KnE Social Sciences

The 8th Legal International Conference and Studies: Integrating Climate Change and Biodiversity into National & International Legislation—Harmonizing Knowledge

KNE Publishing

Research Article

The Impact of Climate Change on Biodiversity in Jabodetabek

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Abstract.

Climate change has become a global issue that has serious impacts on biodiversity, including in the Jabodetabek metropolitan area which is experiencing ecological pressure due to massive urbanization and environmental degradation. This study aims to analyze the impact of climate change on the existence and sustainability of local flora and fauna species in Jabodetabek, identify weaknesses in existing policies, and formulate mitigation efforts within the context of national environmental issues. The method used is a legal-sociological approach with data collection techniques through literature studies, field observations, and limited interviews with stakeholders. The results show that rising temperatures, changes in rainfall patterns, and declining habitat quality have caused species migration, local extinction, and ecosystem imbalance. Weaknesses lie in the lack of integration between climate and conservation policies, minimal oversight, and low public participation. Recommended mitigation measures include strengthening conservation regulations, habitat restoration, providing ecological corridors, and multi-stakeholder collaboration between the government, community, and private sector. This study emphasizes that biodiversity protection must be an integral part of climate change adaptation strategies, in line with Indonesia's commitment to sustainable development.

Keywords: biodiversity, climate change, ecosystem adaptation

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Published: 29 October 2025

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the 8th Legal International Conference and Studies Conference Committee.

1. Introduction

Climate change is the greatest challenge to the sustainability of global ecosystems in the 21st century. Its impacts are not only felt by industrialised nations but also by developing countries like Indonesia, which boasts the second-highest biodiversity in the world after Brazil (Intergovernmental Panel on Climate Change (IPCC), 2022) Changes in global temperature, rising sea levels, extreme weather, and changes in rainfall patterns have put significant pressure on various species of flora and fauna. This vulnerability becomes even more complex in urban areas such as Jabodetabek (Jakarta, Bogor, Depok, Tangerang, Bekasi), which is both the epicentrum of economic growth and the center of environmental degradation.

The Jabodetabek region is experiencing rapid population growth and urbanisation, with the conversion of forest and agricultural land into residential, industrial, and infrastructure areas (Bappenas, 2022) This massive land use change has resulted in the fragmentation of natural habitats and a reduction in green open spaces, directly threatening the existence of local biodiversity. This situation is exacerbated by high carbon emissions from motor vehicles, commercial buildings, and industries, leading to an increase in urban microclimate temperatures (urban heat island effect). (Suprayogi, Bambang. 2022).

Research conducted by LIPI states that in the Jabodetabek area, there has been a significant decline in the population of bird species, pollinating insects, and various types of endemic plants that previously grew around urban forests, parks, and water catchment areas (LIPI Press) In addition to habitat loss, species also experience ecological stress due to air and water pollution, light pollution, and microclimate changes that disrupt their reproductive and migration cycles (Wicaksono, Andri. 2002)

The issues of climate change and biodiversity loss have become a major concern in national and international forums. Indonesia, as a party to the Convention on Biological Diversity (CBD) and the Paris Agreement, has developed various national policies that integrate climate change adaptation and biodiversity conservation. One of these is through the National Action Plan on Climate Change Adaptation (RAN-API) and the Indonesian Biodiversity Master Plan (RIKHI). (KLHK). In the 2020–2024 National Medium-Term Development Plan (RPJMN) document, the government targets emission reductions and biodiversity protection based on ecoregions. However, policy implementation in the Greater Jakarta area often faces structural obstacles such as weak coordination between local governments, limited funding, and conflicts between economic interests and environmental conservation (Taufiq, Fadli. 2021)

Furthermore, the role of the community in maintaining ecosystems in urban areas is still relatively low. Ecological awareness has not been internalised in the collective behaviour of city residents, while economic and social pressures mean that environmental conservation is not considered a priority. However, biodiversity plays an important ecological role in maintaining local climate stability, providing oxygen, absorbing carbon, and protecting against natural disasters such as floods and landslides. If damage continues to be allowed (Nugroho, Heru. 2023) not only will species become extinct, but the quality of human life will also be threatened.

Therefore, a comprehensive and scientifically based study is needed on the impact of climate change on biodiversity in the Greater Jakarta area, linked to the national policy context. This study is expected to provide strategic recommendations for the formulation of climate change-adaptive biodiversity protection policies, particularly in urban areas with high ecological pressure.

2. Methods

This study uses a descriptive qualitative approach with a case study method focused on the Greater Jakarta area. This approach was chosen because it is able to describe in depth the socio-ecological realities that occur, particularly in assessing the impact of climate change on biodiversity in urban areas with high human activity. This research is interdisciplinary, combining environmental, policy, and social aspects to examine the relationship between the impacts of climate change at the local level and national policy responses.

The research location is centered in the Jabodetabek region, which has complex ecological and urbanisation characteristics, including conservation areas, urban parks, and green open spaces affected by environmental degradation. The research was conducted from January to July 2025. Data sources include primary and secondary data. Primary data was collected through field observations and in-depth interviews with stakeholders from the Environmental Agency, academics, and NGOs working in conservation and climate change. Meanwhile, secondary data was obtained from official documents such as the National Medium-Term Development Plan (RPJMN), Strategic Environmental Assessment (KLHS), National Action Plan on Climate Change Adaptation (RAN-API), climate reports from the Meteorology, Climatology, and Geophysics Agency (BMKG), and relevant scientific publications.

3. Result and Discussion

3.1. Impact of Climate Change on Biodiversity in Jabodetabek

Climate change has had a significant impact on biodiversity in the Jabodetabek metropolitan area. This region, as the largest urban agglomeration in Indonesia, faces dual environmental pressures in the form of rising average temperatures, extreme rainfall, air pollution, and massive land conversion. According to data from the Indonesian

Meteorological, Climatological, and Geophysical Agency (BMKG) and the Ministry of Environment and Forestry (KLHK), the annual maximum temperature in Jabodetabek has increased by approximately 1.2–1.5˚C over the past two decades, accompanied by seasonal shifts and extreme weather events such as tidal floods, droughts, and tornadoes (BMKG, 2022).

These conditions have directly impacted the degradation of natural habitats such as urban forests, riverbanks, and wetland areas, which were previously important habitats for various migratory bird species, pollinating insects, and endemic plants. Some species, such as the Javanese sparrow (Lonchura leucogastroides), fruit bats (Pteropus vampyrus), and ground orchids, are becoming increasingly difficult to find due to the disruption of micro-ecosystems and the lack of buffer zones (KLHK, 2023). Data from the Kehati Foundation shows a decline in local biodiversity indices of up to 35% in several riparian zones in South Tangerang and Depok in 2022 (Yayasan KEHATI).

Furthermore, climate change exacerbates the effects of urbanisation. Imbalances in the water cycle, rising surface temperatures (urban heat island effect), and loss of vegetation lead to population instability and an increase in invasive species such as house mice, Aedes aegypti mosquitoes, and weeds, which further accelerate biodiversity loss (Wahyuni, F. 2023). Research by the University of Indonesia (2023) shows that the presence of native species in urban green open spaces (RTH) has declined drastically due to air pollution and acid rain contamination, which disrupts the reproductive cycle of flora (KLHK).

3.2. Weaknesses in Addressing the Impacts of Climate Change

Addressing the impacts of climate change on biodiversity still faces various fundamental weaknesses, both in terms of regulatory, institutional, and public awareness aspects. First, there is still no strong synergy between the central and regional governments in the implementation of ecosystem-based adaptation (EbA) policies. Although the Ministry of Environment and Forestry has developed the National Biodiversity Master Plan (RIK) and RAN-API, these policies have not been fully mainstreamed into spatial planning and urban development in Greater Jakarta (KLHK).

Second, the lack of mapping of local biodiversity is a major obstacle. Most areas in Jabodetabek do not yet have an up-to-date inventory of local species. This results in conservation policies that are not based on solid ecological data. Third, the low capacity of human resources and budget in the environmental sector, especially at the city/district

government level, has led to a lack of sustainable habitat protection and rehabilitation programmes (Bappenas, 2022).

From the community perspective, the lack of ecological awareness, especially among the urban youth, exacerbates the biodiversity crisis. Urbanisation of lifestyles and short-term economic orientation result in low community participation in local conservation efforts, such as the preservation of local trees, wastewater management, or biodiversity-based urban agriculture. This weakness is also evident in the integration of environmental education curricula, which have not addressed local contexts and the role of citizens in climate adaptation (Sari N, 2022).

3.3. Ecosystem-based Mitigation and Adaptation Efforts

Various efforts have been made to minimise the impact of climate change on biodiversity, but their effectiveness still needs to be improved. Local governments such as Jakarta, Bogor, and Bekasi have implemented urban forest restoration programmes, such as the 'Jakarta Tanam Pohon' (Jakarta Plants Trees) and 'Bogor Green City' programmes, as well as the revitalisation of river basins (DAS) such as Ciliwung and Cisadane as natural habitats for local flora and fauna. The Ministry of Environment and Forestry (KLHK) also promotes biodiversity conservation through ecological fiscal transfer (EFT) schemes and community-based conservation area pilot projects (Pemprov DKI Jakarta, 2023).

Non-governmental organisations (NGOs) such as Yayasan Kehati, WALHI, and the World Resources Institute (WRI) Indonesia play an active role in fostering local communities to develop ecological restoration programmes, such as urban biodiversity gardens, species monitoring through citizen science, and climate adaptation training for young people. The ecosystem approach is also strengthened by the use of digital technology, such as GIS biodiversity mapping, habitat modelling, and air quality monitoring, which are used to identify areas at risk of species loss.

Going forward, environmental governance reform based on ecological justice is needed. Local governments in Jabodetabek need to develop a biodiversity conservation master plan that is integrated with transportation systems, infrastructure, and spatial zoning. Additionally, locally-based climate education must be a strategic priority in shaping urban environmental culture. The expansion of green open spaces should not only be quantitative but must also consider ecological quality and habitat connectivity to ensure species can migrate and reproduce sustainably.

4. Conclusion

Climate change has a real impact on the decline of biodiversity in the Jabodetabek region, characterised by rising average temperatures, degradation of natural habitats, and ecosystem disruption due to intensified urban development. This pressure is exacerbated by the weak integration of climate change adaptation policies into spatial planning and the lack of valid local biodiversity data. Some native species are beginning to face extinction or displacement by invasive species that are more adaptive to degraded environmental conditions. Additionally, public awareness and the institutional capacity of local governments in environmental conservation remain suboptimal, so mitigation efforts have not been able to offset the rate of damage occurring (KLHK). Local governments in the Greater Jakarta area need to integrate biodiversity protection into spatial planning and sustainable development policies by strengthening conservation regulations and local biodiversity databases. There is also a need to improve environmental education for the public and strengthen cooperation between the government, academia, and communities in mapping species and habitats. In addition, the revitalisation of green open spaces and the development of ecological corridors must be prioritised in order to maintain ecosystem connectivity. The involvement of the private sector through green incentives and environmental partnership programmes also needs to be increased to strengthen the collective role in biodiversity conservation amid the pressures of climate change (Nuraini, R. 2024).

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