



BRIEF

**MANGROVE ECOSYSTEM
SERVICE VALUATION IN
INDONESIA'S NEW
CAPITAL CITY – IKN**

*Strengthening Sustainable Land-Use
Planning*



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This brief is one of multiple outputs from a comprehensive mangrove ecosystem service valuation conducted in Ibu Kota Nusantara (Nusantara Capital City) by a team led by Juan Robalino and composed of Rahmina Masdar and Oktovina Trisia from Landesa; and Sang Phan from the University of Queensland.

This mangrove ecosystem service valuation was conducted under the overall guidance and support of Myrna Asnawati Safitri (Deputy for Environment and Natural Resources of OIKN), Pungky Widiaryanto (Director of Forestry and Water Resources of OIKN), Mardha Tillah (Landesa Indonesia Program Director), and Rachel McMonagle (Landesa Climate Change Director).

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ETHICAL CONSIDERATIONS & QUALITY ASSURANCE

The mangrove ecosystem service valuation was conducted in compliance with comprehensive ethical safeguards, receiving approval from the University of Queensland Human Research Ethics Committee (Application #2024/HE002085) and ethical clearance from BRIN (No. 089/KE.01/SK/02/2025). Landesa convened a validation workshop to review the valuation findings with key government and community stakeholders. The workshop was held under official authorization from the Deputy for Environment and Natural Resources (Letters No. S-126.OIKN.7.2024 and S-31.OIKN.7.2025), and with entry approval into IKN granted by the Deputy of Development and Control (Letter No. S-129.4.2025).

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Executive Summary

The development of **Indonesia's intended new capital, Nusantara Capital City** (Ibu Kota Nusantara – IKN), in East Kalimantan presents a unique **opportunity to align urban growth with ecosystem conservation**. Under the leadership of the Nusantara Capital City Authority, Landesa, Landesa Indonesia, and the University of Queensland have conducted a **comprehensive valuation of mangrove ecosystem services in IKN's coastal areas**, emphasizing their contributions to climate change mitigation, adaptation, and sustainable community livelihoods.

This valuation was designed, among other objectives, to **support IKN's strategic spatial planning**, particularly in light of the Authority's mandate to review and update the spatial plan every five years to help achieving key goals such as the Strategic Plan of Zero Emissions 2025 and the Master Plan of Biodiversity on IKN, among others.

Using a mixed-methods approach, the assessment mapped **10,922.8 hectares of mangrove forests across four ecological conditions**, each with a corresponding **minimum annual ecosystem service value** per hectare: **healthy mangroves** (8,655.2 ha, valued at a minimum of USD 11,488/ha/year), **medium mangroves** (525.5 ha, valued at USD 11,270/ha/year), **regrowth mangrove** (188.8 ha, valued at USD 2,300/ha/year), and **degraded mangrove** (1,155.5 ha, also valued at USD 2,300/ha/year).

Integrating these ecosystem service values into land use planning through detailed spatial plans can help **identify and harmonize relationships between ecologically valuable areas and proposed development zones**. This enables the adoption of strategies such as development clustering, preservation of green corridors, and the application of a mitigation hierarchy that prioritizes the avoidance of high-value mangrove ecosystems. **Recognizing and integrating the ecosystem services of mangroves into planning decisions**, complemented with conservation efforts and sustainable resource use through strengthened tenure rights, is essential to **promoting sustainable land use** while advancing IKN's vision of environmental stewardship and inclusive community engagement.

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Introduction

Landesa's Coastal Livelihoods and Mangroves Program

Landesa, through its **Coastal Livelihoods and Mangroves Program**¹, is strengthening coastal land tenure rights in the Bay of Bengal (Bangladesh and India) and Southeast Asia (Myanmar, Thailand, Cambodia, Malaysia and Indonesia). This ambitious project aims to sustain livelihoods, protect mangrove forests, and mitigate climate change through context-specific and gender equality and social inclusion (GESI) responsive activities in each country. These include policy advising, legislative support, community assessments, forest cover mapping, and locally led climate adaptation and mitigation.

In Indonesia, Landesa Indonesia is supporting and collaborating with the **Nusantara Capital City Authority (OIKN)**, the **Ministry of Land Affairs and Spatial Planning/National Land Agency**, and the **Ministry of Marine Affairs and Fisheries** at the intersection of land rights, spatial planning, and climate change.

Mangrove Ecosystems in IKN

Indonesia's intended new capital, Nusantara (Ibu Kota Nusantara – IKN), located in Kalimantan's Island, aspires to be a **model of sustainability**, with a design centered on environmental stewardship, including the conservation of its mangrove ecosystems. According to **Presidential Regulation No. 64/2022**, the IKN area covers approximately 11,668 hectares of mangrove ecosystems across 26 villages (*kelurahan* and *desa*), planned as protected area and other land uses. These mangroves provide essential

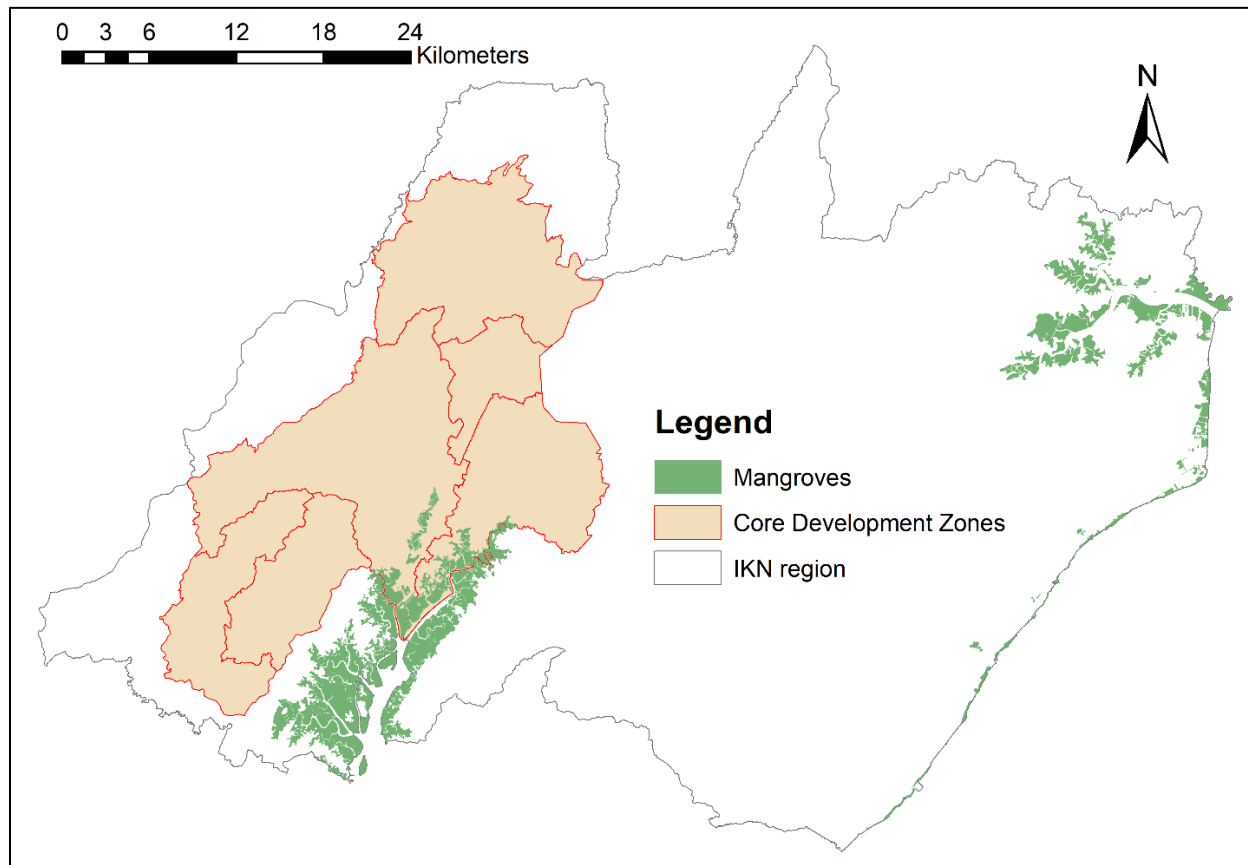
¹ <https://cdn.landesa.org/wp-content/uploads/Coastal-Livelihoods-and-Mangroves-Project-brochure.pdf>

services to local communities while playing a significant role in enhancing climate resilience.

Mangrove ecosystems are crucial for carbon sequestration and storage, making them key components of climate change mitigation strategies. According to the **IKN National Strategic Area Spatial Pattern Plan (RTR-KSN) for 2022–2042**, the protection of mangrove ecosystem areas will result in an estimated **total mitigation potential of 3,100,098 tCO₂e over 20 years**. Mangroves also offer natural coastal protection against increasing climate-related risks such as storm surges and sea-level rise.

As Indonesia continues to develop its new capital, integrating the value of mangrove ecosystems into planning processes is essential for achieving the dual goals of urban development and environmental sustainability.

Figure 1. Mangroves in IKN



Valuation Objectives

Under the **guidance of the Nusantara Capital City Authority (OIKN)**, Landesa and Landesa Indonesia partnered with the **University of Queensland** with the main goal to conduct a comprehensive valuation of mangrove ecosystem services in the IKN area,

supporting **evidence-based decision-making for integrated coastal management, spatial planning, and climate resilience**. Under this overall goal, the specific objectives of this valuation included:

- Assess current status and spatial extent of mangrove ecosystems across IKN;
- Quantify ecological, economic, and social values of key ecosystem services provided by mangroves; and
- Formulate recommendations for integrating mangrove ecosystem services valuation into IKN's spatial planning.

Valuation Methodology

The valuation of ecosystem services employed a **mixed-methods research design**, integrating quantitative ecosystem service valuation with qualitative community engagement assessment. **Primary data** collection included **190 household surveys**, key informant interviews with government officials and experts, focus group discussions across three sub-districts, and environmental assessments of mangrove conditions. The valuation implemented informed consent procedures for all participants, voluntary participation with right to withdraw, confidentiality protection and data anonymization, cultural sensitivity protocols developed with local partners, and participant compensation.

Ecosystem services have been assessed following the **Millennium Ecosystem Assessment (MEA) framework**, which categorizes ecosystem services into **four main types: provisioning, regulating, supporting, and cultural services**. Provisioning services include tangible goods that directly support local livelihoods. Regulating services encompass climate regulation services such as carbon sequestration or coastal protection through wave attenuation. Supporting services provide fundamental ecological functions including nutrient cycling, primary production, and habitat provision that underpin all other ecosystem services. Cultural services deliver non-material benefits including recreation opportunities, aesthetic values, spiritual significance, and educational resources that contribute to human wellbeing and cultural identity.

The economic valuation of identified ecosystem services employed a multi-method approach, including market price methods for direct use values, replacement cost and avoided damage methods, infrastructure replacement costs, travel cost method, contingent valuation, benefit transfer, and participatory assessments. The **valuation process adhered to community-centered participation principles**, recognizing and incorporating local knowledge while upholding scientific rigor in assessing ecosystem services. This integrated approach enabled triangulation of data sources and methods, ensuring a comprehensive and balanced capture of both tangible and intangible ecosystem values.



Findings & Recommendations

Mangrove Extension and Condition

The IKN coastal area encompasses approximately 68,189 hectares of coastal waters bordered by the Mahakam Delta and Balikpapan Bay, extending to the Makassar Strait. Within this region, mangrove ecosystems represent a critical component of coastal biodiversity, **covering a total area of 10,922.8 hectares²** across four distinct condition categories:

- **Healthy Mangrove:** Mangrove stands that remain largely undisturbed, characterized by a dominance of mature mangrove trees with closed canopies. The aboveground tree biomass carbon stock is at least 65 Mg C per hectare.
- **Moderately Disturbed (Medium) Mangrove:** Mangroves that have been affected by anthropogenic activities, such as selective logging. The vegetation includes a mix of mature trees and regenerating individuals. Aboveground tree biomass carbon ranges between 10 and 60 Mg C per hectare.
- **Degraded Mangrove:** Mangroves that have been severely impacted by human activities. Vegetation primarily consists of shrubs and a few low-quality trees. Aboveground tree biomass carbon is estimated between 0.5 and 10 Mg C per hectare.
- **Regenerating Mangrove:** Previously non-mangrove areas where mangrove vegetation is gradually reestablishing. These areas are dominated by shrubs and

² The discrepancy with the previously reported figure of 11,668 hectares is due to the latest National Strategic Area Delineation Map of the National Capital (IKN), as outlined in Law Number 21 of 2023 of the Republic of Indonesia.

small regenerating trees. Tree biomass carbon ranges from 0.5 to 10 Mg C per hectare.

- **Non-Mangrove Areas:** Former mangrove areas that have been entirely cleared or converted to other land uses. These sites are currently abandoned with little to no tree cover.

Figure 2. IKN's Mangrove Status in 2025.

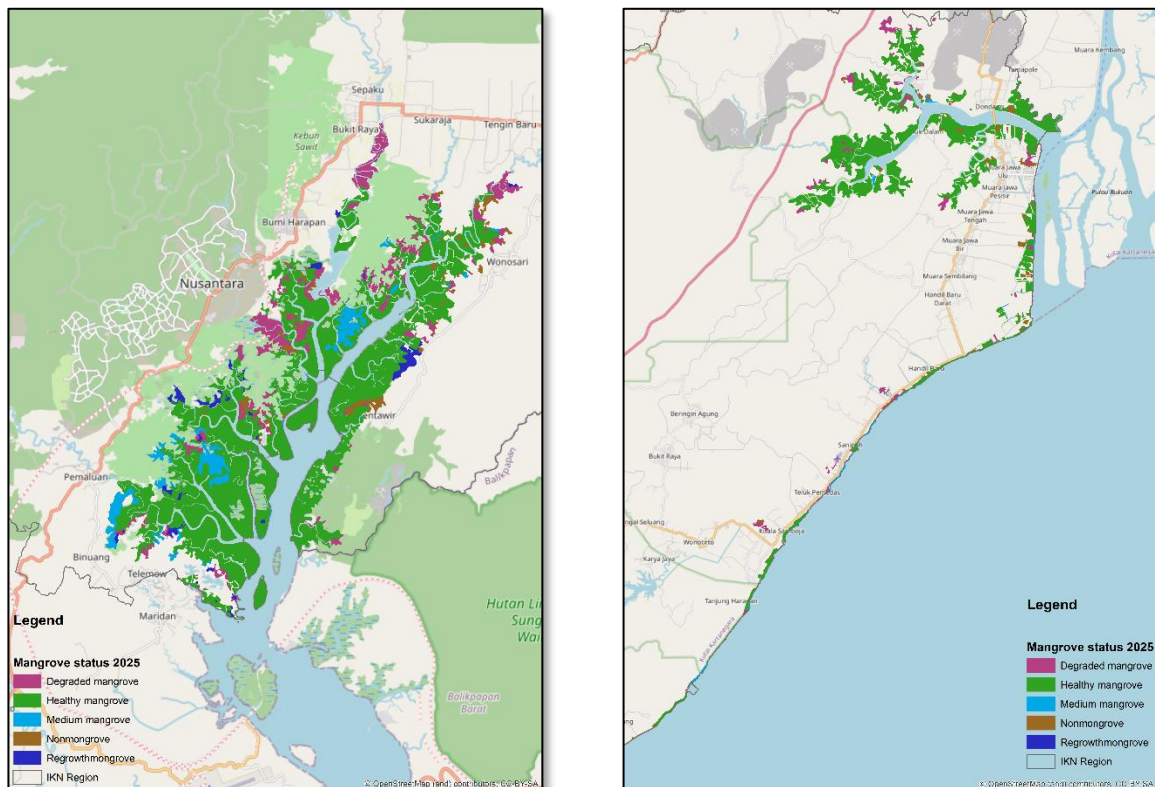


Table 1. IKN's Mangrove Status in 2025.

<i>Type*</i>	<i>Area (ha)</i>
<i>Healthy mangrove</i>	8,655.2
<i>Medium mangrove</i>	525.5
<i>Regrowth mangrove</i>	188.8
<i>Degraded mangrove</i>	1,155.5
<i>Non-mangrove</i>	397.7

The distribution of mangrove forests along IKN reveals significant variation in ecosystem quality and conservation status. **Healthy mangroves represent the largest category**, indicating substantial areas of undisturbed, intact mangrove forest that provide optimal ecosystem service delivery. **Degraded mangroves**, while comprising a smaller proportion, **represent an opportunity for mangrove forest plantation** with high potential benefits from effective restoration efforts.

Carbon Storage and Sequestration Services Valuation

Community survey results revealed **exceptionally high valuation of carbon storage services**, with respondents identifying air quality and carbon regulation as one of the most valued ecosystem services provided by mangroves. Field assessments in the IKN area indicated carbon storage densities consistent with Indonesia's national mangrove carbon inventory. Based on a comprehensive biomass and carbon assessment, **mangroves in healthy condition store an average of 1,038 Mg/ha of carbon**, whereas **degraded areas store significantly less, approximately 488 Mg/ha**. Under carbon pricing scenarios ranging from **USD 20 to USD 60 per tCO₂e** (reflecting both current voluntary market prices and projected values under ambitious compliance market scenarios) the conservation of IKN's 8,655.2 hectares of healthy mangroves **could reduce emissions of 2.35 million tCO₂e**. This corresponds to an **estimated economic value between USD 46.9 million and USD 140.7 million**, depending on the carbon price applied.

Coastal Protection Valuation

Community survey results revealed coastal protection as the **most highly recognized ecosystem service**. This strong community valuation reflects a local understanding of mangroves' critical role in mitigating storm surges, coastal erosion, and sea-level rise, aligning with global evidence of mangrove effectiveness for coastal protection. The economic valuation of these services employed a replacement cost method for wave attenuation, an avoided damage approach for erosion prevention, and infrastructure replacement costs for storm surge protection. Given the infrastructure investment planned in IKN and its location near or around coastal areas, this protection service offers significant value in protecting public and private assets, with a **total protection value ranging from USD 8,120 to USD 21,369 per hectare for mangrove forests in healthy to moderately disturbed condition**.

Fisheries and Provisioning Services Valuation

Survey data identified **fishing as the dominant mangrove-related activity**, with **68.4% of respondents reporting regular fishing practices**. Mangrove ecosystems serve as critical nursery grounds and habitats for numerous commercially valuable species. Meta-analyses show that fish abundance is significantly higher in mangrove areas compared to adjacent non-mangrove habitats, with nursery functions contributing substantially to overall fisheries productivity. The valuation methodology followed established approaches for quantifying mangrove contributions to fisheries, accounting for their role as nursery habitats (production function), spawning grounds (market price), and support for aquaculture (enhanced productivity). Based on these factors, the **total value of fisheries and provisioning services ranges from USD 2,300 to USD 4,800 per hectare for**

mangroves in healthy, moderately disturbed, degraded, and regenerating condition.

Cultural and Tourism Service Valuation

Field assessments identified areas such as Mentawir Village as having significant potential for sustainable ecotourism development, combining unique biodiversity with traditional cultural knowledge and practices. The integration of cultural heritage with ecosystem conservation presents an opportunity to enhance both conservation outcomes and economic benefits, while preserving community ownership and cultural integrity. Using a combination of valuation methods, including the travel cost method for ecotourism services, contingent valuation for cultural heritage, benefit transfer for recreational value, and participatory assessment for spiritual values, **the total estimated value of cultural and tourism services ranges from USD 750 to USD 2,400 per hectare for mangroves in healthy to moderately disturbed condition.**

Table 2. Total Minimum Economic Value Calculated Per Hectare Per Year.

<i>Type*</i>	<i>Area (ha)</i>	<i>Carbon Storage* (annual \$/ha)</i>	<i>Coastal Protection (annual \$/ha)</i>	<i>Fishery Support (annual \$/ha)</i>	<i>Cultural Value (annual \$/ha)</i>	<i>Total Min. Value of IKN Mangrove Eco. Services (\$ per year)</i>
<i>Healthy mangrove</i>	8,655.2	\$ 318	\$ 8,120	\$ 2,300	\$ 750	\$99,430,938
<i>Medium mangrove</i>	525.5	\$ 100	\$ 8,120	\$ 2,300	\$ 750	\$5,922,385
<i>Regrowth mangrove</i>	188.8	\$ 0	\$ 0	\$ 2,300	\$ 0	\$434,240
<i>Degraded mangrove</i>	1,155.5	\$ 0	\$ 0	\$ 2,300	\$ 0	\$2,657,650
<i>Non-mangrove</i>	397.7	\$ 0	\$ 0	\$ 0	\$ 0	\$0

**Reduced emissions for 17 years (2025-2042).*

Sustainable Land Use Planning in Mangrove Areas in IKN

Recognizing and valuing the economic benefits provided by mangrove ecosystems, based on their current ecological condition, can play a pivotal role in guiding land use planning. In the context of urban development ambitions, decision-makers can assess the opportunity cost of converting mangrove forests. For instance, **replacing just one hectare of healthy mangrove results in the loss of ecosystem services valued at a minimum of USD 11,488 per year.**

Armed with this information, spatial analysis can be used to identify conflicts between high-value ecosystem service areas and proposed development zones. This can support the **adoption of systematic, sustainable planning strategies** such as:

- **Development clustering:** Concentrate urban expansion in areas with lower ecosystem service value, thereby safeguarding high-value conservation zones. This

spatial optimization enhances both development potential and conservation outcomes.

- **Maintaining green corridors:** Preserve ecological connectivity across development zones to ensure landscape-scale functions remain intact. These corridors support biodiversity, water flow, and other essential ecological processes, even within urbanized landscapes.
- **Implementing a mitigation hierarchy:** Prioritize the avoidance of high-value mangrove areas; where impacts are unavoidable, minimize them, and apply compensatory measures such as restoration or biodiversity offsets. This approach ensures that development does not result in a net loss of ecosystem services and provides a sustainable landscape approach to land and marine ecosystem management.

Integrating mangrove ecosystem service values into detailed spatial plans enables development that is compatible with long-term ecological sustainability. It also supports adaptive management, aligning urban growth with IKN's sustainability vision while embedding green infrastructure, such as mangrove forests, within the urban fabric.

By incorporating green infrastructure, **the new intended capital can access critical services such as coastal protection, carbon sequestration, and biodiversity conservation at a significantly lower cost than traditional engineering solutions.** This, in turn, creates a positive feedback loop in which development enhances, rather than degrades, the ecosystem services that underpin climate resilience and community well-being.

Finally, it is **strongly recommended that all development proposals in mangrove areas undergo an Environmental Impact Assessment (EIA)** that:

- Integrates quantified valuations of ecosystem service impacts;
- Applies a mitigation hierarchy, prioritizing avoidance and minimization;
- Includes mechanisms for appropriate compensation or restoration; and
- Accounts for cumulative impacts at the landscape scale³.

Managing trade-offs require a systematic application of the mitigation hierarchy (avoid, minimize, restore, offset). **Careful spatial planning and adaptive management will be essential to balance development pressures with conservation objectives.** Such an approach may ensure that development proceeds in a way that supports IKN's long-term goals for sustainability, resilience, and inclusive growth.

³ As part of the economic super hub that includes the IKN region, the cities of Balikpapan and Samarinda, along with Kutai Kartanegara Regency and Penajam Paser Utara Regency

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