Review Article

Research Progress on the National Greening Program in the Philippines: A Review

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ABSTRACT

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| The Philippine government launched the National Greening Program (NGP) in 2011 to reforest 1.5 million ha of degraded land, later expanding its target to 7.1 million ha by 2028. This review synthesizes research published from 2014 to 2024 in Scopus-indexed journals, supported by relevant policy and technical literature, to evaluate scholarly engagement with the NGP. A total of 22 peer-reviewed documents were analyzed and grouped into four thematic areas: remote sensing and monitoring, policy and governance, community participation and socioeconomic impact, and species selection and biodiversity. Findings reveal notable advances in geospatial monitoring and regulatory reforms, which have improved oversight, seedling standards, and policy integration. However, persistent implementation challenges, such as fragmented planning, weak community involvement, and inadequate ecological matching, continue to limit the program’s effectiveness. While some socioeconomic benefits have been observed, the literature indicates that the NGP often falls short in delivering sustained livelihood improvements due to limited tenure security and post-planting support. This review underscores the need to shift from purely quantitative planting targets toward quality-driven, site-specific, and inclusive restoration strategies. Key recommendations include integrating biodiversity-sensitive practices, enhancing community-led planning, strengthening governance mechanisms, and institutionalizing the use of high-quality, ecologically appropriate planting materials. As the NGP approaches its 2028 target, evidence-based, participatory approaches will be critical to ensuring the program’s long-term ecological and social success. |

*Keywords:* Community participation, Environmental governance, Forest restoration, Remote sensing, Reforestation, Sustainable land management

**1. INTRODUCTION**

The Philippines has experienced significant forest loss and degradation over the past century. Forest cover declined from approximately 17 million hectares in 1930 to just 5.8 million hectares by 2000 (Dolom, 2003), posing a critical threat to the country’s rich biodiversity (Verburg et al., 2006). The main drivers of deforestation include commercial logging, illegal forest activities, agricultural expansion, and shifting cultivation, locally known as kaingin (Verburg et al., 2006; Mukul et al., 2016). According to the most recent report by the Forest Management Bureau (FMB), forest cover had modestly increased to 7.2 million hectares by 2020 (FMB, 2024).

Forest degradation has far-reaching ecological and socio-economic consequences. It reduces the capacity of ecosystems to provide essential services such as carbon sequestration, wood production, and biodiversity conservation (Thompson et al., 2013). Moreover, deforestation exacerbates the severity of environmental hazards, including flooding and landslides (Nistor, 2021). These challenges are compounded by the Philippines’ high vulnerability to climate anomalies, which threaten national economic growth and the well-being of millions, particularly marginalized and poor communities (Fuentes & Conception, 2007).

In response to these environmental and socio-economic threats, the Philippine government launched the National Greening Program (NGP) in 2011 through Executive Order No. 26. Initially covering the period 2011–2016, the program aimed to plant 1.5 billion trees across 1.5 million hectares of denuded and degraded lands. This was later expanded under Executive Order No. 193 in 2015, with an extended target of 7.1 million hectares by 2028 (Aquino, 2015; Fontanoza, Jr. & Navarra, 2020; Goltiano et al., 2021; von Kleist et al., 2021). The NGP pursues multiple objectives: poverty reduction, food security, biodiversity conservation, and climate change mitigation (Cagalanan, 2016; Goltiano et al., 2021).

Led by the Department of Environment and Natural Resources (DENR), the NGP is implemented in partnership with Local Government Units (LGUs), civil society organizations, and grassroots communities. LGUs are mandated to contribute by planting and maintaining trees in public spaces such as parks and urban forests (Fontanoza, Jr. & Navarra, 2020). A central strategy of the NGP is the involvement of farmers and local residents, who receive training and labor-based incentives to promote sustainable reforestation (Goltiano et al., 2021).

Despite its ambitious scope and planting achievements, the program’s effectiveness in delivering long-term biodiversity and livelihood outcomes remains contested. While some gains have been noted in knowledge and technical capacity, immediate socioeconomic benefits to participants were found to be limited and inconsistently distributed (Goltiano et al., 2021). The NGP has also been criticized for prioritizing quantitative targets over ecological integrity, often neglecting biodiversity-sensitive practices and community-based forestry principles (von Kleist et al., 2021).

Further constraints arise from issues of poor governance, inadequate planning, and regulatory gaps. Satellite-based assessments show that although forest cover initially increased, deforestation resurged between 2016 and 2018, resulting in minimal net forest gain (Perez et al., 2020). The FMB (2024) reported only a 3% increase in forest cover from 2015 to 2020, underscoring the limited progress in reversing deforestation trends. These persistent challenges highlight the need for improved program design, stronger stakeholder participation, and more robust monitoring frameworks. Scholars advocate for deeper community engagement, clearer policy alignment, and the use of advanced remote sensing technologies to evaluate ecological and social outcomes (Diwa et al., 2024; von Kleist et al., 2021; Goltiano et al., 2021).

More than a decade after its launch, the NGP remains one of the most ambitious environmental and development initiatives in Philippine history. Its multi-dimensional goals, ranging from ecosystem restoration to poverty alleviation, make it a complex undertaking with broad implications for sustainability, governance, and rural development. As implementation continues toward its 2028 targets, there is an urgent need to critically assess how the program has been studied, understood, and evaluated by the academic and policy communities.

Although several studies have explored specific components of the NGP, such as planting performance, livelihood effects, and governance dynamics, no comprehensive synthesis has been undertaken to consolidate the scope, direction, and findings of these works. The existing literature remains fragmented by theme, scale, and methodology, limiting the ability to derive integrated insights about the program’s strengths, weaknesses, and future potential. Moreover, questions remain regarding the balance between environmental and social outcomes, the effectiveness of monitoring mechanisms, and the extent of meaningful community participation in implementation.

Given these gaps, a systematic review of research conducted on the NGP from 2011 to 2025 is both timely and necessary. This paper aims to provide a holistic overview of peer-reviewed and policy-relevant literature that has examined the program since its inception. By identifying dominant research themes, geographic and institutional coverage, methodological approaches, and evidence-based insights, this review seeks to highlight both the achievements and limitations of current knowledge.

Anchored on the overarching goal of assessing scholarly engagement with the NGP, this paper seeks to achieve the following specific objectives:

1. Determine the extent and thematic focus of peer-reviewed research on the NGP published between 2011 and 2025;

2. Analyze the contributions of these studies to the understanding, evaluation, and improvement of the program’s implementation, outcomes, and impacts; and

3. Identify key research gaps and recommend future research thrusts and directions that can enhance the program’s refinement, sustainability, and long-term success.

By addressing these objectives, this review aims to deliver a synthesized and critical account of how the NGP has been represented in the literature, offering insights that are relevant for both academic inquiry and policy advancement.

**2**. **SCOPE AND METHOD OF LITERATURE REVIEW**

To address the identified research gaps and meet the objectives of this review, a literature analysis was conducted focusing on Scopus-indexed publications relevant to the NGP. The review specifically covers documents published from 2014 to 2024, aligning with the years following the official implementation of the program in 2011.

A systematic search was carried out using the Scopus database, applying the keywords “National Greening Program” AND “Philippines” to the title, abstract, and keyword fields. This search yielded a total of 22 documents, which were subjected to detailed metadata analysis. Each document was reviewed for information, including publication year, document type, citation count, subject area, and source title. The documents were then categorized into four major subject areas based on their central thematic focus (Table 1).

Table 1. Scopus-indexed studies related to the National Greening Program in the Philippines (2014–2024).

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| **Author(s)** | **Year** | **Major subject area** |
| **Garcia and Principe** | **2024** | **Remote Sensing, GIS, and Landscape Change Monitoring** |
| **Diwa et al.** | **2024** |
| **Pansit and Parilla** | **2024** |
| **Israel and Bantayan** | **2021** |
| **Fontanoza, Jr. and Navarra** | **2020** |
| **Perez et al.** | **2020** |
| **Arellano et al.** | **2019** |
| **Jardeleza et al.** | **2019** |
| **Estoque et al.** | **2018** |
| **Pada et al.** | **2016** |
| **von Kleist et al.** | **2021** | **Policy and Environmental Governance** |
| **Cruz** | **2018** |
| **Navarrete et al.** | **2018** |
| **Gregorio et al.** | **2017** |
| **Baynes et al.** | **2016** |
| **Cagalanan** | **2016** |
| **Wiset et al.** | **2023** | **Community Participation and Socioeconomic Impact** |
| **Goltiano et al.** | **2021** |
| **Cororaton et al.** | **2016** |
| **Le et al.** | **2014** |
| **Nabua et al.** | **2023** | **Species Selection, Biodiversity, and Tree Improvement** |
| **Engay-Gutierrez et al.** | **2022** |
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In terms of document type, 15 were journal articles, five were conference papers, and two were book chapters (Figure 1). These were published across 18 distinct sources, with the *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences (ISPRS Archives)* contributing the largest number (n = 3). As of June 2025, 18 of the 22 documents had been cited at least once, with a total citation count of 277. The resulting h-index for this dataset is six, indicating that six documents have received at least six citations each.

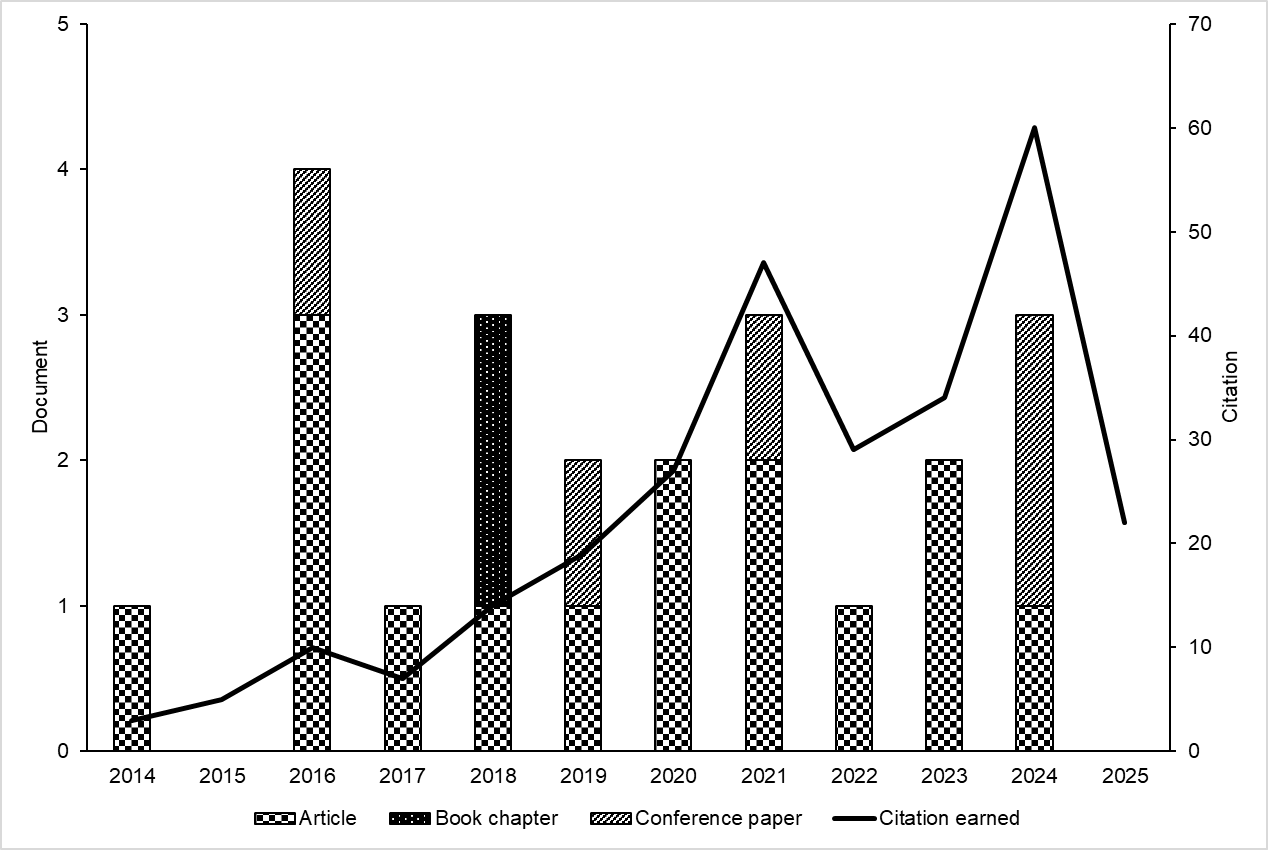


Fig. 1. Year of publication, document type, and citation count of Scopus-indexed studies on the National Greening Program in the Philippines.

All reviewed documents were written in English and formed the core dataset for identifying research trends, thematic concentrations, and gaps in the literature. To provide a broader and more nuanced discussion, this review also incorporated additional sources, such as government reports and recent technical publications, where appropriate.

**3.** **REMOTE SENSING, GIS, AND LANDSCAPE CHANGE MONITORING**

This section highlights the use of geospatial tools in monitoring forest conditions, land cover change, and NGP outcomes. Technologies such as Normalized Difference Vegetation Index (NDVI) analysis, radar imaging, and mangrove suitability mapping have supported forest disturbance detection and spatial policy assessments (Estoque et al., 2018; Arellano et al., 2019; Jardeleza et al., 2019; Fontanoza and Navarra, 2020; Perez et al., 2020). These methods have also revealed spatial mismatches in site selection, landscape-scale forest dynamics, and varying impacts of reforestation across regions (Israel and Bantayan, 2021; Pada et al., 2016; Garcia and Principe, 2024; Pansit and Parilla, 2024; Diwa et al., 2024).

Several studies have confirmed that remote sensing platforms, particularly the use of NDVI, SAR backscatter, and Google Earth Engine, offer scalable, near-real-time tools for evaluating vegetation trends under the NGP. Radar backscatter analysis has also been employed to differentiate forest structural conditions. Arellano et al. (2019) used Sentinel-1A SAR data to assess dense versus sparse forest growth in Zamboanga Sibugay and Bohol, demonstrating the utility of radar imagery for structural characterization in cloud-prone regions. Their findings revealed that radar backscatter values could effectively distinguish varying biomass densities and canopy structures, providing an objective measure of forest condition. This is significant for the NGP as it enhances the capacity to monitor forest development over time, particularly in areas where frequent cloud cover hinders the use of optical satellite imagery. The study supports the integration of advanced geospatial technologies into national reforestation efforts, offering a more accurate and consistent means of evaluating project outcomes and informing adaptive management strategies.

Diwa et al. (2024) have developed a methodology using both optical (Sentinel-2 and MODIS) and radar (Sentinel-1 SAR) satellite imagery to assess reforestation efforts in Zambales. Their approach utilized indices such as NDVI, RVI (Radar Vegetation Index), and RFDI (Radar Forest Degradation Index), and applied advanced techniques like Random Forest classification via Google Earth Engine. The results showed consistent increases in vegetation cover from 2016 to 2022, indicating successful greening efforts in the area. These findings were validated with field data, highlighting the reliability of combining remote sensing with on-the-ground verification. On the other hand, Israel and Bantayan (2021) found that countrywide NDVI mosaics indicated a positive trend in vegetation cover from 2011 to 2018, especially in protected areas and ancestral domains, suggesting that the NGP had a measurable impact in areas with stronger institutional stewardship.

Moreover, monitoring forest fragmentation and urban greening efforts has also featured prominently. Fontanoza and Navarra (2020) applied mean patch size as a spatial metric to evaluate the effectiveness of Quezon City’s urban reforestation under the NGP, finding increased patch cohesion and vegetation density in key urban parks. Furthermore, Casisirano et al. (2024) applied remote sensing and GIS in their study on tree planting prioritization in the National Capital Region, Philippines, using remote sensing, analytic hierarchy process, and GIS to aid local government agencies and environmental organizations in evaluating and recalibrating their local greening programs. Meanwhile, Estoque et al. (2018) conducted a multi-temporal landscape analysis in the La Mesa Watershed, concluding that while tree cover had improved from 2002 to 2016, urban encroachment remained a threat, and forest fragmentation continued at the peripheries. These findings underscore the potential of remote sensing not only to assess gains but also to identify persistent pressures on forest systems.

Furthermore, the Philippine Space Agency (PhilSA) (2023), in partnership with the DENR, launched a national initiative in 2023 to institutionalize geospatial monitoring for the NGP. This program involves the monthly generation of vegetation and forest-cover maps through satellite data, complemented by DENR's own field and policy data. The integration aims to enhance the DENR’s capacity to assess the performance of the NGP and detect forest disturbances more efficiently. A geospatial database system has been developed under this initiative, and DENR staff are being trained to operate and interpret satellite data using platforms like Google Earth Engine. These efforts ensure that the remote sensing outputs directly reflect the realities on the ground and conform to official DENR records and standards (PhilSA, 2023). Overall, both the Diwa et al. (2024) study and the DENR–PhilSA collaboration highlight the growing potential of GIS and remote sensing to provide accurate, up-to-date, and policy-relevant data for evaluating the progress of the NGP.

Despite these technological advances, other studies have observed limited or uneven gains in forest cover. Pansit and Parilla (2024) reported minimal positive NDVI changes in Central Visayas between 2013 and 2019, with only modest vegetation recovery in Negros Oriental. Cebu, on the other hand, experienced vegetation loss due to low seedling survival, agricultural conversion, and unregulated tourism. Similarly, Perez et al. (2020) demonstrated that despite large-scale planting campaigns in Northern Luzon, satellite data did not reflect meaningful forest recovery due to ongoing deforestation driven by subsistence activities and logging.

Forest disturbance monitoring and land use modeling have also formed critical components of recent assessments. Garcia and Principe (2024) used the Normalized Difference Moisture Index (NDMI) to detect changes in the Kaliwa River Forest Reserve, where forest loss was significantly driven by kaingin practices and illegal logging, although reforestation initiatives had slowed the rate of disturbance. Jardeleza et al. (2019) utilized land cover change models to simulate deforestation trends nationwide and projected future forest loss under different policy scenarios. Their study emphasized that unless forest governance is strengthened, NGP’s reforestation gains may be eroded by continued land conversion.

In terms of site suitability assessment, Pada et al. (2016) conducted a GIS-based evaluation of mangrove planting sites in Kabankalan, Negros Occidental. The study revealed that many reforestation efforts had failed due to species-site mismatches. By analyzing pH, salinity, soil type, and elevation, the authors provided a detailed suitability map that could guide future mangrove restoration. Their work reinforces the argument that ecological diagnostics must precede planting activities to ensure survival and success.

A related issue in upland reforestation was identified by Emam and Lubos (2021), who reported that many NGP sites in upland areas of Bukidnon experienced high seedling mortality due to mismatches between soil characteristics and the species planted. Emam and Lubos (2021) further stressed that planners often bypassed soil testing, slope analysis, and rainfall assessment, resulting in the planting of fast-growing exotic species in degraded or poorly suited environments. This study signifies one of the factors affecting the implementation of the largest reforestation activity in the country.

While the NGP is a significant project aimed at improving forest cover in the Philippines, and the DENR is advancing its ability to measure and monitor the program, the initiative was reported to be slow in its implementation. A report from the Philippine Institute for Development Studies (PIDS) (2015) indicated that in its first three years, the NGP planted only 398 million seedlings out of a planned 600 million, with an average survival rate of 61%, which falls short of the 85% target. In 2019, a Commission on Audit (COA) performance audit revealed that the NGP fell far short of its 1.5 million ha target, achieving only about 177,000 ha, or 12% of its goal. The audit cited rushed planning, untenured sites without maintenance, and the planting of largely agroforestry species that did not contribute to true forest cover (COA, 2019).

These studies underscore that while the Philippines has made progress in remote monitoring of reforestation, the overall outcomes of the NGP remain uneven. Technological tools have enhanced the ability to measure vegetation change and forest disturbance, yet implementation challenges, including poor site-species matching, continuing deforestation, and urban expansion, remain unresolved. Remote sensing can identify where forest gains are occurring and where they are not, but translating these insights into adaptive management strategies remains a critical gap in NGP governance. These monitoring gaps highlight the importance of examining how institutional frameworks and policy designs can better respond to the on-the-ground realities revealed by geospatial tools.

**4.** **POLICY AND ENVIRONMENTAL GOVERNANCE**

This section highlights the institutional and regulatory frameworks of the NGP, focusing on integrated policy design, seedling standards, science-based planning, and governance reforms to support biodiversity and productivity goals (Baynes et al., 2016; Cagalanan, 2016; Gregorio et al., 2017; Cruz, 2018; Navarrete et al., 2018). This section will also present persistent issues, including evidence of fragmented planning, weak coordination, limited community inclusion, and implementation gaps such as poor site matching and top-down decision-making (von Kleist et al., 2021).

Cruz (2018) positioned the NGP as a strategic policy instrument within the broader context of water and land management in the Philippines. He argued that when reforestation efforts are effectively aligned with watershed rehabilitation and climate change mitigation strategies, they hold strong potential to enhance long-term environmental security. Nonetheless, institutional fragmentation and weak sectoral alignment have significantly constrained the program’s efficacy. In response, the Philippine government introduced several policy instruments, most notably the Philippine Master Plan for Climate Resilient Forestry Development 2022–2030, which aims to harmonize sectoral approaches in forestry, water, and land-use planning (DENR, 2022). The institutionalization of Forest Land Use Planning (FLUP) among LGUs, together with DENR’s convergence strategy, reflects efforts to improve both vertical and horizontal coordination. Despite these developments, these initiatives have yet to consistently address field-level fragmentation.

Reflecting these concerns, Israel (2017) emphasized that although the NGP has successfully mobilized financial and institutional resources, its operational coherence has been undermined by ambiguities in the roles of national agencies and LGUs, as well as overlapping mandates within the DENR. He advocated for the integration of reforestation initiatives within broader watershed management frameworks to enhance institutional accountability. This concern was partially addressed through DENR Administrative Order No. 2021-18, which mandates site-specific, science-based planning that considers topographic, hydrological, and ecological suitability (DENR, 2021b). In line with the recommendations of Israel (2017), this policy provides a conceptual framework for improved governance; however, persistent implementation challenges, particularly in upland municipalities, continue to hinder its overall effectiveness.

Luna (2016) critiqued the NGP’s siloed governance, wherein administrative targets, particularly regarding the number of trees planted, often outweighed the need for integrated landscape management. He advocated incorporating climate adaptation, disaster risk reduction, and land-use harmonization in reforestation planning. Reforms such as Executive Order No. 193 of 2015 and DAO 2021-11 have begun steering the program toward landscape-level approaches and ecological integrity (DENR, 2021a). However, in practice, program success remains largely measured by output-oriented indicators like planting targets, rather than by outcomes related to ecosystem services. This reflects a persistent disconnect between policy narratives and operational frameworks.

Building on this critique of technical and administrative shortcomings, Gregorio et al. (2017) highlighted inadequacies in nursery accreditation and seedling quality control, pointing to procurement practices that prioritized cost-efficiency over biological quality as a major contributor to high seedling mortality. DAO 2021-11 was enacted to address these concerns by establishing stricter nursery accreditation procedures, third-party audits, and mandatory seedling performance monitoring (DENR, 2021a). These provisions align with earlier critiques and represent progress in strengthening the technical foundation of forest restoration.

Complementing this perspective on ecological planning, Navarrete et al. (2018) emphasized the absence of soil-based considerations in NGP planning and implementation, leading to ecological mismatches and lower seedling survival rates. They recommended integrating soil diagnostics, land classification, and agroecological zoning into program protocols. DAO 2021-18 responds to these gaps by requiring soil data collection and application during site assessments (DENR, 2021b). Yet, uneven technical capacity and limited access to soil data remain barriers to effective implementation.

From an institutional collaboration standpoint, Cagalanan (2016) presented empirical evidence on the positive outcomes of public-private partnerships (PPPs) in enhancing reforestation, citing a successful case in Negros Occidental where collaboration between a geothermal firm and local communities improved both ecological and social results. Although current DENR policy directions and the Master Plan for Climate Resilient Forestry Development recognize the value of PPPs, institutional incentives and enabling conditions for long-term private sector engagement are still underdeveloped, limiting the replicability of such models (DENR, 2022).

von Kleist et al. (2021) offered a governance-centered critique, identifying factors that constrained biodiversity outcomes in the program: prioritizing planting volume over ecological suitability, marginalization of community-based forestry systems, and inadequate implementation planning. Attempts to recalibrate the NGP through the Master Plan and DAO 2021-18 acknowledge the importance of biodiversity-oriented and participatory strategies (DENR, 2022; DENR, 2021b). Nonetheless, entrenched institutional norms and centralized decision-making continue to impede transformative reforms.

Baynes et al. (2016) further examined governance limitations, revealing how inequitable power dynamics within community forestry groups and among stakeholders fostered exclusion and resistance. Their findings highlighted the limitations of devolving authority without ensuring participatory structures and equitable benefit-sharing. Although recent policies emphasize stakeholder engagement and participatory governance, especially through improved FLUP protocols, actual implementation often remains top-down, revealing a gap between policy ideals and field realities (DENR, 2022).

Collectively, the reviewed studies illustrate both the progress made and the challenges that persist in the institutional and governance landscape of the NGP. While recent policy reforms signify a shift toward more integrated, science-based, and participatory approaches, key issues remain unresolved. These include inconsistencies in local implementation, constrained institutional capacity, and the continued focus on quantitative metrics rather than ecological and social outcomes. Addressing these gaps requires not only technical improvements but also systemic institutional reforms that prioritize coherence, inclusivity, and long-term ecological sustainability in forest governance. These governance reforms are especially crucial when evaluating how policies translate into actual community participation and socioeconomic benefits at the grassroots level.

**5.** **COMMUNITY PARTICIPATION AND SOCIOECONOMIC IMPACT**

This section reviews the engagement of local communities in the NGP and its associated socioeconomic impacts, highlighting community-led forest restoration, the lived experiences of smallholders, and the broader economic potential of reforestation in reducing poverty and enhancing livelihood resilience in the Philippines (Le et al., 2014; Cororaton et al., 2016; Goltiano et al., 2021 and Wiset et al., 2023).

Since its launch in 2011, the NGP has planted over 2 million hectares of forests, produced more than 1.8 billion seedlings, and generated over 5.3 million jobs across the country. These accomplishments represent major strides in restoring degraded forestlands, enhancing ecosystem services, and contributing to rural employment and poverty reduction (FMB, 2024).

For instance, Wiset et al. (2023) examined the effectiveness of community engagement in reforestation initiatives under the NGP in Leyte and Biliran. Their study focused on the role of People’s Organizations (POs) in restoring degraded forest landscapes. It revealed that while the program mobilized collective action, it often failed to give communities meaningful participation in planning and decision-making. The authors observed that local actors were typically limited to fulfilling labor contracts, with minimal input in species selection, site design, or monitoring frameworks. This limited engagement diminished the sense of ownership and undermined long-term commitment to forest maintenance. Wiset et al. (2023) emphasized that the success of large-scale reforestation is contingent not just on technical execution but on securing tenure, empowering communities, and fostering a bottom-up governance model. This case reflects common patterns in Philippine reforestation, where top-down delivery mechanisms overlook the nuanced needs of upland communities (Pulhin et al., 2024). This aligns with the observations of Baynes et al. (2016), who argue that community forestry efforts across Southeast Asia often struggle due to weak participatory structures and a lack of local autonomy in decision-making.

Complementing these insights, Goltiano et al. (2021) further explored these themes by evaluating the socioeconomic outcomes of NGP implementation among smallholder farmers in Caibiran, Biliran. Their research revealed a disconnect between measured improvements and participants’ perceptions of change. While quantitative indicators suggested increased income and skills development among farmers, respondents expressed skepticism about any real improvement in their quality of life. Many of the perceived shortcomings were tied to the absence of post-planting livelihood support, limited market access, and top-down decision-making that excluded smallholders from planning and monitoring roles. The study concluded that without sustained engagement, capacity-building, and integrated support services, the economic benefits of NGP remain short-lived and superficial. Comparable issues are highlighted in the study conducted by Chechina et al. (2018), who found that forest-dependent communities in the Philippines achieved better socioeconomic outcomes when local livelihoods, such as non‑timber forest products, were deliberately integrated into conservation planning.

At the national level, Cororaton et al. (2016) conducted an economic modeling study to assess the broader potential of the NGP in improving rural livelihoods and reducing poverty. Their findings indicated that full implementation of the NGP could lead to increased agricultural productivity, lower food prices, and improved household welfare, particularly among the poorest segments of the population. However, the authors cautioned that these outcomes heavily depended on program continuity, effective governance, and the integration of NGP objectives into a wider rural development strategy. This reflects a recurring challenge in Philippine development programs: strong short-term implementation with weak long-term institutional integration. This reflects global insights, such as those by the Weltbank (2021), which emphasize that natural capital investment alone is insufficient without strong institutions, consistent policy support, and poverty-focused development frameworks.

Adding a broader systems perspective, Le et al. (2014) examined 43 reforestation projects in Leyte and identified critical success drivers, including revegetation methods, funding sources, education campaigns, forest protection mechanisms, infrastructure, and community dependence on forest resources as essential to both environmental and socioeconomic outcomes. Their study revealed that successful projects often combined mixed-species plantations with marketable trees, enabling communities to meet conservation and livelihood needs. Education and awareness campaigns improved local stewardship, while road conditions were surprisingly influential, affecting seedling transport and market access. Forest protection mechanisms, such as grazing control and fire prevention, were indispensable for maintaining planted areas.

Le et al. (2014) emphasized that reforestation success depends not on isolated actions but on the interaction of technical, institutional, and social factors. When communities are empowered through inclusive planning, appropriate incentives, diversified livelihood options such as agroforestry and non-timber forest products, and strong partnerships with government and NGOs, projects are more likely to achieve ecological restoration and sustainable development goals. These findings are echoed by Börner et al. (2020), who emphasized that secure tenure, community participation, and robust incentive structures are fundamental to effective and enduring forest restoration across developing countries. Their global review reinforces the need for multi-dimensional approaches that move beyond planting targets to address underlying governance, economic, and infrastructural conditions. Their work strongly supports integrated strategies that combine technical interventions with social investment, infrastructure development, and sustained capacity-building for local stakeholders.

These studies illustrate that while the NGP has created temporary employment and introduced forest restoration practices at the community level, it has not yet achieved its full promise as a poverty reduction and social development program. In the local context, many community members involved in NGP projects still face land tenure insecurity and unstable incomes despite their direct contributions to forest rehabilitation. Structural limitations in participation, livelihood integration, and follow-through have prevented communities from fully benefiting from their involvement in the program. For the NGP to become an effective driver for inclusive growth, it must adopt a systems-based approach that strengthens socio-economic incentives, encourages community leadership, and supports enabling conditions such as road infrastructure, market access, and multi-actor partnerships. In future iterations, integrating long-term livelihood strategies, adaptive management practices, and grassroots-driven monitoring systems could enhance the program's ecological and social outcomes. Such inclusive approaches are equally vital when considering biodiversity and tree improvement strategies that must align with both ecological objectives and community needs.

**6. SPECIES SELECTION, BIODIVERSITY, AND TREE IMPROVEMENT**

This section examines the ecological contributions of the NGP, emphasizing the use of native tree species, biodiversity-centered reforestation strategies, and appropriate species-site matching, particularly in mangrove ecosystems (Engay-Gutierrez et al., 2022; Nabua et al., 2023).

Engay-Gutierrez et al. (2022) conducted a tree improvement assessment in Mt. Banahaw de Lucban, Quezon, in Southern Luzon, identifying 22 superior individual trees across 12 native forest tree families. Using phenotypic selection criteria including height, diameter, and canopy structure, the study identified biologically vigorous trees predominantly found at mid-elevations (700–900 m above sea level). These individuals demonstrated strong site adaptability, making them valuable genetic resources for future reforestation initiatives. This approach aligns with fundamental principles of tree improvement programs, which emphasize the selection of genetically superior traits to enhance forest regeneration, wood quality, and resilience under changing environmental conditions (Commission on Genetic Resources for Food, 2014). The authors underscored the importance of formally documenting and conserving these plus trees through biodiversity registers, alongside implementing protective measures against environmental threats. Their findings emphasize that both genetic quality and ecological suitability should serve as guiding principles in the implementation of the NGP.

This position is consistent with existing national policy frameworks. Specifically, DENR Administrative Order No. 2010-11 outlines protocols for the identification, registration, and utilization of plus trees as official seed sources for reforestation programs (DENR, 2010). Additionally, DENR Memorandum Order No. 2023-03 mandates the exclusive use of quality planting materials sourced from individual plus trees (IPTs), Seed Production Areas (SPAs), or accredited nurseries for NGP activities to ensure the biological integrity and field performance of planted seedlings (DENR, 2023). Institutionalizing tree improvement and integrating forest genetic resource management into restoration planning will significantly enhance the long-term ecological sustainability and productivity of reforestation efforts, an approach aligned with internationally recognized best practices in forest genetic conservation (ITTO, 2009).

Shifting to a coastal perspective, Nabua et al. (2023) examined the condition of mangrove ecosystems in Panguil Bay, where the implementation of the NGP has led to a notable expansion in mangrove cover. At the national level, mangrove rehabilitation was established as a key component of the program’s broader reforestation agenda. By 2016, the NGP reported the planting of over 1.8 billion seedlings across approximately 2.17 million hectares, a significant portion of which was allocated to mangrove areas (DENR, 2016). For instance, in the Malampaya Sound Protected Landscape and Seascape in Palawan, about 136 ha of mangroves were established between 2011 and 2013, increasing the area from 2,513 ha in 2005 to 3,064 ha by 2016 (FMB, 2016). Similarly, in Bohol, reforestation activities from 2011 to 2017 resulted in the establishment of approximately 2,090 ha of mangroves, with Nasingin Island alone accounting for around 250 ha (Gerona-Daga & Salmo, 2022). Collectively, these initiatives significantly contributed to the national mangrove inventory, which stood at an estimated 303,373 ha as of 2015 (FMB, 2015).

Despite these quantitative accomplishments, the studies highlight persistent ecological challenges associated with mangrove restoration under the NGP. Notably, many efforts have been marked by the indiscriminate planting of *Rhizophora* species, often without due consideration of site-specific biophysical conditions. While administratively convenient, this monoculture approach has been linked to several ecological drawbacks, including reduced species diversity, heightened vulnerability to pests and diseases, and poor survival rates in ecologically mismatched sites. These outcomes mirror broader global critiques of monoculture reforestation, which caution against ecological simplification and its detrimental impact on coastal resilience (Primavera & Esteban, 2008). In response, Nabua et al. (2023) advocate for a more ecologically grounded framework for mangrove restoration. They recommend strategies such as species diversification, the use of native taxa suited to local salinity, substrate, and tidal regimes, the development of community-based mangrove nurseries, and participatory species-site matching. These approaches are expected to not only improve seedling survival and ecological functionality but also to strengthen local stewardship and promote the social sustainability of restoration initiatives (Gerona-Daga & Salmo, 2022).

These studies highlight both the achievements and the persistent ecological limitations of the NGP. While the program has made commendable progress in expanding forest cover and rehabilitating mangrove ecosystems, a critical analysis reveals that such gains must be weighed against the quality, sustainability, and ecological integrity of restoration practices. The success of efforts like the selection of plus trees in upland areas highlights the importance of integrating genetic improvement and biodiversity into reforestation strategies. Likewise, the experiences in mangrove rehabilitation underscore the risks of relying on monocultures and neglecting species-site matching. These insights point to a central lesson: ecological restoration must be context-specific, scientifically grounded, and socially inclusive.

For the NGP to evolve into a resilient and ecologically responsible program, it must move beyond a numbers-driven approach and embrace quality-based restoration. This includes using high-quality and site-appropriate planting materials, institutionalizing tree improvement programs, diversifying species, and actively involving communities in decision-making processes. Only through this holistic and integrated approach can the NGP fulfill its goal of long-term ecological resilience, biodiversity conservation, and sustainable benefits for future generations. This underscores the need for future NGP assessments to adopt interdisciplinary lenses that integrate ecological, social, and institutional dimensions of reforestation success.

7. Conclusion

Over a decade since its launch, the NGP remains the Philippines' most ambitious reforestation initiative, with far-reaching implications for ecological restoration, rural development, and climate change mitigation. This thematic review of Scopus-indexed literature from 2014 to 2024 reveals that while substantial progress has been made in documenting and evaluating the NGP’s implementation, critical challenges persist in its design, governance, and on-the-ground outcomes.

The literature points to notable advances in remote sensing applications, which have enhanced the monitoring of vegetation recovery and forest disturbance. Policy and governance research has highlighted important regulatory reforms aimed at improving seedling quality, ecological planning, and inter-agency coordination. Studies on community participation have emphasized the need for genuine engagement beyond labor contracts, pointing to the importance of tenure security, livelihood integration, and participatory governance. Meanwhile, ecological studies underscore the necessity of using genetically diverse, site-suitable species and avoiding monoculture planting practices, especially in mangrove rehabilitation.

Despite these efforts, the review underscores that the NGP continues to face implementation bottlenecks, including weak institutional alignment, limited community empowerment, and a persistent focus on planting targets rather than long-term ecological and social outcomes. Research reveals gaps in integrating biodiversity-sensitive practices, adaptive management, and livelihood support, which are essential for achieving both environmental and developmental goals.

To move forward, future research must support a paradigm shift from a numbers-driven to a quality- and outcomes-based restoration model. This includes:

* Strengthening multi-level governance and accountability mechanisms;
* Institutionalizing site-species matching protocols and forest genetic resource management;
* Embedding community-led approaches with tenure security and capacity-building; and
* Applying remote sensing innovations to guide adaptive, evidence-based interventions.

The NGP’s long-term success depends on reconciling its ecological ambitions with inclusive, science-informed, and socially responsive strategies. As the program enters its final years toward the 2028 target, research and policy must converge to transform the NGP from a tree-planting campaign into a resilient, equitable, and biodiversity-rich forest restoration movement.

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