.: A large and persistent carbon sink in the world's forests. *Science* 333(6045), 988-993 (2011).
15. Resosudarmo, B. P., et al.: Industrialization, economic growth, and environmental sustainability in Asia-Pacific. *Asian Economic Policy Review* 13(1), 32-46 (2018).
16. Sereenonchai, S., et al.: The role of knowledge transfer in climate change mitigation: Lessons from Asia-Pacific. *Climate Policy* 20(4), 487-498 (2020).
17. United Nations.: Sustainable Development Goals: 17 Goals to Transform Our World. UN (2015).
18. Dasgupta, S., et al.: Pathways to low-carbon development in the Asia-Pacific region: Policies and opportunities. *Asian Development Bank Report* (2019).
19. IPCC.: Climate Change 2021: The Physical Science Basis. Cambridge University Press (2021).
20. Lassa, J., Surjan, A.: Institutional challenges for climate adaptation in the Asia-Pacific. *Climate Policy* 17(3), 354-372 (2017).
21. Tavoni, M., et al.: The role of forests in climate change mitigation: Assessing the economics of REDD+. *Proceedings of the National Academy of Sciences* 104(46), 18925-18930 (2007).
22. Gupta, J., et al.: Low-carbon cities in the Asia-Pacific: Knowledge transfer and collaborative action. *Urban Climate* 23, 110-120 (2018).
23. UNFCCC.: Paris Agreement: Indonesia's Nationally Determined Contributions. UNFCCC (2020).

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

