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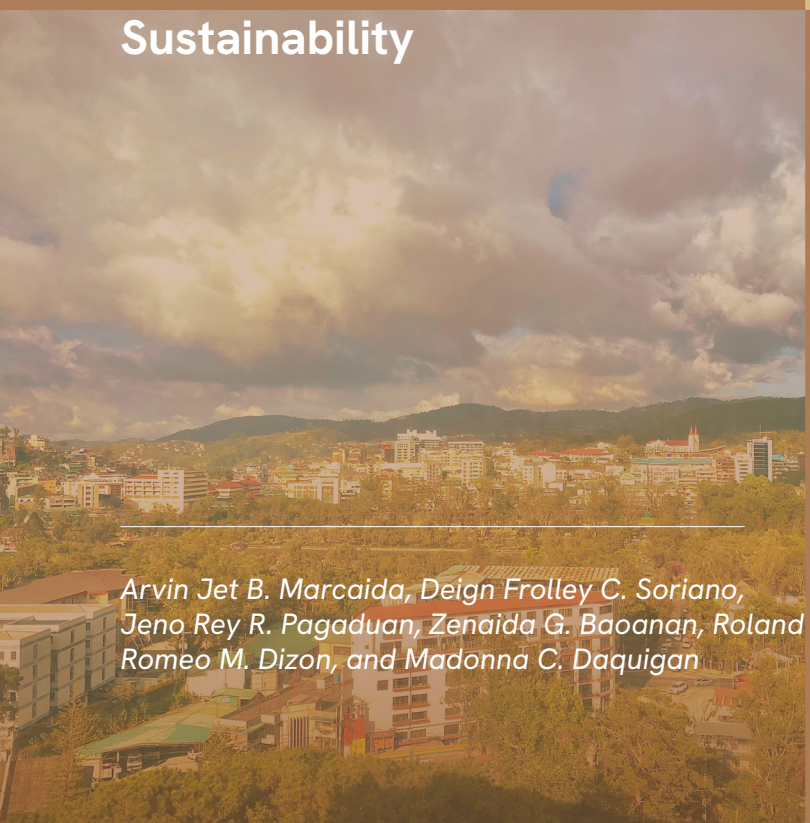
Baguio's Biodiversity Greenprint

Rethinking Policy and Environmental Governance for Urban Biodiversity and Sustainability



Arvin Jet B. Marcaida, Deign Frolley C. Soriano, Jeno Rey R. Pagaduan, Zenaida G. Baoanan, Roland M. Hipol, Romeo M. Dizon, and Madonna C. Daquigan

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UP CIDS Discussion Paper Series
is published by the

University of the Philippines
Center for Integrative and Development Studies
Lower Ground Floor, Ang Bahay ng Alumni
Magsaysay Avenue, University of the Philippines
Diliman, Quezon City 1101

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Website: cids.up.edu.ph

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ISSN 2619-7448 (Print)
ISSN 2619-7456 (Online)

Cover image credit
"Green spaces in Central District of Baguio City"

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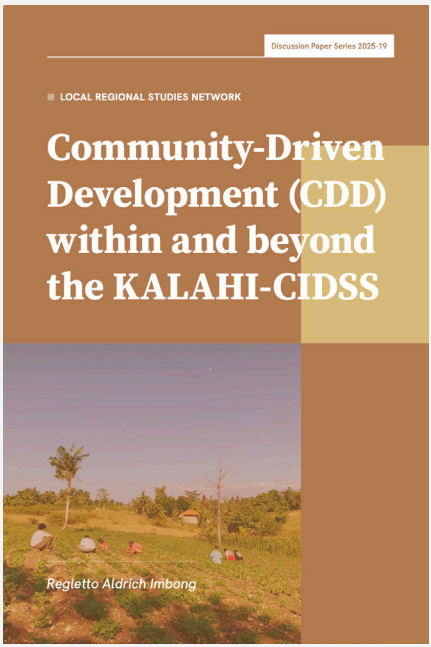

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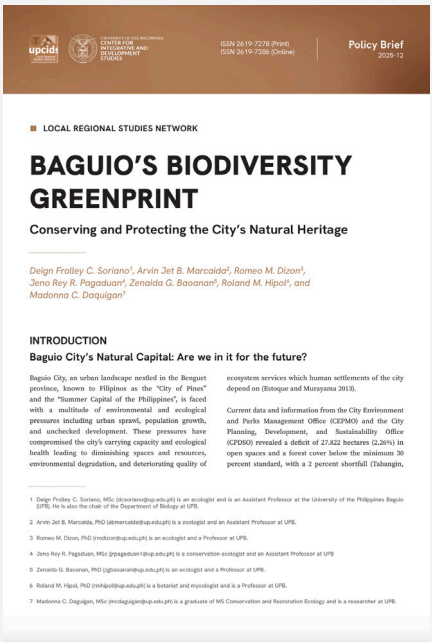

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BAGUIO'S BIODIVERSITY GREENPRINT

Rethinking Policy and Environmental Governance for Urban Biodiversity and Sustainability

Arvin Jet B. Marcaida, Deign Frolley C. Soriano, Jeno Rey R. Pagaduan, Zenaida G. Baoanan, Roland M. Hipol, Romeo M. Dizon, and Madonna C. Daquigan

ABSTRACT

Baguio City, a significant urban landscape in the northern region of the Philippines, is undergoing rapid urbanization leading to severe environmental degradation, biodiversity loss, and reduced ecosystem services, which ultimately strain the city's ecological health and resilience. Despite existing policies at various scales, gaps in environmental and socio-political governance, weak enforcement mechanisms, and uncoordinated conservation efforts hinder sustainable urban environmental planning. This study employs policy review, ecological hotspot mapping, and stakeholder consultations and engagement to assess the effectiveness of urban environmental policies, revealing misalignments in regulations, ecologically vulnerable areas, and governance challenges. Through consultations with policymakers, academic institutions, Indigenous Peoples and local communities, the youth sector, and environmental groups (CSOs, NGOs, etc.), the study proposes policy and environmental governance solutions to integrate biodiversity conservation into urban planning. The Baguio Biodiversity's Greenprint adopted the International Union for Conservation of Nature-Natural Resource Governance Framework (IUCN-NRGF) that was introduced as a strategic framework to emphasize strong monitoring and implementation, multi-stakeholder coordination, indigenous and community-based conservation; address urbanization and ecological degradation, promotion of sustainable urban greening and climate resilience, and advance scientific and evidence-based decisions. With the Biodiversity Greenprint in place, Baguio City can mitigate biodiversity loss and serve as a model urban landscape for sustainable urban development in the country.

Key Takeaways:

- Rapid urban sprawl has led to loss of forest cover in Baguio City, contributing to habitat degradation and urban species decline.
- Despite existing environmental laws, weak enforcement, and misaligned urban planning contribute to continued ecological deterioration.
- Spatial analysis identifies key areas in the city that require urgent conservation and protection efforts, particularly urban green spaces and watersheds.

- Indigenous knowledge, scientific studies, and community engagement are essential for a more effective urban biodiversity management and sustainable urban planning.

- A strategic policy framework advocating for sustainable land use, improved conservation policies, and enhanced governance mechanism should be crafted and implemented.

Keywords: Urban, Biodiversity, Conservation, Sustainability, Policy Framework

INTRODUCTION

Southeast Asia harbors 20 percent of the world's flora and fauna, underscoring the region's ecological importance (PAWB 2009; Ambal et. al., 2012; DENR-BMB 2014). The Philippines ranks among the world's 18 mega biodiverse countries with nearly half of its 1,100 terrestrial animals and vascular plants being endemic. However, decades of environmental neglect, unsustainable resource management, and rapid urbanization have made it into one of the world's most vulnerable biodiversity hotspots (Myers et al. 2000; Posa et al. 2008).

Ranking fourth on Conservation International's list of the world's most threatened forest hotspots (Conservation International 2011), its forest cover has declined from 90 percent in the pre-colonial period to less than 25 percent in recent decades (ESSC 1999; Kastner 2009; Kastner et al. 2010). Rapidly expanding urbanization and land use-cover change (LUCC) drive habitat loss and ecosystem change, threatening ecosystems within and beyond urban areas (Sala et al. 2000; Millennium Ecosystem Assessment 2005; Grimm et al. 2008; Elmqvist et al. 2013; Concepcion et al. 2016; Simkin et al. 2022). These changes have endangered nearly 21 percent of vertebrate species and 215 plant species, as listed in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (Myers et al. 2000; Posa et al. 2008). The greatest impact of biodiversity loss is expected in urban areas and their fringes, where human populations are most concentrated (Gonzales and Magnaye 2018). This loss persists despite advances in our understanding of Philippine biodiversity and

despite conservation efforts to mitigate the damage (Posa et al. 2008). Without timely and effective action, ongoing degradation of ecosystems could lead to further biodiversity loss and eventual species extinction (Ambal et al. 2012).

Baguio City is a showcase of rapid urban sprawl in a fragile montane ecosystem. Renowned as the "Summer Capital" of the Philippines, it has remained a vital economic and cultural hub for over a century (Crosette 1999; Reed 1999; Estoque and Murayama 2013). It is politically independent from Benguet Province and operates under its own charter (CPDO 2002). Its highland location and cool climate attract both migrant residents and short-term visitors (Estoque and Murayama 2013) and has made Baguio one of the country's fastest-growing urban centers (Pelingen et al. 2021). From 1988 to 2009, urbanization tripled its developed area, leading to substantial reductions in green spaces, biodiversity, and ecosystem services (Estoque and Murayama 2013). In 2020, its population reached 366,358 (Philippine Statistics Authority, 2022), twelve times more than its original carrying capacity, resulting in a 60 percent reduction in its annual ecosystem service value due to urban sprawl and land-use changes (Estoque and Murayama 2013). This has led to severe environmental consequences, including habitat destruction and declining biodiversity.

Research on urban biodiversity in the region remains scarce and underfunded, with the majority of the studies concentrated in Benguet Province (Baoanan et al. 2020), making it difficult to develop effective conservation policies. Conservation initiatives are further hampered by limited expertise, inadequate funding, and challenges in publishing taxonomic and ecological research. These issues are intensified by socio-economic and political factors, making biodiversity conservation and management increasingly difficult (Posa et al. 2008). Without comprehensive baseline data, developing effective conservation policies remains elusive and biodiversity loss could become irreversible.

This paper examines the impact of rapid urbanization on Baguio's biodiversity, identifies policy gaps in urban conservation, and proposes a Greenprint framework for sustainable urban governance. Using policy review, ecological hotspot mapping, and stakeholder engagement, it offers evidence-based recommendations to integrate conservation into urban planning and strengthen multi-sector collaboration. This Greenprint aims to help Baguio

City transform into a model of ecological resilience through evidence-driven policies and actionable conservation, protection, and management strategies that address the city's socio-economic and environmental challenges.

METHOD

Policy Review and Assessment

Baguio City's local government consists of 19 offices, along with several national and regional offices, that are responsible for managing the land, water, and air resources within the region. From these offices, relevant local and national-level documents related to urban development plans, environmental and biodiversity laws, policies, ordinances, resolutions, and other related materials were obtained. Individual reviews of these documents as well as combined and comparative analyses were conducted to evaluate the implementation of local policies. Local-level policies were compared against national policies to assess their alignment, list shared objectives and approaches, and identify any gaps that require attention. Finally, city-level planning documents, guidelines, and biodiversity action plans were reviewed to determine the level at which urban biodiversity enhancement strategies are integrated in urban planning, design, and construction. Common biodiversity regulations and recommendations across regions were also noted in the planning and design guidelines.

Ecological hotspot identification

Satellite imagery, land-use maps, green space data, and environmental information were obtained from government agencies like the City Planning, Development, and Sustainability Office (CPDSO) and from open-access geospatial databases. ArcGIS was used to overlay polygon shapefiles of green spaces from CPDSO and map biodiversity research sites in Baguio City. Ecological hotspots were identified based on spatial distribution of green spaces and biodiversity sampling locations while published studies and gray literature were reviewed to assess biodiversity levels, identify species of conservation concerns, and evaluate the vulnerability of identified hotspots.

Stakeholder Engagement

Engaging stakeholders is critical in ensuring that the outcomes of the analyses performed are not only academically robust, but also address the genuine needs and concerns of the local community. To achieve this, the project organized various activities, including two public forums, a focus group discussion (FGD), an online survey, and a panel discussion that were all aimed at promoting collaboration and the exchange of knowledge about Baguio City's urban development, sustainability, and biodiversity conservation. A diverse array of stakeholders with a keen interest on the environment actively participated, including representatives from local government offices, government agencies, environmental organizations, non-government organizations (NGOs), academia, civil society groups, indigenous communities, businesses, and students.

The final activity, the panel session, refined and finalized policy recommendations for Baguio's Biodiversity Greenprint, ensuring they reflected the diverse perspectives of the city's communities and stakeholders.

Synthesis and Development of the Greenprint

All the policies reviewed, along with the information collected from forums and the FGD, were integrated, analyzed, and synthesized to develop a comprehensive understanding of how the various policies align, intersect, or conflict with each other. Following this synthesis, policy recommendations and development of the Greenprint were crafted. These recommendations were aimed at gaining widespread support and providing actionable steps for nature conservation and the creation of a greener, more sustainable future for Baguio City.

DISCUSSION

Baguio City's Urbanization

1. Historical Development

Baguio City, originally known as Kafagway, derives its name from the Ibaloi word "*bigyiw*" or "*bag-iw*", referring to a native moss-like plant that grows

in the area (Estoque and Murayama 2013). Baguio was historically a grassy marshland with a shallow lake and home to indigenous Ibaloi and Kankanaey tribes. The land was traditionally used for settlement, grazing, and agriculture, particularly coffee farming.

During the Spanish and American colonial periods, Baguio evolved into a hub for various uses, including mining, small-scale ranching, and sanatoria (Tolentino 2009; Canilao 2011; Morley 2018). In the 1900s, the Americans, recognizing its favorable climate (15°C to 23°C), envisioned Baguio as a "convalescent-cum-recreational center" to serve as a refuge from "tropical fatigue" (Estoque and Murayama 2013).

In June 1903, the Philippine Commission designated Baguio as the country's summer capital, prompting an extensive call for infrastructure development. To bring this vision to life, American architect Daniel H. Burnham was commissioned to design Baguio as a modern city. His design intended to accommodate 25,000 residents, incorporating green zones and preserving indigenous species (Crosette 1999).

Baguio was then formally established as the second chartered city in 1909, following Manila (Guerra 2006; Doronila 2009; Gutierrez and Cariño 2009). This milestone further spurred rapid infrastructure development, including transportation routes and government buildings. After World War II, Baguio evolved into a key transportation hub, a thriving center for education and tourism, and the seat of regional government. It also emerged as a hub for commerce, encompassing industrial, medical, and agricultural sectors (Gonzales 2016).

2. Urban Growth and Expansion

Baguio's planned low-density urban retreat drastically changed due to rapid population growth, transfer of administrative authority to Filipino officials, and increased urban development (Reed 1999; Estoque and Murayama 2013; Morley 2018). Between 1988 and 2009, built-up areas more than doubled from 1,075.86 hectares to 2,985.12 hectares, causing a 63.28 percent decline in forest cover (Estoque and Murayama 2010; Morley 2018). During the same period, 19 percent of the city's croplands and 13 percent of its brushlands were converted into urban zones, increasing pressure on resources and exacerbating informal settlements (Gutierrez and Cariño 2009; Estoque and Murayama 2011).

By 2010, Baguio's population had surged to 380,354, far exceeding Burnham's original vision (NSO 2012; CPDSO, 2023). Projections also estimate a population of 488,374 by 2043, with peak tourism seasons pushing daytime numbers to 700,000 and seasonal populations to approximately one million (See, 2010; CPDSO, 2023).

Recently, the pressure for residential, commercial, and public infrastructure has accelerated the conversion of land-use categories, reshaping the city's natural environment. Due to the ever-increasing demand for better living conditions, Baguio City's carrying capacity, in terms of natural, physical, and socio-economic resources, has reached critical status (Estoque and Murayama, 2011). This continued urban expansion, if left unchecked, threatens Baguio's long-term sustainability.

3. Environmental Impacts

Among the most critical impacts of urbanization is the rapid, continuous decline of forest covers. Forests play a vital role in protecting and rejuvenating the soil, and stabilizing slopes. Given Baguio's mountainous topography and susceptibility to tropical storms, typhoons, flooding, sinkholes, and earthquakes due to fault lines traversing the city (Nolasco-Javier et al. 2015; Comanda 2015), loss of forest cover increases likelihood of erosion and landslides with catastrophic outcomes.

Deforestation has also greatly contributed to the deterioration of air quality (OCPDC 2002; See 2007; Estoque and Murayama 2012). The loss of forest covers has compounded the problem of air pollution from greenhouse gas (GHG) emissions and particulate matter (Cassidy et al. 2007; See 2007; Estoque and Murayama 2013; Ramos and Blanco 2019). The increase in atmospheric GHG, combined with extensive building construction, has also exacerbated the Urban Heat Island (UHI) effect in Baguio City, leading to rising temperatures and worsening thermal discomfort (Baloloy et al. 2019; 2020).

Watersheds, which serve as a critical water resource for the city, also rely on forest cover to regulate the availability of clean and fresh water (CPDO 2010; Estoque and Murayama 2012). Although the Cordillera Administrative Region (CAR) has a relatively high ground water storage capacity, the water requirements of Baguio, coupled by its shrinking forest cover, have outstripped

the city's water resources leading to water shortages (CEPMO 2010; Ciencia et. al. 2015).

Urbanization also heightened the city's vulnerability to the adverse effects of climate change. According to the City Environment and Parks Management Office (CEPMO), the city has been identified as one of the World Bank's Top Seven Risk-Prone Cities in Asia, with the predictions of irreversible urban decay by 2043 (Gonzales 2016).

Urban Biodiversity and Conservation

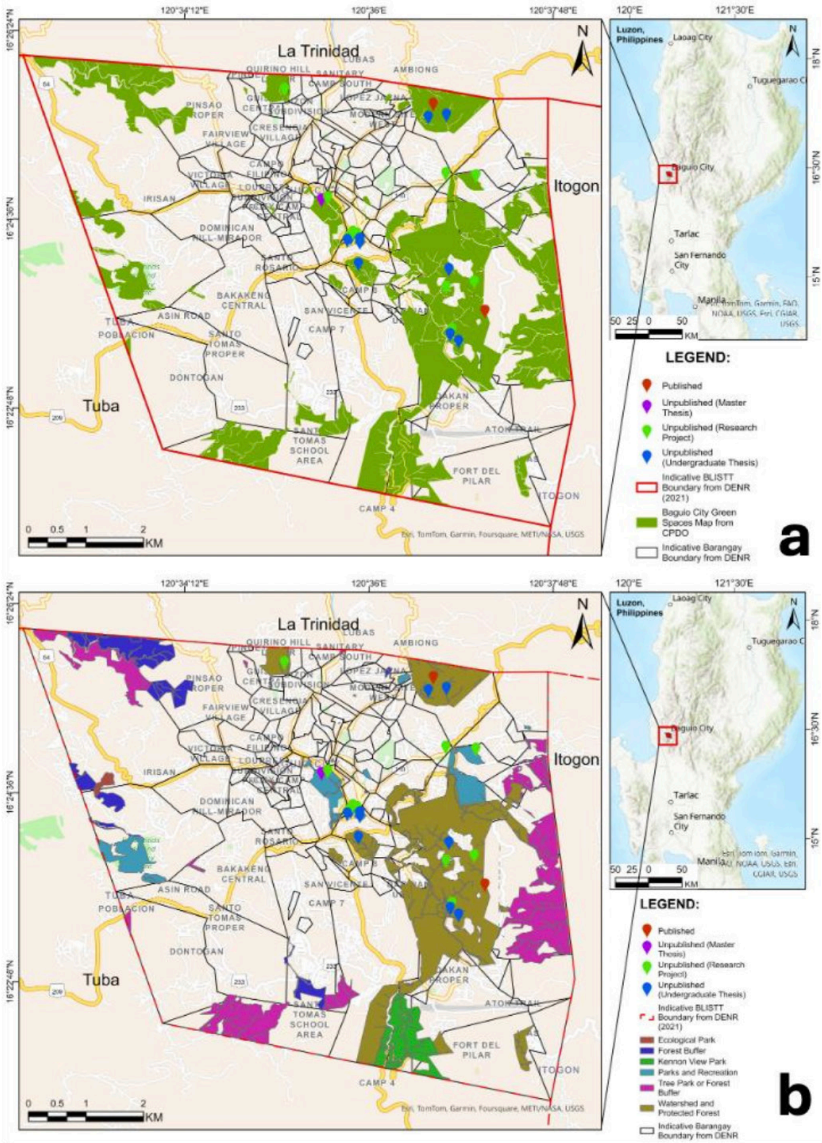
While numerous studies highlight the negative impacts of urbanization on biodiversity (Pernat et al. 2024; Sanetra et al. 2024; Santos et al. 2024), well-managed cities were found to support significant biodiversity at the local scale (Ventura et al. 2024). This urban biodiversity, coupled with the emerging recognition of urban green spaces as potential refugium, spurs great interest in strategies that are designed to enhance and sustain urban ecosystems.

Understanding the dynamics of urban biodiversity not only enhances our comprehension of ecological resilience, but also informs urban planning and policy-making aimed at creating sustainable cities. Adaptive management frameworks must integrate conservation concepts and local socioeconomic data into urban planning, ensuring that both native and non-native species are managed in a way that promotes ecological balance without sacrificing the unique character of each urban area (Parker 2015; Kowarik et al. 2020).

As Baguio City expands and evolves, future city development efforts must account for critical ecosystems such as ecological parks, forest patches, forest reserves, and watersheds to ensure protection of biodiversity and sustained delivery of ecosystem services (McPhearson et al. 2018). Identification and systematic cataloguing of these green spaces form a crucial foundation for informed urban planning, conservation efforts, and policy development.

This study mapped key green spaces, along with areas where published and unpublished ecological research has been conducted (Figure 2). These mapped sites serve as a valuable starting point, providing baseline data to guide future ecological assessments, conservation efforts, and urban planning. The data on conducted research were sourced from three universities: University of

the Philippines Baguio (UPB), Saint Louis University (SLU), and Benguet State University (BSU).



■ **Figure 1.** Green spaces in Baguio City. (a) Map showing all identified green spaces, represented in a single color. (b) Map differentiating green spaces based on their categories. Pins indicate locations where ecological data have been collected from published and unpublished studies.

POLICY REVIEW AND ANALYSIS

National and Regional-Level Biodiversity Strategies

The Philippines is a country rich in environmental laws that protect, conserve, and regulate every organism that exists in nature (Rabang 2020). While there is no single overarching environmental code legislating for environmental protection, the country has numerous statutes and regulations that address various aspects of environmental governance. Some of these are the Environmental Policy Act, Environmental Impact Statement System, Revised Forestry Code, National Integrated Protected Areas System, Clean Air Act, Clean Water Act, Climate Change Act, and Wildlife Act (Table 1). Among these, the Revised Forest Code plays a pivotal role in regulating forest utilization and promoting reforestation efforts, while Executive Order No. 23 (2011) enforces a nationwide moratorium on logging in natural forests. These policies reflect the Philippines' strong commitment to mitigating deforestation—one of the major drivers of biodiversity loss.

TABLE 1. KEY PHILIPPINE ENVIRONMENTAL LAWS AND THEIR OBJECTIVES

REPUBLIC ACT (RA)/ PRESIDENTIAL DECREE (PD)	DATE ENACTED	GOALS AND PURPOSE
Presidential Decree No. 1151 – Environmental Policy Act	June 6, 1977	Ensures a healthy and sustainable environment for present and future generations. It mandates environmental impact assessments for projects that may significantly affect the environment.
Presidential Decree No. 1586 – Environmental Impact Statement System	June 11, 1978	Requiring government and private projects that have a significant environmental impact to undergo an environmental impact assessment before approval.
Presidential Decree No. 705 – Revised Forestry Code	May 19, 1975	Governs the management, utilization, and conservation of forest lands and resources. It aims to ensure the sustainable use of forests while preventing illegal logging and deforestation.
Republic Act No. 7586 – National Integrated Protected Areas System Act	June 1, 1992	Establishes a system for the classification, administration, and management of protected areas to maintain ecological balance and preserve biodiversity.
Republic Act No. 8749 – Clean Air Act	June 23, 1999	Aims to protect the country's air quality by setting emission standards, regulating industrial pollution, and promoting sustainable development practices.
Republic Act No. 9275 – Clean Water Act	March 22, 2004	Seeks to protect water bodies from pollution by regulating wastewater discharges and implementing pollution control programs to maintain the quality of freshwater and marine resources.
Republic Act No. 9729 – Climate Change Act	October 23, 2009	Coordinate, formulate, and implement policies and strategies to mitigate and adapt to climate change impacts in the Philippines.
Republic Act No. 9147 – Wildlife Act	July 30, 2001	Protects and conserves Philippine wildlife resources and their habitats by regulating wildlife trade, preventing poaching, and ensuring sustainable use of biodiversity.

The Philippine Constitution declares that all natural resources and lands of the public domain are under the ownership, full control, and supervision of the State. Consequently, laws involving the exploitation of natural resources are co-implemented with the Department of Environment and Natural Resources (DENR), the main Philippine environmental regulator agency (Bunye 2019). The DENR oversees the conservation, management, development, and sustainable use of the country's environment and natural resources, specifically forests and grazing lands, mineral resources, including those in reservation and watershed areas, and lands of the public domain (DENR 2024). In particular, the DENR has been instrumental in implementing the National Greening Program (NGP) through Executive Order No. 26. This large-scale reforestation program targets deforested and degraded areas, emphasizing the critical role of forest rehabilitation in restoring habitats and mitigating climate change.

Biodiversity conservation is further strengthened by the National Integrated Protected Areas System (NIPAS) Act of 1992 and the Wildlife Resource Conservation and Protection Act (Republic Act No. 9147), which establish a framework for protecting ecosystems and species. The extended NIPAS Act of 2018 expands the coverage of protected areas, while the Wildlife Act regulates the collection, trade, and possession of threatened species. These laws aim to balance conservation with sustainable resource use, prevent biodiversity loss caused by human activities, and strengthen environmental governance by providing mandates for agencies like the DENR. Additionally, they promote public awareness and community involvement, encouraging local participations in conservation efforts.

Internationally, the Philippines is among the signatories of several Multilateral Environmental Agreements (MEAs), including the Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), and the United Nations Framework Convention on Climate Change (UNFCCC). These agreements guide national conservation strategies such as the Philippine Biodiversity Strategy and Action Plan (PBSAP), which envisions restoring and effectively managing biodiversity by 2028. However, the effectiveness of these commitments depends on proper policy design, implementation, and enforcement (Posa et al. 2008). Despite legal frameworks, biodiversity conservation in urban areas remains inadequately addressed (DENR 2014). The lack of literature on urban biodiversity and

challenges in defining it within city environments hinder conservation efforts (Gonzales and Magnaye 2018).

Urban development, particularly under the Urban Development and Housing Act (UDHA) of 1992 (Republic Act No. 7279), presents significant challenges to biodiversity. While the UDHA aims to provide housing and equitable access to land, its implementation often leads to habitat destruction, pollution, and ecological degradation. Land conversion for housing and infrastructure contributes to deforestation, habitat fragmentation, and the loss of endemic species (Turner et. al. 2001; Millennium Ecosystem Assessment 2005; DENR-BMB 2020). Encroachment into protected areas intensifies threats like illegal logging and poaching. Additionally, urban expansion increases pollution levels, affecting air, water, and soil quality while diminishing essential ecosystem services like water filtration, flood control, and climate regulation (Millennium Ecosystem Assessment 2005; Asian Development Bank 2020).

The pressure on biodiversity hotspots and urban green spaces exacerbates ecological imbalances. The reduction of urban greenery contributes to the "urban heat island effect" and the loss of habitats among species adapted to city environments (UN Habitat 2022). Informal settlements in ecologically sensitive areas, such as riverbanks and mangroves further accelerate biodiversity decline. Moreover, the UDHA lacks explicit provisions for integrating biodiversity conservation into urban planning. Housing and infrastructure projects often proceed without adequate environmental impact assessments, and weak institutional coordination between agencies like the DENR leads to gaps in biodiversity protection (DENR-EMB 2018).

Regional Policies and Programs Specific to Urban Biodiversity

The Cordillera Regional Development Plan (CRDP) 2023-2028 aligns with the overarching strategic framework of the Philippine Development Plan (PDP) 2023-2028 to reinvigorate job creation and accelerate poverty reduction, fostering deep economic and social transformation. This regional agenda is driven by key transformational strategies, including digitalization, service-driven development, dynamic innovation ecosystem, enhanced connectivity, stronger collaboration between local and national government, and increased partnership with the private sector.

A critical component of this regional vision is the Cordillera Regional Spatial Development Framework (RSDF) 2019-2049, which supports long-term economic transformation toward a more prosperous, inclusive, and resilient society, aligns with AmBisyon 2040. This long-term vision and development agenda of the Philippines was launched by the National Economic and Development Authority (NEDA) in 2016. It envisions a "matatag, maginhawa, at panatag na buhay" for all Filipinos by 2040. This vision serves as the foundation for national and regional development plans, guiding policies across different sectors. By integrating land use management with economic and social development, the RSDF adopts the principles of concentration, connectivity, and vulnerability reduction in the National Spatial Strategy (NSS) and the Luzon Spatial Development Framework (LSDF) 2015-2045. The resulting Regional Spatial Strategy (RSS), known as the North and South Clusters Plus, aims to promote balanced regional development through a network of primary, secondary, and tertiary growth centers across the six provinces of the CAR.

An assessment of CAR's performance in implementing these spatial strategies reveals progress in managing urban expansion, improving inter- and intra-regional connectivity, and reducing environmental vulnerabilities. However, challenges remain with emerging pressures related to rapid urbanization, ecological sustainability, and biodiversity conservation.

The 2019-2049 RSDF outlines three sub-strategies of Concentration, Connectivity, and Vulnerability Reduction, to enhance regional development. The first sub-strategy, Concentration, promotes efficient land use and sustainable urban development by guiding population and economic activities into designated growth centers. It seeks to prevent uncontrolled urban sprawl or encroachment of forested area while ensuring that urbanization supports economic vitality and environmental sustainability.

The second sub-strategy, Connectivity, enhances both intra- and inter-regional linkages to improve accessibility, mobility, and economic integration. By investing in transportation networks and digital infrastructure, it facilitates the seamless movement of people, goods, and services, strengthening urban and rural linkages across the Cordillera region. This includes reopening the Baguio City Airport for commercial flights, completing major road projects like the Cordillera Roads Improvement Project, and leveraging convergence

programs to enhance access to tourism destinations and markets. The Tarlac-Pangasinan-La Union Expressway (TPLEX) has also significantly reduced travel time to and from the region, boosting accessibility.

The third sub-strategy, Vulnerability Reduction, mitigates environmental risks and enhance the region's resilience to climate change, natural disasters, and other ecological threats. It integrates disaster risk reduction, sustainable resource management, and climate adaptation measures to safeguard communities and ecosystems. Efforts include increasing forest cover through the National Greening Program, maintaining air and water quality, and enhancing disaster preparedness through the establishment of Disaster Risk Reduction and Management (DRRM) offices in LGUs.

On the other hand, RDP strategies are geared towards helping bring the country to its high growth path and begin economic transformation for a prosperous, inclusive, and resilient Cordillera region. This transformation is aligned with the Sustainable Development Goals (SDGs) and critical for achieving the country's long-term vision of providing a "matatag, maginhawa at panatag na buhay para sa lahat" of the AmBisyon 2040.

One of the strategies of the RDP is to accelerate climate action and strengthen disaster resilience. It aims to enhance the region's resilience to natural hazards and climate change by 2028 through strengthened climate action and disaster risk reduction efforts. Key strategies include increasing the resilience of communities and ecosystems, promoting a low-carbon economy, and ensuring the sustainable management of the region's natural resources. As the "Watershed Cradle of North Philippines," the region will prioritize the rehabilitation of its river basins to support water supply, hydroelectric power, and ecological services for both local and downstream communities. Additionally, the promotion of a green economy will create livelihood opportunities while advancing environmental sustainability. These initiatives will be guided by the effective implementation of disaster risk reduction and climate change policies to secure long-term resilience for the Cordillera people.

In the assessment and challenges of this strategy, the CAR faces increasing vulnerabilities due to climate change and natural disasters, threatening both communities and ecosystems. Key challenges include degradation of natural

resources, deforestation, forest fires, and watershed depletion, weakening the region's ability to sustain water resources and biodiversity. Urban expansion and land-use changes have also contributed to environmental stress, increasing susceptibility to landslides and flash floods. Additionally, gaps in climate adaptation planning, limited funding for environmental-related activities, and weak enforcement of environmental policies hinder efforts to build resilience against climate risks.

By 2028, the region aims to strengthen climate and disaster resilience through three main objectives: (1) increasing the adaptive capacity of communities and institutions, (2) enhancing the resilience of ecosystems, and (3) enabling the transition to a low-carbon economy. These targets will be met by promoting sustainable land use, increasing investments in climate-smart infrastructure, and strengthening governance mechanisms for disaster risk reduction and climate action. The rehabilitation of degraded ecosystems, improved watershed management, and expansion of protected areas are also central to achieving these goals.

The implementation of these strategies is expected to result in greater environmental sustainability and disaster preparedness across the region. Anticipated outcomes include improved watershed and forest management, strengthened urban resilience through green infrastructure, and enhanced biodiversity conservation. The promotion of a green economy is also expected to generate sustainable livelihoods while reducing carbon emissions. Strengthened coordination between local governments, national agencies, and communities will ensure that climate adaptation measures are effectively implemented and sustained.

To support these initiatives, the region seeks to enhance existing environmental and disaster resilience laws while introducing new policies that promote sustainable urban planning, climate financing, and ecosystem protection. Key legislative priorities include stricter land-use regulations, enhanced enforcement of environmental policies, and the institutionalization of climate adaptation programs at the local level. Strengthening legal frameworks on forest conservation, renewable energy adoption, and solid waste management will further support the region's climate action agenda.

Local Policies, Ordinances, Resolutions, Programs, and Plans for Urban Biodiversity and Conservation

Biodiversity conservation in urban areas like Baguio City is crucial for sustainable governance. The DENR-CAR and CEPMO have implemented policies to address urban biodiversity challenges, aligning with national and international frameworks. Their initiatives focus on integrating conservation into urban planning and climate strategies. Key measures prioritize reforestation, watershed protection, sustainable land use, and green infrastructure to mitigate the effects of urbanization and climate change.

A. DENR-CAR Guidelines on Assessing and Managing Urban Biodiversity

The DENR-CAR has existing programs that help stakeholders manage urban biodiversity. The interventions are enumerated in the table below.

TABLE 2. OVERVIEW OF DENR INTERVENTIONS FOR URBAN BIODIVERSITY MANAGEMENT

DENR INTERVENTIONS	BASIS OF THE INTERVENTIONS	PURPOSE OF THE INTERVENTIONS
Technical Bulletin 2018-02	Republic Act No. 7160 (Local Government Code of 1991), PBSAP 2016-12	Establish procedures for assessing urban biodiversity and support informed decision-making for local development plans.
City Biodiversity Index (CBI)	Singapore Index on Cities' Biodiversity, CBD	Integrate urban biodiversity into local development plans for enhanced urban sustainability.
Urban Biodiversity Management Planning	Republic Act No. 7160 and DENR Administrative Order 2016-12	Provide a structured framework for formulating biodiversity management plans that integrate conservation into urban planning.
Standardization of Biodiversity Management Plans	PBSAP 2015-2028	Ensure uniformity in developing biodiversity management plans with clear strategies and interventions.
Multi-Stakeholder Participation	Policy on Community Engagement	Identify issues, threats, and opportunities in urban biodiversity conservation, enhancing governance.

DENR INTERVENTIONS	BASIS OF THE INTERVENTIONS	PURPOSE OF THE INTERVENTIONS
Climate Change Adaptation and Disaster Risk Reduction	National Climate Change Action Plan	Mainstream adaptation and resilience measures in urban biodiversity management.
Local Government Framework Integration	CLUP and CDP guidelines	Reinforce the role of biodiversity in local government development frameworks for comprehensive planning.
Monitoring and Annual Reviews	Guidance from BMB and DENR Regional Office	Assess the effectiveness of biodiversity management strategies and guide policy adjustments based on evaluations.

B. Urban Forestry Management Plan 2021-2030

In addition to the programs of DENR-CAR, the Urban Forestry Management Plan (UFMP) 2021-2030 of the Baguio City provides a comprehensive strategy designed to protect, enhance, and sustainably manage the city's urban forests. This plan outlines policies, programs, and initiatives aimed at ensuring the long-term preservation of the Baguio's natural resources while balancing urban development. The plan is anchored on five primary goals as seen in the table below.

TABLE 3. URBAN FORESTRY GOALS AND PROGRAMS FOR SUSTAINABLE DEVELOPMENT

GOALS AND PROGRAMS	KEY ACTIONS	OBJECTIVES AND PURPOSE
Goal 1: Protecting Urban Trees and Forests	■ Amend Zoning Ordinance and Comprehensive Land Use Plan (CLUP) for tree preservation. ■ Mandatory tree inventory and preservation in development plans. ■ Review Environmental Code for enforcement. ■ Create an Urban Forest Advisory Committee (UFAC).	■ Mitigate rapid urbanization and climate change effects. ■ Enhance biodiversity and protect significant lands.
Program 1-A	■ Activate Safeguarded Lands Identification, Protection, and Management Committee (SLIPMC).	■ Protect areas of cultural, historical, physical, biological, and environmental significance against exploitation.
Program 1-B	■ Secure valuable forest lands by exercising eminent domain	■ Preserve urban forest cover, especially from private lands. ■ Ensure integration of forested land protection in government projects.
Program 1-C	■ Reclaim critical environmental areas	■ Prevent encroachment and degradation in watersheds, river easements, and forest reservations such as Busol and Buyog watersheds.
Goal 2: Expanding Urban Forest Cover through Green Initiatives	■ Activate city-wide tree planting programs and urban tree stewardship initiatives. ■ Support citizen action groups.	■ Increase urban forest cover and enhance community participation. ■ Foster ecosystem stability and biodiversity.
Program 2-A	■ Activate the Baguio City Green Building and Urban Gardening committee to establish standards for sustainable urban forest expansion.	■ Promote best practices in urban development for forest conservation. This includes infrastructure green design models, heat mitigation strategies, water conservation policies, and creek restoration plans.

GOALS AND PROGRAMS	KEY ACTIONS	OBJECTIVES AND PURPOSE
Program 2-B	■ Align greening strategies with other city plans in order to integrate greening into city frameworks (e.g., Burnham Park Master Plan, Climate Change Action Plan, Market Modernization Plan, CDRRM Plan, parks development plans, and road widening projects of the DPWH).	■ Ensure cohesive urban planning that supports biodiversity and greening efforts.
Goal 3: Community Stewardship of Urban Forests	■ Promote environmental education and tree care workshops.	■ Foster community participation and environmental awareness among residents, schools, and organizations.
Program 3	■ Explore barangay gardens and commercial crop production.	■ Enhance urban resilience and food security through community engagement in farming.
Goal 4: Monitoring and Management Mechanisms	■ Conduct a city-wide tree inventory using Geographic Information System (GIS). ■ Capacitate forest rangers and create an online reporting platform.	■ Strengthen forest management and ensure accountability in urban forestry efforts.
Goal 5: Sustainable Funding for Urban Forestry	■ Identify funding sources and implement environmental fees on developments. ■ Explore congestion fees for tourists.	■ Ensure sustained funding and investment for ongoing urban greening projects and preservation of natural heritage.

C. Ordinances and Resolutions on Biodiversity Conservation, Green Space Management, Reforestation, and Regulation of Urban Sprawl

Baguio City has also implemented a range of resolutions and ordinances aimed at biodiversity conservation, green space management, reforestation, and regulating urban sprawl. The summary table of city ordinances below reflect a commitment to sustainable urban development by integrating environmental protection measures into land use planning, construction regulations, and community initiatives.

TABLE 4: BAGUIO CITY ORDINANCES PROMOTING URBAN GREENING AND ENVIRONMENTAL SUSTAINABILITY

ORDINANCES	GOALS AND PURPOSE
Ordinance No. 03, Series of 2006	"Baguio City Green Patch Ordinance" encourages planting fruit-bearing trees in homes, neighborhoods, and public areas to enhance air quality and greening efforts.
Ordinance No. 44-88 and Ordinance No. 05, Series of 2011	Requires owners of new constructions to plant trees before obtaining an occupancy permit, reinforcing the goal of increasing canopy cover.
Ordinance No. 06, Series of 2010	Regulates tree cutting, trimming, and transportation of wood, setting strict conditions for cutting trees and mandating a tree replacement system.
Ordinance No. 18, Series of 2016	Serves as Baguio's Environmental Code, establishing policies for land use, biodiversity conservation, and watershed protection, along with sustainable construction practices.
Ordinance No. 129, Series of 2020	Identifies landslide-prone areas suitable for tree planting, integrating reforestation into disaster risk reduction strategies.
Ordinance No. 93, Series of 2023	Promotes the creation and maintenance of healthy public open spaces, ensuring accessibility, eco-friendliness, and climate resilience.
Ordinance No. 110, Series of 2023	"Adopt-A-Park" initiative allows organizations to take responsibility for the maintenance and development of parks.
Ordinance No. 96, Series of 2017	Designates demonstration areas for using organic fertilizers from environmental recycling and sewage treatment processes for sustainable landscaping.
Ordinance No. 43, Series of 2017	Institutionalizes Baguio City Environment Week to raise awareness and promote community participation in environmental conservation.

D. Stakeholders' Perspectives

A stakeholder engagement event brought together representatives from government agencies, academic institutions, civil society organizations,

indigenous communities, and the private sector. The goal was to collaboratively develop a policy framework for sustainable urban biodiversity management. Various activities such as FGDs, public forums, and panel discussions were held to identify ecological challenges, policy gaps, and conservation opportunities. The events facilitated exchanges of knowledge, allowing stakeholders to present data-driven insights, traditional ecological practices, and community-led solutions. The following sections summarize key contributions.

1. Governance and Policy Implementation Challenges

Governance and policy implementation face challenges due to inconsistent enforcement and coordination among agencies. While environmental and urban development policies exist such as the proposed "Smart Sustainable City Manage" through initiatives like "Blue-Green Playbook," Urban Forest Management Strategy, and the City Regreening Spectrum presented by the government, their implementation remains fragmented due to overlapping mandates among agencies such as the CEPMO, the DENR, and the LGUs. Barangay-level conservation efforts often lack sustained LGU support, leading to stalled initiatives. The Environment Code of the City provides a framework for sustainability, yet its enforcement is issue-based due to the absence of well-defined Implementing Rules and Regulations (IRR) and a comprehensive monitoring system. Additionally, a management plan for invasive species should be included in policies and development plans, ensuring proper identification, monitoring, mapping, and eradication efforts to mitigate their impact on biodiversity.

2. Integration of Indigenous Knowledge and Traditional Stewardship

Indigenous communities stress integrating traditional ecological knowledge into biodiversity management. Indigenous Knowledge Systems and Practices (IKSPs) like *aywanan* (environmental guardianship) of the Ibaloi community in Barangay Happy Hallow, *muyong* system of the Ibaloi and the Ifugao, *batangan* (forest management) of the Kankanaey, promote sustainability but lack policy recognition. Stakeholders urge legal protections, alignment of conservation efforts with indigenous practices, and formal dialogue mechanisms to ensure indigenous contributions are acknowledged and incorporated into urban environmental governance.

3. Community Engagement and Citizen Science Initiatives

Urban biodiversity initiatives thrive on community engagement and citizen science. University-led research aids conservation, but challenges remain in fostering long-term environmental values. Strengthening information dissemination and partnerships is crucial to shifting societal attitudes from short-term efforts to sustainable ecological responsibility among the youth, parents, teachers, communities, and policymakers.

4. Addressing Urbanization Pressures and Ecological Degradation

Urban expansion continues to exert pressure on Baguio's fragile ecosystems, causing habitat loss, deforestation, and water resource depletion. Stakeholders raised concerns over unregulated land conversion, the proliferation of non-native species, and the increasing vulnerability of watersheds.

5. Institutional Collaboration and Scientific Research

Academic institutions play a critical role in bridging scientific research with policy development. Various universities in Baguio, including UPB, SLU, and UB, have been conducting biodiversity inventories, ecological assessments, and sustainability research to inform conservation strategies. However, gaps in institutional collaboration hinder the full utilization of scientific data in policy formulation.

6. Sustainable Urban Greening and Ecological Connectivity

Several challenges were raised in enhancing Baguio's urban biodiversity:

a. Absence of green corridors linking parks, forests, and riparian zones limits species movement and ecosystem services.

b. Lack of prioritization of native species in urban greening efforts, affecting habitat diversity and ecological resilience.

c. Lack of infrastructure like permeable pavements and vertical gardens to combat urban heat islands and stormwater runoff.

d. No strong policies encouraging private landowners to maintain green spaces and adopt sustainable landscaping.

e. Tree-planting efforts lack alignment with planting seasons and structured requirements (e.g., marriage/occupancy permits).

f. Many trained forest rangers are not deputized, limiting their authority to enforce environmental laws.

g. Lack of integration of rangers into barangay conservation programs affects local monitoring and enforcement.

h. The Urban Forest Management Plan (UFMP) lacks provisions for firebreaks and fire lines to protect high-risk areas.

i. Limited pest management strategies to address infestations that endanger tree populations (e.g., bark beetle infestation on pine trees).

j. Limited use of composting, vermiculture, and Black Soldier Fly Culture to improve soil nutrients and biodiversity.

k. Economic barriers limit free access to urban parks, disproportionately affecting younger generations and lower-income residents.

E. Baguio's Biodiversity Greenprint Framework

Urban biodiversity frameworks play a crucial role in assessing and guiding conservation efforts in cities worldwide. Several well-established frameworks exist, including the Urban Biodiversity Index (UBI)/Singapore Index on Cities' Biodiversity (also known as the City Biodiversity Index) (Chan et al. 2014), the Nature-Based Solutions (NbS) by IUCN (Cohen-Shacham et al. 2016), Urban Nature Index (UNI) (IUCN, 2023), the Green City framework (World Bank 2021), and the UN-Habitat's Urban Biodiversity and Ecosystem Services Framework (UN-Habitat 2020). However, these primarily focus on biodiversity assessment rather than governance. Given Baguio's socio-ecological challenges, the IUCN Natural Resource Governance Framework (NRGF) (Springer et al. 2021) was selected as the foundation of the Greenprint to emphasize governance, equity, and sustainable resource management (Ostrom 2009).

The NRGF ensures effective, inclusive, and policy-driven conservation, engaging stakeholders such as Indigenous communities and local agencies. It is based on 10 governance principles, underpinned by two values (Springer et al. 2021): sustaining nature and realizing social equity and human rights. Values are inherent in the NRGF's mandate to promote the effective and equitable governance of natural resources, by taking a rights-based approach (IUCN 2016). Moreover, the NRGF was aligned with the goals of Baguio 2043, which envisions the city as livable, inclusive, and creative (CPDO 2023).

By integrating the NRGF with Baguio's policy landscape, the Greenprint ensures that biodiversity conservation is institutionalized within city planning processes. Local policies such as the UFMP and the Baguio Environmental Code can be strengthened by using NRGF principles to enhance enforcement mechanisms and community participation. Additionally, aligning the framework with international commitments, such as the CBD, reinforces Baguio's role as a model for sustainable urban governance.

Ultimately, the adoption of the IUCN NRGF over other urban biodiversity frameworks reflects a strategic choice to prioritize governance and policy-driven conservation. While biodiversity indices provide valuable benchmarks, effective governance is the foundation for sustainable urban biodiversity management (Lockwood et al. 2012). Through this approach, Baguio's Greenprint (Figure 2) not only safeguards the city's ecological heritage but also fosters a more resilient and inclusive urban environment, in line with the aspirations of Baguio 2043.

CONCLUSION

Baguio City Beyond 2043: Blooming and Thriving

Baguio City's aspiration to realize an urban landscape that is inclusive, creative, and livable by year 2043 requires proactive and decisive actions. As one of the Philippines' most economically and environmentally significant urban landscapes, Baguio City sits between balancing economic growth and sustainable development. The city must be able to harmoniously align its ecological and environmental policies and urban development plans with ambitious but realistic and feasible conservation and protection goals for biodiversity, ecosystems, and the benefits that we gain. Achieving all these

requires a paradigm shift—one that acknowledges that mainstreaming biodiversity conservation and ecosystem management compels stakeholders—citizens, policymakers, academics, and other groups to participate and collaborate actively. Moreover, this shift should not only focus on rethinking and redefining environmental policies and local frameworks, but also on considering the behavioral aspect of community stakeholders when it comes to economic progress and environmental sustainability. With policy coherence, effective enforcement, and strong societal participation, Baguio City can truly achieve a livable city for all.

POLICY RECOMMENDATIONS

1. Strengthening Environmental Governance

A. Promoting cohesive inter-agency coordination and existing policy integration

- Local governance bodies in the city (e.g. CPDSO, CEPMO, DENR-CAR, etc.) should strengthen their multi-stakeholder coordination to ensure that urban conservation policies are consistent.
- Implementing Rules and Regulations (IRRs) for existing environmental codes and city ordinances should be crafted clearly to avoid inconsistencies in implementation and enforcement.
- Ensure that future assessments, evaluation, review, and reimplementation of policies align with local, national, and international biodiversity and sustainability frameworks and strategies such as the Philippine Biodiversity Strategy and Action Plan (PBSAP) and the Convention on Biological Diversity (CBD).

B. Creating Long-term Monitoring and Evaluation Metrics and Methods

- Establish and implement a system of tracking efforts and initiatives that focus on biodiversity (forest cover, species diversity, etc.) and consider a Baguio Biodiversity Report Card that integrates metrics from the Seal of Good Local Governance (SGLG) to herald accountability and proactive compliance.

- Employ on-the-ground checks to assess the effectiveness of biodiversity-related policies that are being implemented.

2. Harnessing Culture and Community: Indigenous Knowledge and Community-led Urban Conservation

A. Complementing Environmental Solutions with Indigenous Conservation Approaches

- Integrate the Indigenous Peoples' Biodiversity Strategy and Action Plan (IPBSAP) at the city level to institutionalize indigenous knowledge in urban environmental planning.

- Designate an Indigenous Biodiversity Management Zone for citizens within specified ancestral domains while strengthening the protection framework for such sites.

- Consider placing a financial incentive scheme for indigenous groups who are maintaining ecologically-important zones.

B. Complementing Environmental Solutions with Indigenous Conservation Approaches

- Enhance citizen participation in biodiversity conservation and pro-environment behavior through urban greening efforts, formal and informal integration of environmental education especially in schools and local youth councils, and promoting citizen science programs.

3. Balancing Urban Development with Environmental Sustainability

A. Enacting an Ecosystem-based Urban Planning and Zoning Regulations

- Enforce stricter zoning regulations in areas with high probability of urban sprawl and encroachment such as the city's remaining green spaces which are mostly privately-owned areas.

- Encourage and promote conservation and protection easements for landowners where they receive incentives for protecting biodiversity resources and habitats on identified private properties.

B. Mitigating the detrimental impact of urban development on the city's natural environment

- Strengthen the implementation of Environmental Compliance Certificates (ECCs) and ensure that developments incorporate facets aiming to curb environmental decay.
- Explore financial offsets for developers implementing greening initiatives commensurate with the degree of environmental disturbance.

4. Promoting Nature-based Solutions (NbS) for enhancing Biodiversity and Climate Resilience

A. Enhancing Biodiversity and Greenspaces through Nature-based Solutions

- Use geospatial data and on-the-ground assessment in identifying high-priority conservation areas and habitats.
- Craft an ecological connectivity strategy that interlinks urban green spaces, forests, watersheds, and other ecological habitats to promote species movement and enhance the delivery of urban ecosystems services.
- Strengthen the Urban Forest Management Plan (UFMP) and watershed rehabilitation programs to maintain the delivery of provisioning ecosystem services such as food and water.

B. Applying NbS for Soil and Water Health, and Waste Management

- Provide opportunities to initiate organic composting and vermiculture initiatives in communities.

5. Institutionalizing Scientific Research and Evidence-based Environmental and Urban Planning Policymaking

A. Adopting a Centralized Biodiversity and Environmental Health Information System

- Establish a Baguio Urban Biodiversity Data Repository System that will be managed by academic institutions, select government agencies, environmental groups, and citizen scientists.

- Adopt and integrate global and national biodiversity assessment frameworks (e.g., IUCN Urban Nature Index, Singapore Index on Cities' Biodiversity) with local metrics to improve the assessment and monitoring of Baguio City's biodiversity and ecosystems.

B. Integrating Science and Socio-cultural Contexts into Environmental Policy and Planning

- Conduct biodiversity impact assessments as a requisite for policy proposals and city development plans while employing long-term ecological assessments on significant conservation challenges such as introductions of non-native species and re-greening initiatives.

- Harness and empower collaboration and meaningful partnerships between scientists, policymakers, citizens, and other stakeholders through regular policy dialogues and knowledge-sharing avenues.

■ **Figure 2.** Alignment of policy recommendations with the IUCN Natural Resource Governance Framework (NRGF) principles and criteria. The figure highlights how each proposed policy supports key governance elements such as legitimacy and voice, direction, performance, accountability, and fairness and rights. By structuring our recommendations within this framework, we ensure that biodiversity management strategies in Baguio City are not only ecologically sound but also socially inclusive and institutionally robust. This alignment strengthens policy implementation by promoting stakeholder participation, transparency, and adaptive management—key factors in achieving long-term sustainability in urban biodiversity governance.

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