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# Sustainable Urban Planning through Green Belt in IKN: A Literature Review

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**Abstract.** The rapid urbanisation of cities presents a significant challenge to biodiversity and ecological balance. A pertinent example is Ibu Kota Nusantara (IKN), Indonesia's new capital city, which is poised for swift urban development. The area of IKN is part of Indonesia's biodiversity hotspot and has a high level of endemism. This study explores the implementation of a green belt in IKN, focusing on its potential to enhance sustainable urban planning. It draws comparative insights from successful global examples in cities like London, São Paulo, and Melbourne, highlighting how green belts help prevent urban sprawl while providing co-benefits such as supporting net zero initiatives and preserving natural habitats and biodiversity. Through a comprehensive review of policy frameworks, existing environmental conditions of IKN, and case studies, recommendations for green belt implementation are developed. These recommendations emphasise the need for strong governmental commitment, active community engagement, and the integration of advanced technological tools in the planning and management processes. The integration of a green belt is envisioned to transform IKN into a model of sustainable urban development, harmonizing urban growth with ecological preservation.

## 1. Introduction

The designation of IKN as Indonesia's new capital city represents a crucial turning point in urban planning and environmental management. This strategic move, driven by the need to alleviate demographic pressures on Jakarta and promote equitable economic growth throughout the archipelago, presents a unique opportunity. Additionally, the abundant forest resources in IKN present a unique opportunity to integrate the forest city concept into urban development. This concept involves preserving and conserving natural resources, environmental sustainability, and forest integrity, all aimed at fostering a harmonious balance between urban development and environment preservation [1].

The anticipated urbanisation linked to the capital's relocation carries considerable environmental risks, particularly the risk of urban sprawl. This refers to the uncontrolled spread of urban development into adjacent rural areas, which could endanger the local biodiversity [2].



Therefore, the strategic implementation of a green belt is proposed to address these challenges and serve as a foundation for achieving sustainable urban planning. This approach is designed as a physical buffer to prevent sprawl and control urban expansion [3]. Moreover, the co-benefits of the green belt extend towards aiding the achievement of net zero targets and enhancing biodiversity conservation, aligning with the goals of the Nusantara Net Zero Strategy 2045 and the global environmental commitments set forth in the Kunming-Montreal Global Biodiversity Framework. The term "net zero" refers to a strategy aimed at reducing greenhouse gas emissions to counteract global warming [4].

Globally, research has recognised green belt as effective urban planning tools that provide substantial environmental, social, and economic benefits. Examples from cities like London, São Paulo, and Melbourne illustrate the role of green belts in managing urban growth, safeguarding natural habitats, and enhancing the sustainability of urban areas. This broader range of benefits highlights the importance of green belt in contemporary urban planning and supports their inclusion as a central component of sustainable urban planning strategies. This paper conducts a thorough examination of IKN's existing forest conditions, green belt potential, and relevant policy frameworks to offer a comprehensive analysis of how green belts could enhance IKN's sustainable urban planning. Furthermore, this study aims to provide actionable insights and recommendations for policymakers involved in developing IKN, ensuring a sustainable urban future.

## 2. Literature Review

### 2.1 Green Belt towards Sustainable Urban Planning

The conceptual framing of green belt functions is crucial for achieving sustainable urban planning. A green belt is an area of open land designed to prevent urban sprawl and protect the area from urban development [5]. These designated areas of open land not only define urban boundaries but also maintain the distinctiveness of rural and urban zones.

From an environmental standpoint, green belts are vital habitats for various plant and animal species, fostering biodiversity and creating green corridors that connect isolated natural areas [6]. Green belts are also instrumental in climate regulation by absorbing carbon dioxide, moderating local temperatures, and improving air quality [7]. Economically, green belts are vital for supporting agriculture in areas surrounding urban centres, thereby reducing the urban carbon footprint by shortening food supply chains [8]. By integrating natural and built environments, green belts are essential in promoting sustainable urban planning.

### 2.2 Co-benefits from Green Belt: towards Net Zero and Biodiversity Conservation

Green belts are pivotal in reducing urban carbon footprints by sequestering carbon. Various vegetation within the green belt, especially trees and shrubs, can absorb carbon dioxide, effectively acting as a carbon sink. Tree planting can offset human activities' carbon dioxide and absorb significant air pollutants such as NO<sub>x</sub> [9]. Trees planted near buildings can regulate temperature and wind, reducing the need for air conditioning and lowering building energy consumption. This phenomenon not only helps to mitigate the urban heat island effect but also contributes to emission reductions. The creation of larger planted areas increases evapotranspiration rates, provides more shade, enhances cooling effects, and sequesters more significant amounts of carbon [10].

A study estimated that urban parks can store an average of 15.3 tons of carbon per hectare [11]. The highest carbon sequestration and storage values are observed in areas dominated by

broadleaf trees and closed canopy cover. Studies have demonstrated that green belts excel at planar carbon storage and contribute to overall carbon storage by suppressing urban sprawl. Furthermore, green belts are 5-8 times more effective than carbon storage mechanisms such as crop expansion and roof greening [12]. This ability to effectively store carbon suggests that urban green spaces are essential in achieving carbon neutrality.

Green belts also serve an important role in biodiversity conservation, which in turn positively impacts the urban environment. Green belts provide habitats for a variety of species, thereby increasing urban biodiversity. In addition to serving as habitats, green spaces in urban areas play a pivotal role in facilitating biodiversity corridors [13]. The presence of diverse flora and fauna in urban environments can exert a considerable influence on the urban microclimate, including the regulation of soil temperature, green space biomass, soil carbon storage, and the maintenance of soil moisture [14]. It is essential to consider the habitat structure to support biodiversity abundance in the form of understory and canopy complexity and diversity, leaf litter, woody debris, long grass, and wetlands [15].

### 3. Methods

This study employed a comprehensive methodology to assess the potential of green belt implementation in IKN. It included a policy review that analysed current policies and regulations in IKN for alignment with green belt development. Additionally, the literature review considered existing research and case studies from cities such as London, São Paulo, and Melbourne to identify best practices.

The methodology included a descriptive analysis to synthesise the findings from the policy review, literature review, and case studies. This analysis aimed to comprehensively assess the multifunctional benefits of green belts, including preventing urban sprawl, supporting net zero targets, and preserving natural habitats and biodiversity. By combining these methods, the study generated valuable insights and recommendations for integrating a green belt into IKN's sustainable urban planning.

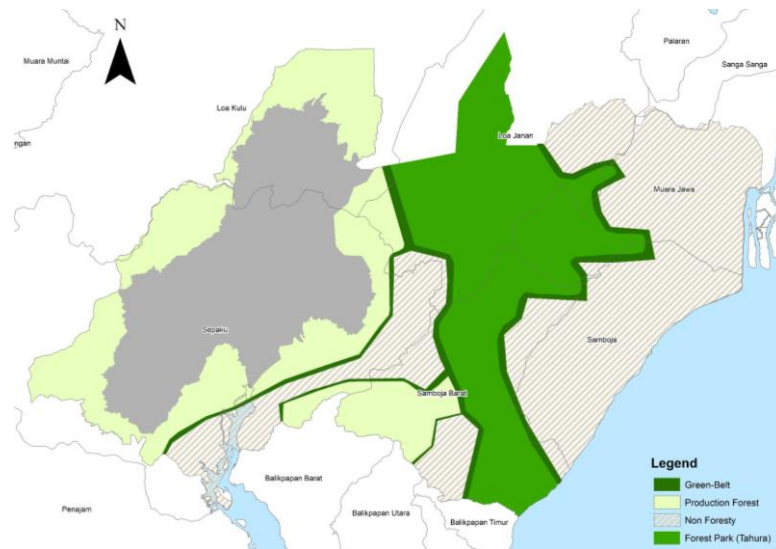
### 4. Results and Discussions

#### 4.1 Green Belt in IKN: Potential Implementation

Existing forest land use in IKN has an area of 109,808.38 Ha or 42.87%, consisting of protected forests, production forests, conservation production forests, limited production forests, and great forest parks [16]. The great forest park is the Soeharto Great Forest Park, designated as an area with high biodiversity value. It has 201 flora and fauna species, some of which are protected species. In addition to Soeharto Great Forest Park, seven other areas in IKN are included in the area with high biodiversity value [17].

The characteristics of the existing land cover, such as dividing lines between urban areas and rural areas (farmland, forest), and even the presence of local tribes, will significantly influence the potential of the green belt. The existing forest form of the IKN area has indicated the existence of a green belt (see Figure 1.), such as Sepaku, which the great forest park and production forests surround, and Samboja and Muara Jawa in coastal areas, directly bounded by Tahura as well. A study also indicates a potential green belt as a buffer zone to prevent urban expansion in several sub-districts, namely Samboja, Muara Jawa, Penajam, and small Loa Kulu [18]. Furthermore, maintaining forest connectivity between great forest park and production forests in Samboja,

south of IKN, is crucial for supporting urban ecosystem services and biodiversity (e.g., seed migration and proliferation, animal migration, and gene flow) [19].



**Figure 1.** Green Belt in IKN

#### 4.2 Policies and Regulations Review in IKN

The availability of policies and regulations plays an important role in maintaining the existence of forest land cover and its potential, as well as in mainstreaming the functions and benefits of the green belt. For instance, the Forest City Concept in IKN, as outlined in Presidential Regulation No. 63 of 2022 on the Details of the IKN Master Plan, becomes one of the development concepts in IKN capable of achieving sustainable urban planning by emphasising six principles: 1) conservation of natural resources and wildlife habitats; 2) connection with nature; 3) low-carbon development; 4) adequate water resources; 5) anti-sprawl development; 6) community involvement in achieving the forest city [20].

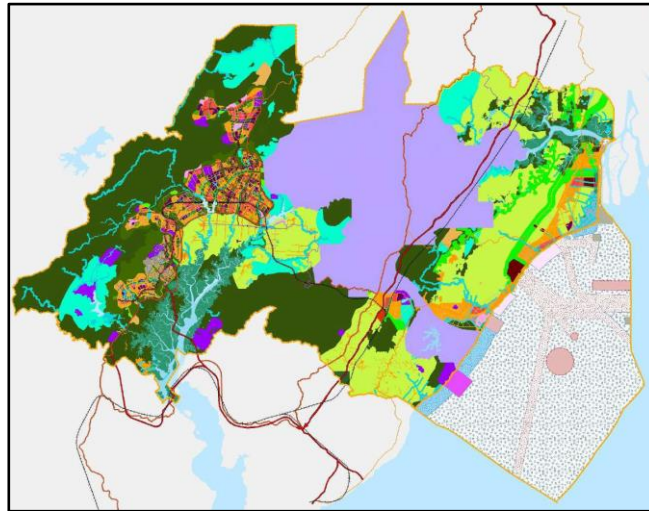
In addition, there are several regulations that provide more detailed and operational guidance regarding forest utilisation to address urban sprawl, support net zero targets, and preserve natural habitats and biodiversity. These include presidential decrees, regulations from the Ministry of Environment and Forestry and the Ministry of Public Works, provincial regulations in Kalimantan, and Nusantara Capital City Authority, among others. Table 1 presents several related policies and regulations.

**Table 1.** Policies and Regulations Review

Co-Benefits	Policies & Regulations	Policies & Regulations Review
Prevent Urban Sprawl	<ul style="list-style-type: none"> <li>• Presidential Regulation No. 63 of 2022 on the Details of the IKN Master Plan</li> <li>• Presidential Regulation No. 64 of 2022 on the Spatial Plan for the National Strategic Area of the IKN Year 2022-2042</li> <li>• 9 Detailed Spatial Plans (Rencana Detail Tata Ruang/RDTR) of National Capital City</li> <li>• Regulation of the Head of the Nusantara Capital City Authority (<i>Otorita Ibu Kota Nusantara/OIKN</i>) No. 10 of 2023 on the Procedures for Monitoring and Evaluating the Implementation of IKN Master Plan</li> <li>• Regulation of the Head of the OIKN No. 12 of 2023 on the Procedures for Land Administration in IKN</li> </ul>	<p>These regulations collectively contribute to preventing urban sprawl in IKN Nusantara by enforcing structured development, clear land use zoning, and continuous monitoring and evaluation of urban growth. The regulations also play a critical role in preserving existing forest land use and implementing the green belt. The government regulation also already discusses the role of green belts in controlling urban development. Specifically, these regulations state that green belts establish boundaries between urban and rural areas by utilising green corridors along regional transportation routes and riparian zones.</p>
Support net zero target	<ul style="list-style-type: none"> <li>• Nusantara Net Zero Strategy 2045</li> <li>• Climate Resilience Development 2020-2045</li> <li>• Govt. Regulation No. 22 of 2021 on Implementation of Environmental Protection and Management</li> <li>• MoEF Regulation No. 33 of 2016 on Guidelines for Preparing CCA Actions</li> <li>• East Kalimantan Regional Regulation No. 7 of 2019 on CCA and Mitigation</li> </ul>	<p>These regulations collectively support IKN's net zero targets by promoting robust environmental management, sustainable development practices, and climate resilience measures. Forest land use is targeted to become a net sink; several strategies are carried out, including reducing deforestation, restoring industrial forest, and community forest management.</p>
Preserve natural habitats and biodiversity	<ul style="list-style-type: none"> <li>• Nusantara Biodiversity Management Master Plan</li> <li>• Indonesia Biodiversity Strategy and Action Plan (IBSAP)</li> <li>• Presidential Instruction No. 1 of 2023 on "Mainstreaming Biodiversity Conservation in Sustainable Development"</li> <li>• Presidential Regulation No. 64 of 2022 on the Spatial Plan for the National Strategic Area of the IKN Year 2022-2042</li> </ul>	<p>The development of IKN pays attention to biodiversity conservation in line with the Kunming-Montreal Global Biodiversity Framework targets. The implementation of green belts as habitat connectivity is stated, for instance, to create wildlife corridors to ensure habitat connectivity within the urban development framework of the National Capital City (2022-2042).</p>



Based on the review, IKN already has regulations and policies that direct the mainstreaming of green belts as an effort to anticipate urban sprawl; this is explicitly stated in the IKN spatial regulation. Spatially, the green belt is mostly planned in the northeast area, namely in the sub-districts of Muara Jawa, Samboja, and West Samboja (See Figure 2). This is quite in line with the indications of existing forest cover found in Figure 1. but there are still areas that have good potential as green belts.



**Figure 2.** IKN Zoning Plan 2022-2042 [21]

#### 4.3 Case Studies

Green belt practices vary between countries. The case studies from the London, São Paulo, and Melbourne provide key examples that are insightful for IKN. These approaches will guide the strategic integration of green belts into IKN's development.

##### 4.3.1 London—Metropolitan Green Belt and London Urban Forest

The Metropolitan Green Belt, characterized by a mixture of farmland, country parks, and woodland, offers profound insights into preventing urban sprawl by establishing clear boundaries between urban and rural areas. This strategy has successfully preserved the ecological balance and ensured that these green spaces remain accessible to city dwellers. This success underscores the importance of robust legal frameworks in urban planning to protect green areas from encroaching development. A strong political commitment from the government, along with unwavering support for the continued protection of the Green Belt, has been crucial. This idea, initially introduced in the 1930s and further developed through Abercrombie's 1944 Greater London Plan, carries a deep-rooted history and underscores the enduring tradition of maintaining green spaces [22]. The London Plan 2021 emphasises the importance of the green belt in combating urban sprawl, supporting climate resilience, and enhancing recreational spaces for Londoners [23].

London's commitment to detailed, data-driven urban forestry through London Urban Forest is exemplified by its use of Geographic Information Systems (GIS), such as the London Street Tree Map. This open-access platform facilitates effective tree management and monitoring through accessible data sharing [24]. Furthermore, the community's involvement through

initiatives like the stewardship of London's urban forest and the wider urban forest community further strengthens the conservation efforts and sustainable management of the green belt [25].

#### *4.3.2 São Paulo Green Belt Biosphere Reserve*

The São Paulo Green Belt Biosphere Reserve (SPGBR) is a prime example of the green belt strategy in action. Established in 1994 and recognised by UNESCO, the SPGBR spans over 1.6 million hectares, encircling the urban areas of São Paulo. This biosphere reserve is a diverse mix of land uses, including urban forests, agricultural zones, and biologically rich Atlantic Forest patches. The green belt plays a vital role in preserving ecosystem services such as hydrological stability, air purification, and significant carbon storage. SPGBR has an important role considering apart from the regulation of greenhouse gases, they also provide ecosystem services such as water production, erosion, and landslide control, and also climate regulation, which helps the well-being of 24 million inhabitants of São Paulo, a substantial contribution to regional climate goals. The coordinated policy frameworks and community participation are crucial to the SPGBR's success.

The extent of SPGBR forested landscapes is connected, allowing for the movement of species and the flow of ecological processes. High connectivity allows for greater gene flow, species migration, and resilience to environmental changes. Zoning plans can integrate ecological connectivity by designating specific zones for conservation, green spaces, and green infrastructure to make low-impact development.

The State of São Paulo and its associated municipalities have jointly implemented strong spatial planning and development control measures that closely regulate urban expansion and promote environmental stewardship. Incentives, such as payment for ecosystem services, support these policies, involving local communities in conservation initiatives [26]. It has become a multifaceted system comprising forests, river basins and water resources, agricultural lands, coastal and marine ecosystems, cultural heritage, cities, and residents who coexist and interact with one another [27].

#### *4.3.3 Melbourne Green Wedges*

According to the Planning and Environmental Act of 1987, green wedge land in Melbourne consists of non-urban areas outside the urban growth boundary [28], including wetlands, forests, and grasslands. The Melbourne Green Wedges offer many ecological, social, and economic benefits, rendering them indispensable for conserving biodiversity, preserving culture, providing food, and advancing the economy. Environmentally, the Melbourne Green Wedges are critical for protecting native wildlife and nationally important vegetations, including species such as the Dwarf Galaxias and the Growling Grass Frog [29]. These areas include sites of international and national significance, such as the Ramsar-listed wetlands of Western Port, the Edithvale-Seaford wetlands, Port Phillip Bay, the Western Grassland Reserve, the UNESCO-designated Mornington Peninsula, and Western Port Biosphere Reserve. Conservation efforts in these areas include tree planting, enhancing tree diversity, establishing habitat baselines, creating habitat corridors, and developing new open spaces to support biodiversity [30]. These initiatives underscore the green wedges' critical environmental and ecological functions, further establishing their importance in regional planning and environmental management.

The 2018 election reaffirmed the government's commitment to protecting Melbourne's Green Wedges from overdevelopment. This commitment encompasses several legislative measures, including the enhancement of regional planning control laws, the clarification of the definition of permitted land use, the determination of appropriate sizes and scales of uses in non-urban areas, and the strengthening of permanent planning controls and legislation to protect and



support agricultural land around Melbourne. This initiative is consistent with the Melbourne Plan 2017-2050 objectives. It underscores the significance of productive land uses in Melbourne's non-urban areas and the necessity of enhancing their protection and management [31].

The Victorian government actively involves the public in the management of green wedges. Some of the efforts made include: 1) promoting biodiversity understanding and local community participation in management, 2) raising awareness of the Green Wedge's cultural heritage and partnering with Aboriginal organisations for best practices in land and environmental management, 3) encouraging landowners and residents to join Melbourne Water, Landcare and Catchment Management Authority programmes, 4) engage over 37 local groups in Kingston City for projects such as plant propagation, revegetation, weed control, erosion prevention and water quality monitoring, and 5) support community participation in critical environmental programmes and establish Friends Groups for watercourses and new reserves [32].

#### 4.4 Lessons Learned for IKN from Case Studies

The following table provides a comparative analysis of the characteristics of green belts in IKN, London, São Paulo, and Melbourne. This overview highlights the similarities and differences in type of vegetation, main objectives, key features, governance, and successes, offering insights into how each city approaches the integration of green spaces within its urban fabric to address urban planning challenges.

**Table 2.** Comparative Analysis

Characteristic	IKN	London	São Paulo	Melbourne
<b>Type of Vegetation</b>	Tropical forests including protected, production, and conservation forests	Mixture of farmland, country parks, and woodland	Mixed land uses with Atlantic Forest patches, urban forests, and agricultural zones	A range of landscapes such as wetlands, forests, and grasslands
<b>Main Objectives</b>	Biodiversity preservation, urban-rural demarcation, and sustainable urban planning	Prevent urban sprawl, maintain ecological balance, and ensure accessibility to green spaces for city dwellers	Preserve ecosystem services, regulate greenhouse gases, and provide environmental benefits to urban areas	Conserve biodiversity, protect agricultural lands, and support economic activities outside urban growth boundaries
<b>Key Features</b>	High biodiversity with endemic flora and fauna, dense canopy cover, integral to ecosystem services	Historical sites, managed parklands, urban trees, and extensive green spaces interconnected across the city	UNESCO biosphere reserve with significant carbon storage capabilities and vital hydrological services	Green wedges include Ramsar-listed wetlands, significant biodiversity sites, and culturally important landscape

Characteristic	IKN	London	São Paulo	Melbourne
<b>Governance</b>	Developing policies and regulations focusing on forest management and sustainable urban planning	Strong legal frameworks supported by government commitment and detailed urban forestry practices	Coordinated policy frameworks, community participation, and incentives like payment for ecosystem services	Legislation supporting green wedges, public involvement in conservation efforts, and regional planning control laws
<b>Successes</b>	Potential indicated, plans under development	Established green boundary, effective urban containment, and enhancing recreational spaces	Strong community involvement, effective biodiversity and climate regulation	Effective management of natural areas, preventing urban boundary expansions, and robust community engagement

Drawing critical lessons from London, São Paulo, and Melbourne is pivotal for IKN to successfully integrate green belts into its urban development strategy. Each city exemplifies the importance of a strong government commitment to implementing and upholding green belt policies. London's robust legal frameworks backed by governmental support, including the mayor's commitment, have been essential in preserving green spaces from urban encroachment. São Paulo and Melbourne show strong policy support and planning that integrate green belts into broader urban development strategies. For IKN, this emphasises the critical need for ongoing commitment at all levels of government to ensure effective implementation and long-term preservation of its green belt.

The case studies also highlight the green belt's multifunctional value in providing ecological, social, and economic benefits. For instance, São Paulo's green belt plays a crucial role in carbon sequestration and maintaining hydrological stability, while Melbourne's Green Wedges are key to preserving natural habitats and biodiversity. IKN can leverage this multifunctional approach by designing green belts to develop green spaces that are both ecologically resilient and socially beneficial, promoting a balanced interaction between urban development and natural preservation.

Community involvement has played an important role in successfully managing and conserving green belts in all three cities. Engaging local communities in the stewardship of these areas increases public support and ensures the long-term success of conservation efforts. IKN should consider policies that encourage community participation in green belt management in order to tap into local knowledge and instill a sense of ownership in residents.

London's use of Geographic Information Systems (GIS) to effectively manage and monitor green spaces exemplifies the benefits of employing advanced technology in urban and environmental management. GIS tools can help IKN monitor urban expansion, manage forest density, and provide a quantifiable measure of green belt efficacy. Adopting such technology will

allow for accurate planning, real-time monitoring, and informed decision-making when developing and managing green belts.

By combining these lessons learned, IKN can and should develop a comprehensive green belt strategy. This strategy should not only address current urban and environmental issues but also lay the groundwork for long-term urban development.

## 5. Conclusion

The establishment of IKN as Indonesia's new capital is not just a pivotal change in urban development but also an opportunity to embed sustainable practices from the ground up. The proposed implementation of a green belt in IKN aims to address significant challenges such as urban sprawl, contribute to net zero targets, and preserve natural habitats and biodiversity. The lessons drawn from case studies like London, São Paulo, and Melbourne underscore the potential of green belts for sustainable urban planning.

The global case studies show IKN that effective green belt strategies necessitate a coordinated approach that combines strong government commitment, community involvement, and technological advancement. By aligning policy frameworks with community-driven initiatives and utilising modern planning and monitoring technologies such as GIS, IKN can ensure that its green belts serve as critical components of an integrated urban environment. This strategy will aid in the sustainable growth of new capital, benefiting both the environment and the community.

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