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Editorial

Forestry Spatial Planning Policy Direction: Concerning the Long-Term National Development Plan 2025-2045

Arah Kebijakan Perencanaan Ruang Kehutanan: Dalam Rencana Pembangunan Nasional Jangka Panjang 2025-2045

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ABSTRACT

The role of forests is related to the challenges of balancing food, water, and energy, which are likely to increase significantly in the near future. A science-based conception is needed to support the correct application of forest adequacy in terms of forestland and forest cover over a watershed or island to address these challenges and to strengthen the role of forests in performing economic, social, and ecological functions, mainly in the context of water, food, and energy security. However, the minimum extent of forest over land is still debatable. The determination of what is named forest adequacy, in terms of both forestland (*kawasan hutan*) and forest cover (*penutupan hutan*), needs to consider roles of biogeophysical factors, environmental carrying capacity, watershed characteristics, along with flora and fauna diversity. Spatial planning plays a crucial role in implementing the concept of determining the forest's adequacy based on spatial considerations to support the Forestry Spatial Planning Policy in the 2025-2045 National Development Plan to ensure the future security of water, food, and energy supply.

KEYWORDS
The Long-Term National Development Plan (RPJPN), forest policy, forest cover, forestry spatial planning, geospatial information

INTISARI

Peran hutan ke depan akan semakin menantang karena kebutuhan tentang ketahanan pangan, air, dan energi untuk mencapai tujuan Rencana Pembangunan Jangka Panjang Nasional. Untuk menjawab tantangan tersebut, konsepsi berbasis ilmiah diperlukan demi mendukung penerapan kecukupan luas kawasan dan penutupan hutan dalam Daerah Aliran Sungai (DAS) atau pulau. Hal ini guna memperkuat peran hutan dalam menjalankan fungsi ekonomi, sosial, dan ekologis. Namun, jumlah minimal luas kawasan hutan dan penutupan hutan ini masih diperdebatkan. Penentuan luas kawasan dan penutupan hutan ini perlu mempertimbangkan faktor biogeofisik, daya dukung dan tampung lingkungan, karakteristik DAS, serta keanekaragaman flora dan fauna. Di sinilah peran perencanaan berbasis ruang (spasial) menjadi sangat penting. Konsepsi penentuan kecukupan luas hutan berdasarkan pertimbangan ruang dapat digunakan untuk mendukung Kebijakan Perencanaan Ruang Kehutanan dalam Rencana Pembangunan Nasional 2025-2045 guna memastikan suplai air, pangan, dan energi di masa depan.

KATA KUNCI
Rencana Pembangunan Jangka Panjang Nasional (RPJPN), kebijakan hutan, penutupan hutan, perencanaan ruang kehutanan, informasi geospasial

Introduction

The forestry sector has a strategic role in national development but faces significant challenges in performing its role. Despite Law No. 59 of 2024 concerning the Long-Term National Development Plan (RPJPN) 2025-2045 does not explicitly designate Forestry as a sector, Forestry is still able to significantly contribute to national development by ensuring efficient, effective, equitable, and sustainable utilization of natural resources, especially by supporting the balanced use of forestry land through spatial planning to ensure ecological, economic, and social needs.

In 2024, the Government of Indonesia (GoI) enacted Law No. 59 of 2024, which outlines the RPJPN for 2025-2045 and articulated the Golden Indonesia 2045 Vision that envisions a united, sovereign, advanced, and sustainable nation. To evaluate the achievement of the vision, the government aims to accomplish five key targets, consisting of a) raising per capita income equivalent to developed countries; b) reducing poverty and inequality; c) enhancing leadership and global influence; d) increasing the competitiveness of human resources; and e) lowering greenhouse gas emissions to meet net-zero targets. Those five key targets require a balance of social, economic, and ecological concerns. Furthermore, the RPJPN delineates eight development missions: a) social transformation; b) economic transformation; c) governance transformation; d) supremacy of law, stability, and Indonesian leadership; e) socio-cultural and ecological resilience; f) promoting equitable regional development; g) advancing environmentally sustainable infrastructure; and h) development sustainability. Those eight missions support the five visions that indirectly require forestry spatial planning in accordance with the capabilities and carrying capacity to ensure the sustainability of Indonesia's natural resources.

The Policy of Forestry Spatial Planning

The Crucial Roles of Forests in Sustainable Development

The RPJPN 2025-2045 emphasizes the transformation of governance, social, and economic through equitable, sustainable, and socially and ecologically resilient regional development. The RPJPN serves as a guideline in formulating master plans, national strategies, roadmaps, and other long-term and medium-term development plans in sustainable ways. Sustainability issues can be evaluated based on three environmental criteria: a) the depletion of natural resources, b) the reduction of pollution and environmental impacts, and c) initiatives and activities that enhance usable or replaceable resources.

Tackling the depletion of natural resources necessitates the effective, optimal, and efficient allocation of land, marine, and aerial spaces through spatial consideration. Regarding spatial consideration on land, the forestland (*kawasan hutan*) is defined as a particular area designated by the Government to be maintained as a permanent forest and is located on land not assigned with land rights (Government Regulation 23 of 2021). On Indonesia's land, the forestland represents a total area of 120.47 million hectares (KLHK 2022) distributed as seen in Figure 1. It is considered the largest land area in Indonesia (+60%); consequently, forestland is essential to fulfilling the long-term development's visions and missions. Designated forests or forestlands are crucial in addressing the challenges of dynamic global geostrategic, particularly the nexus of food, water, and energy security. Foresters must underscore the urgency of strategic spatial planning in this context, even though it is not a simple task.

The current development and implementation process of spatial planning policies is often a complex challenge in the context of global and local development (Andani 2022). Projections show that by 2050, global demand for water, energy, and food will increase by more than 50% compared to 2015 levels (Ferroukhi et al. 2015). Rapid population growth and rising affluence have driven this surge in demand and significantly heightened the need for these essential resources. This issue extends beyond a specific region, as nearly all countries encounter similar challenges. The combination of high demand, inefficient resource utilization, and restricted availability heightens the risks associated with resource scarcity. These pressures will likely intensify over the next two decades, leading to significant concerns as Indonesia works towards its Golden 2045 vision. The scarcity of

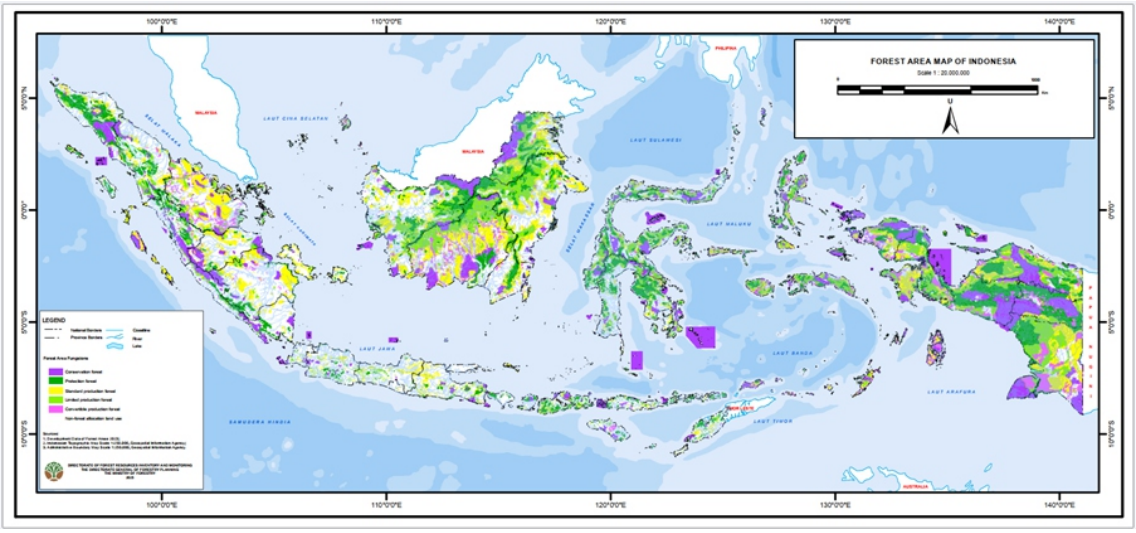

Figure 1. Distribution of forestland in Indonesia. Forestland is a particular area designated by the Government to be maintained as a permanent forest, displayed into five functions: conservation forests (HK), protection forests (HL), production forests (HP), which includes limited production forests (HPT) and convertible production forests (HPK), and outside forestland (APL).

resources and increasing competition across various sectors likely exacerbate interdependent cross-sectoral contestations. For example, the water sector relies heavily on the forestry sector, given that most water catchments are within protected forests (*hutan lindung*/HL). Likewise, the food sector actively requires extensive lands, sourcing some of them from convertible production forests (*hutan produksi konversi*/HPK). Additionally, the energy sector, especially in relation to renewable energy sources like wood pellets, depends significantly on wood supplies from the production forest (*hutan produksi*/HP). Consequently, the management of the forestland is inseparable from its functions and covers.

The growing demand for resources may reduce those natural resources' resilience, escalating conflicts and jeopardizing socio-ecological systems(FAO 2014). Various factors, such as land conflict, limited resources, and lack of coordination between central and regional government institutions, are causing complex issues that require further attention (Gorby et al. 2023). Hamdy (2023) of Utrecht University also highlighted the importance of water availability within the nexus of food, water, and energy security and emphasized the need for supportive factors that foster sustainable economic balance and enhance environmental resilience (Figure 2). Therefore, an integrated management approach for water, energy, and food using truthful geospatial information is essential to harmonize human and environmental systems and their governance. In this context, forestry serves a dual purpose, acting both as a provider and a regulator to ensure the efficient and sustainable use of resources. Regulatory roles are simply denoted in forestland (Figure 1) to spatially facilitate the dual purpose, while provider roles are represented in forest cover (Figure 3).

Forestland in the Policy of Spatial Arrangements

Spatial planning is crucial in achieving a country's sustainable development (Amir 2018). An optimal, effective, and efficient spatial planning policy is essential for addressing the dual role of forests in environmental protection and development support. Government Regulation 21/2021 concerning the Spatial Plan establishes a hierarchical framework for spatial planning, beginning with the National Spatial Plans (*Rencana Tata Ruang Wilayah*/RTRW) and extending down to district and city levels. The RTRW regulates spatial patterns and structures by categorizing areas into protected and cultivation areas. Protected areas are designated to ensure environmental sustainability, while cultivation areas are utilized based on the potential of both natural and human resources.

As about 60% of the land is forestland, Forestry plays a crucial role in the national spatial arrangements, contributing to the sustainability of water,

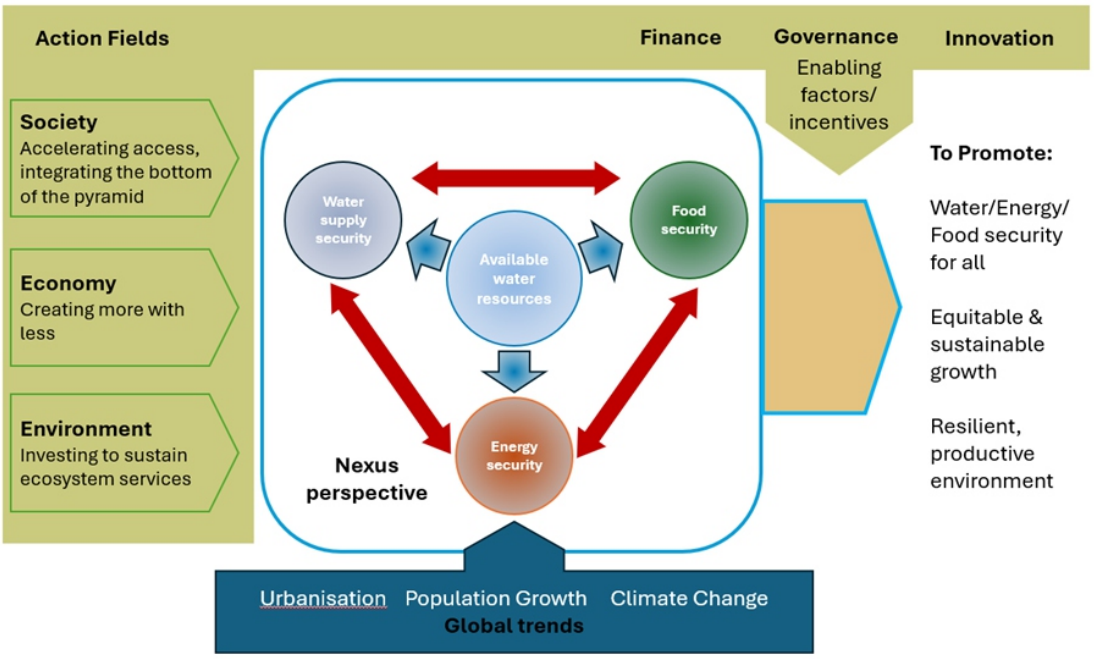

Figure 2. The relationship between water availability in a nexus perspective (Hamdy 2023), available from https://www.water-energy-food.org//resources/policy-paper-managing-water-energy-and-food-nexus-in-egypt

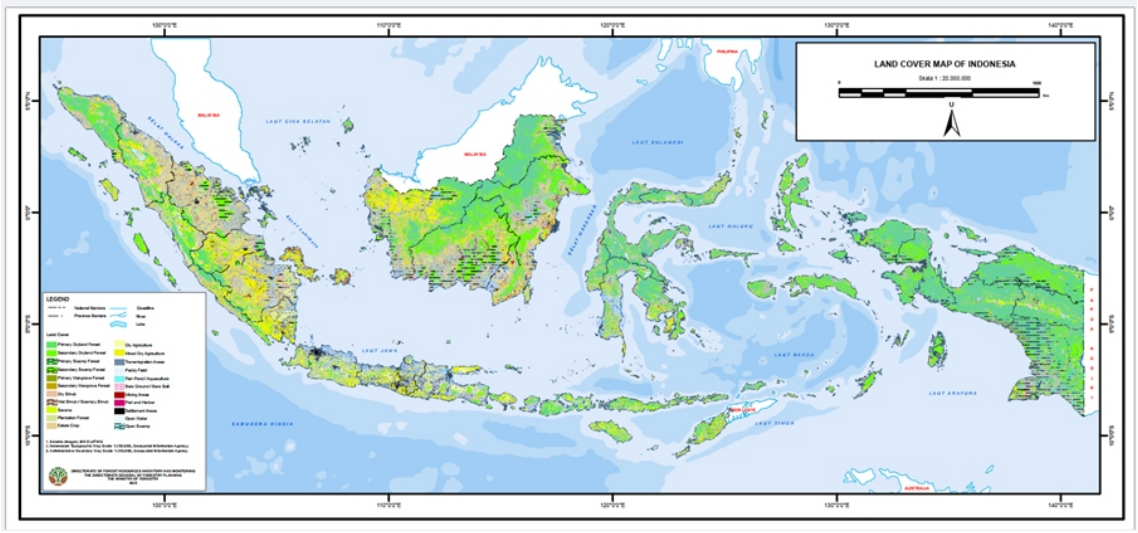

Figure 3. Forest cover of Indonesia, presented in 23 classes of land classifications.

energy, and food resources. Law 41 of 1999 established the requirement for spatially integrated forestry planning and incorporating forestry objectives into regional spatial plans. This planning process within the forestland follows a hierarchical structure, beginning with the National Forestry Plan (*Rencana Kehutanan Tingkat Nasional*/RKTN) and cascading down to the provincial plan and the Long-Term Forest Management Plan of the Forest Management Unit (*Kesatuan Pengelolaan Hutan*).

RKTN has served as a macro-level directive at the national level for over 20 years, focusing on the utilization of space and the potential of forests for both forestry and non-forestry development. It acts as a guideline and framework for national, provincial, and district governments, communities, business entities, and professional organizations, providing strategies and policies to achieve forest management objectives. The formulation of the RKTN is grounded in the results of forest inventories, the gazette of forestland, the management of forests, environmental considerations, and the community's social conditions. Above all, the RKTN process greatly emphasizes the use of geospatial information.

RKTN has established spatial directives, sectoral objectives, and policy strategies for forestry development over the next 20 years. The current RKTN, covering the period from 2011 to 2030, is outlined in the Forestry Minister Regulation No. P.49/MENHUT-II/2011 and further specified by the Environment and Forestry Minister Regulation No. P.41/MenLHK/Setjen/Kum.1/7/2019, dated 31 July 2019 (KLHK 2019). The RKTN delineates spatial directives for each forest function to ensure the optimal utilization of forest areas by all stakeholders involved in the forestry sector, as illustrated in Table 1.

The direction of the forest's spatial plan has made notable advances in recent years. The government has designated 27.43 million hectares for conservation areas and has successfully protected 40.1 million hectares of natural forests and peat ecosystems. Furthermore, the rehabilitation of priority areas has achieved a total of 1.9 million hectares (Ferroukhi et al. 2015), and the allocation for corporate-based forest utilization permits encompasses 31.05 million hectares (KLHK 2024). A noteworthy accomplishment was the implementation of social forestry across 8.02 million hectares, facilitating community-based forest management. This achievement highlighted the crucial role of ongoing support for communities in promoting environmental sustainability while also improving their livelihoods. The government has also designated around 2.95 million hectares for non-forestry use, primarily for Land Objects of Agrarian Reform or TORA (KLHK 2024).

Forest utilization requires a holistic approach, considering its spatial allocation and the interconnectedness of watershed ecosystems within and across multiple islands, collectively forming a biosphere for sustainable development. Therefore, it is crucial to identify the thresholds for adequate forestland and forest cover to effectively manage spatial utilization while supporting social, economic, and environmental functions.

Policy of Forestland and Forest Cover Adequacy

The government has enacted Law Number 32 of 2024 to enhance forest management, amending Law No. 5/1990 concerning the Conservation of Biological Natural Resources and their Ecosystems. This law introduces the concept of preservation areas, the designated areas outside of nature reserves, nature conservation areas, marine conservation areas, coastal zones, and small islands aimed at maintaining ecological balance to support and protect biological natural resources and their ecosystems (Law 32/2024). Mapping preservation areas should employ advanced technologies. There are five recognized forms of preservation areas: a) buffer zones for nature reserves, nature, and aquatic conservation areas; b) ecological corridors that connect ecosystems; c) regions of high conservation value; d) community-managed conservation areas, and e) areas that protect local wisdom.

The legal mandate established in the 2025-2045 Indonesian Biodiversity Strategy and Action Plan (IBSAP) highlights the First Objective: "Strengthening integration and resilience of the ecosystem in terms of biodiversity management, reducing the risk of species extinction and maintaining genetic diversity"; as well as its third national target: "Ecosystems Protection" (Kementerian PPN/ Bappenas 2024). This mandate also requires the revision of the RKTN to designate specific areas for conservation-oriented management. Preservation areas may encompass licensed production forest (HP) aimed at ecosystem restoration (*Perizinan Berusaha Pemanfaatan Hutan-Restorasi Ekosistem*/PBPH-RE),

Table 1. Distribution of spatial directives for utilization of forest areas based on the functions

No.	Utilization Directive	HK	HL	HPT	HP	HPK	Area (million hectares)
1.	Conservation Areas	26.42					26.42
2.	Natural Forest and Peat Ecosystem Protection Areas		24.3	5.83	4.02	6.86	41
3.	Rehabilitation Priority Areas	1.0	1.82	0.39	0.38	0.37	3.96
4.	Corporate-Based Forest Utilization Areas		0.47	15.86	19.62	1.43	37.38
5.	Community-Based Forest Utilization Areas		2.59	4.45	4.37	1.76	13.16
6.	Non-Forestry Areas		0.49	0.26	0.81	2.43	4
	Total	**27.42**	**29.67**	**26.79**	**29.2**	**12.85**	**125.92**

Notes: HK = Conservation Forests, HL = Protected Forests, HPT = Limited Production Forests, HP = Production Forests, HPK = Convertible Production Forests

protected forest (HL), high conservation value zones, and other critical ecosystems within regions designated for non-forestland (APL).

Future forestry spatial policies must adopt broader definitions beyond traditional forestry matters. The main question was, "What were the minimum forests required for optimal ecological, social, and economic benefits?" Addressing this requires a precise understanding of forestland and forest cover adequacy. From an ecological perspective, area adequacy must reflect the expanse's ecological capacity, determined by the forest cover. Meanwhile, from a regulatory standpoint, area adequacy becomes the foundation for spatial arrangements within forestland and its landscape unity beyond the forestland.

Historically, the forest's adequacy has been governed by Law No. 5/1967, which was subsequently replaced by Law No. 41/1999 and amended by Law No. 19/2004, specifically in Article 18. According to Article 18 (1) of Law No. 19/2004, "The Government determines and maintains the adequacy of forestland and forest cover for each watershed and/or island to optimize environmental, social, and economic benefits for the local community." Article 18 (2) stipulated that "The size of forests as in Article 18 (1) must cover at least 30% of the area of a watershed and/or island and should be proportionately distributed." This mandate was later revised under the Job Creation Law (Undang-Undang Cipta Kerja/ UUCK) No. 11/2020, particularly in Paragraph 4 concerning Forestry. Article 1 states, "The Central Government determines and maintains the forestland and forest cover adequacy for each watershed and/or island to optimize environmental, social, and economic benefits for the local community." Article 2 further details that "The Central Government regulates the size of areas to be maintained based on the physical and geographical conditions of each watershed and/or island."

In this context, the UUCK removed the minimum figure of 30% and granted the central government the authority to establish appropriate minimum areas to replace this figure. This shift raises several important questions:

1. Does the elimination of the 30% figure indicate that there is no longer a requirement for minimum forests?
2. If the requirement for minimum forests remains, what concepts, methods, and procedures should guide its calculation?
3. What minimum areas would be adequate to ensure optimal environmental, social, and economic benefits for the local community?

The following sections aim to provide an overview of the development of concepts, methods, and procedures for determining minimum forestland and forest cover to address these questions. The discussion encompasses forests as ecological and landscape units and the adequacy of forestland and forest cover within designated forests and outside designated forests (Areas for another uses/APL).

Concept of Determining the Forestland and Forest Cover Adequacy

The discussion regarding the appropriate extent of forestland and forest cover has been ongoing for decades. Law No. 5/1967, amended by Law No. 41/1999, established a requirement to maintain a minimum of 30% of a watershed's area as forest. Nevertheless, forestry experts have debated the scientific basis for this 30% benchmark. It is associated with environmental carrying capacity, especially concerning the hydrological cycle, which can vary considerably based on regional characteristics.

According to Davis and Robbin, as in Widiaryanto (2020), the 30% forest adequacy concept emerged in Europe and has since been adopted by various other nations. In the early 20th century, during the Dutch East Indies administration, forestry expert Professor Van Arstson applied this 30% benchmark to manage forests in Java, asserting that 30% of land should be covered by forest (Widiaryanto 2020). Further, in the study of a watershed in Jambi, Tarigan et al. (2018) suggested that the watershed should have more or about 30% forest cover and a maximum of 40% plantations to maintain sustainable water ecosystem services. Talumepa (2020) also emphasizes that, as a country with high rainfall intensity, Indonesia is very vulnerable to water system disturbances that can cause flooding. As a result, substantial attention is paid to maintaining combined forestland and forest cover adequacy while optimizing social, ecological, and economic benefits for local communities.

In practice, the 30% benchmark holds significance in two main contexts: forestland and forest cover over a watershed or island. However, due to Indonesia's diverse landscapes, geomorphological variations, and ecosystems, applying a uniform 30% standard across all watersheds or islands presents challenges. This situation necessitates further theoretical and empirical research, especially considering definitions of forests, forestland, and forest cover.

The assessment of forest adequacy in UUCK encompassed two distinct typologies: forestland and forest cover (Law 10/2021). "Forestland" refers to land designated as forest through the gazettement processes, which include land designation, boundary determination, mapping, and classification (Government Regulation No. 23/2021). In practice, the forestland designed based on geophysical criteria encompasses a) soil type related to erosion susceptibility, b) slope indicating vulnerability to erosion, and c) rainfall that reflects hydrological conditions. The biophysical criteria referring to "Forest Cover" determines the land cover as classified in the maps(Margono et al. 2016).

Not all forestland needs to be fully covered by forests, nor should all forested lands automatically be classified as designated forest or forestland. Establishing minimum thresholds for combined forestland and forest cover proved a complex task as it involves regulating forest cover outside forestland (APL). According to Government Regulation No. 23/2021, forestland includes state and customary forests, excluding private forests, whatever the cover, that are considered private goods and should not be designated as permanent forestland. Meanwhile, spatial data analysis from 2021 revealed that approximately 7 million hectares of forested land are within the APL or outside of forestland (KLHK 2022). Such areas can significantly contribute to the adequacy of forestland and forest cover. Regional governments need to preserve these areas to optimize local communities' environmental, social, economic, and cultural benefits.

The policy of at least 30% of combined forestland and forest cover seems like a double-edged sword, especially for provinces with forestland below 30%, such as in Java, as it must find land designated as forestland to meet the benchmark. In contrast, several islands such as Papua, Sumatra, Kalimantan, and other islands with forest cover at around 70% or more will endanger the environment as they provide opportunities for deforestation to reach 30% (Alfajri & Darmono 2022). In this context, the combined forestland and forest cover must be maintained wisely by paying attention to the proportional spatial distribution by considering carrying capacity, biogeophysical capacity, flora and fauna diversity, and watershed characteristics(Amania 2020).

Method for Determining Forestland and Forest Cover Adequacy

Forestland is classified into HK, HL, and HP categories to regulate that categorized land based on several criteria. As for the spatial classification of protection (HL) and production (HP), secondary data was collected through a comprehensive desk analysis. This process employed a scoring system based on three primary spatial parameters: slope class, soil type, and rainfall. The Decree of the Agriculture Minister No. 837/Kpts/Um/11/80 outlines the criteria and procedures for determining HL and Decree No. 683/Kpts/Um/8/81 for HP. The designation of conservation (HK) is governed by Government Regulation No. 28 of 2011, which addresses the management of nature sanctuaries and preservation areas (KSA/KPA). This regulation considers criteria such as high biodiversity, the presence of rare or endangered ecosystems, and the existence of unique natural resources.

Determining the minimum forestland and forest cover adequacy was guided by various criteria aligned with forest management objectives, including optimizing environmental, economic, and social dimensions. Government Regulation No. 23 of 2021, built upon UUCK No. 11 of 2020, established criteria for minimum forestland and forest cover adequacy encompassing these three dimensions. Article 41 of this regulation outlined that the assessment of forest adequacy must consider a) bio-geophysical factors, b) environmental carrying and holding capacity, c) watershed characteristics, and d) the diversity of flora and fauna. These criteria serve as the basis for identifying specific indicators to calculate and analyze area adequacy in more detail.

A series of digital geospatial data significantly

enhanced all analyses, categorizing them into four groups based on the criteria set forth by the UUCK, as presented in Figure 4:

1. The environmental carrying and holding capacity assumed from land carrying capacity, encompassing classes I-VIII that reflect the land's socioeconomic and production potential, resulting from overlaying the soil, slope, and erosion information. The information resulted in categories of exceeded and not-exceeded;
2. Watershed characteristics illustrated disaster vulnerability derived from overlaying spatial data on erosion, upstream watersheds, landslide-prone areas, vulnerable ecosystems, and local protected areas, including peat-lands, karst formations, mangroves, river boundaries, and riparian. This map identifies regions with protective roles and highlights their environmental benefits;
3. Data on biodiversity protection for flora and fauna resulted from habitat analysis, which combined information through overlaying of the Essential Ecosystem Areas with Animal Distribution data;
4. Insights into improving existing conditions underscore strategies for utilizing a piece of land to optimize environmental, social, and economic benefits.

The entire analysis utilized spatial multi-criteria evaluation by overlaying various thematic geospatial information according to the specified criteria. The findings underscored the minimum areas within the designated forest (forestland) and APL, as illustrated in Figure 2, in relation to the associated forest cover (Figure 3). Tables and maps visualized the minimum areas across each island and province within the designated forest areas and APL by the associated land cover. Additionally, the analysis incorporated simulations to assess the forest cover outside the designated forest (forestland) that requires preservation. Further examination focused on the mechanisms and institutional frameworks necessary to regulate the implementation of area adequacy calculations at national and sub-national levels, thereby facilitating the integration of forest management objectives into the spatial plans of provinces and districts/regencies.

The results indicated the forest adequacy for each island and province, detailing the mechanisms, institutions responsible for conducting area adequacy calculations, and the fundamental rules of the simulation for assessing forestland and forest cover adequacy within both forestland and APL. This rule-based simulation considers utilization directives, programs, and policies and identifies areas that should ideally be preserved yet do not meet the current criteria. Conversely, it addresses areas that fulfill existing criteria but do not need to be maintained (see Table 2). The detailed simulation consists of 18 rule-based implementations, provided in Table 3.

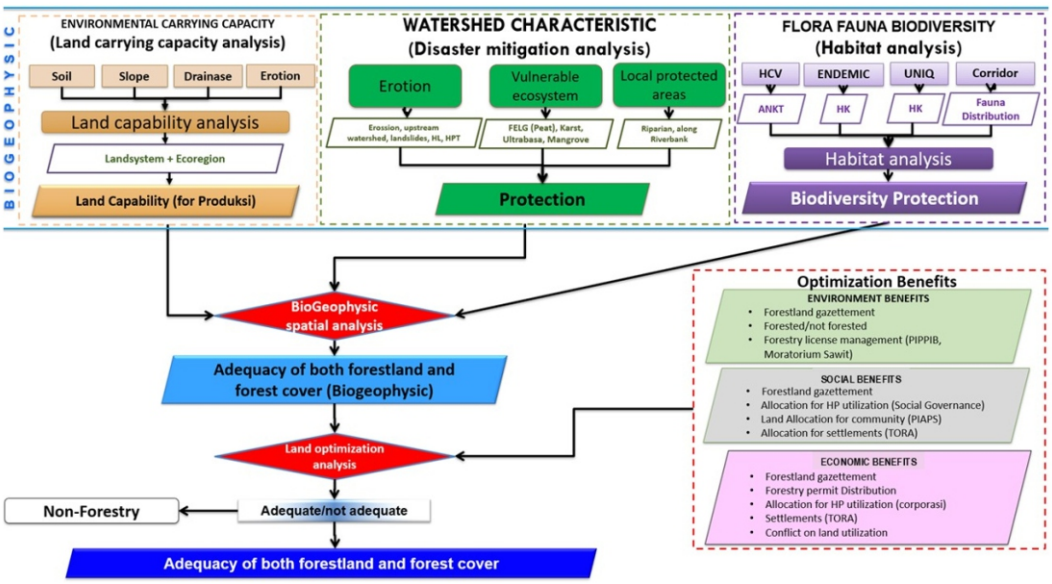

Figure 4. The work flows of the process determining forest area and cover adequacy

Table 2. Simulation of forestland and forest cover adequacy

Forestland	Ideal Function							
	Biodiversity		Biodiversity/ Protection		Protection		Carrying Capacity (Production)	
Existing	Forested	Non-Forested	Forested	Non-Forested	Forested	Non-Forested	Forested	Non-Forested
HK	T1	H1	T1	H1				
HL			T6	H3	T2	H4		
HPT			T4	H2	T5	H5		
HP	T4	H2	T4	H2	T5	H5	P1	L1
HPK	T4	H2	T4	H2	T5	H5	P1	L1
APL	T3	P4	T3	P5	T3	P6	P3	L3

Source : The Ministry of Environment and Forestry, 2021
Notes : The color implements standard color for geospatial data and information of forestry based on the Ministry Regulation No. 399/2024 on forestry geospatial information dissemination.

Table 3. Proposed Rule-based implementation of forest area adequacy and forest cover

No.	Function (Forestland)	Typology	Designed Rule-Based
1	HK	T1	Should be maintained as a forestland for conservation intentions and managed to be forested (covered by forest)
2	HL	T2	Should be maintained as a forestland and managed to be forested (covered by forest) due to protection needs, able to be utilized only for non-timber forest products as well as environment services with strong implementation of soil and water conservation principles
3	APL	T3	Though the area is APL, it is forested and should be maintained to be forested (covered by forest) to protect the biodiversity and local protected needs (eq. essential ecosystem/KEE; HCVF; riverbanks; riparian).
4	HP	T4	Should be maintained as a forestland and managed to be forested (covered by forest); It can be utilized for forestry production with strong implementation of biodiversity protection as well as soil and water conservation principles
5	HP	T5	Should be maintained as a forestland and managed to be forested (covered by forest); It can be utilized for forestry production with strong implementation of water and soil conservation principles
6	HL	T6	Should be maintained as a forestland and managed to be forested (covered by forest), able to be utilized only for non-timber forest products and environmental services with strong implementation of biodiversity protection as well as soil and water conservation principles
7	HK	H1	Should be maintained as a forestland and prioritized to undergo reforestation to restore its native ecosystem, with strong implementation of biodiversity protection as well as soil and water conservation principles
8	HP	H2	Should be maintained as a forestland and prioritized to undergo reforestation to restore its native ecosystem; It can be utilized for forest production with strong implementation of biodiversity protection as well as soil and water conservation principles
9	HL	H3	Should be maintained as a forestland and prioritized to undergo reforestation to restore its native ecosystem, could be utilized only for non-timber forest product and ecosystem services with strong implementation of biodiversity protection as well as soil and water conservation principles
10	HL	H4	Should be maintained as a forestland and prioritized to undergo reforestation to restore its native ecosystem; It could be utilized for only non-timber forest products and ecosystem services with strong implementation of soil and water conservation principles
11	HP	H5	It should be maintained as a forestland and prioritized to be reforested; It could be utilized for forestry production, with strong implementation of water and soil conservation principles
12	HP	P1	It should be maintained as a forestland and managed to be forested (covered by forest), and could be utilized for production forest
13	APL	P3	Though the area is APL, it should be managed with strong implementation of biodiversity protection, and preferable to be planted with trees under agroforestry approaches that prioritized endemic species
14	APL	P4	Though the area is APL, it should be kept forested (covered by forest) and could be utilized only for non-timber forest products and ecosystem services
15	APL	P5	Though the area is APL, it should be managed with strong implementation of biodiversity protection and water and soil conservation principles; It is suggested to grow trees that meet water and soil conservation principles (including appropriate civil engineering)
16	APL	P6	Though the area is APL, it should be managed with strong implementation of water and soil conservation principles; It is suggested to grow trees that meet water and soil conservation principles (including appropriate civil engineering)
17	HPK	L1	Forestland that is reserved for non-forestry development
18	APL	L3	Outside the forestland and not forested, keep it as it is

Source : The Ministry of Environment and Forestry, 2021
Notes : The color used represents specific meaning such as purplish for conservation intention, greenish for protection intention or forested indication, yellowish for production intentions, etc.

These simulated 18 Ruled-Based intend to link the bio-geophysical condition of a piece of land with the proposed proper and adequate management. For example, forestland class HP with typology T5, which means that the existing area is a production forest, is forested and geo-biophysically ideal for protection. That piece of land should be maintained and kept as a forestland, managed to be forested (covered by forest), yet can be utilized for forestry production with strong implementation of water and soil conservation principles. Another example is forestland class HK with typology H1. The existing area is a conservation forest, yet not physically forested but geo-biophysically ideal for conservation biodiversity and protection purposes. That piece of land should be maintained as a forestland and prioritized to undergo reforestation to restore its native ecosystem. It should be preserved with strong implementation of biodiversity protection as well as soil and water conservation principles.

The above simulation is proposed to represent bio-geophysical conditions when considering forestland and forest cover adequacy. The rule-based approach is also applied for APL, as forest cover is distributed throughout forestland and APL, as seen in example No.3 APL with typology P6. Although it is APL and not forested, that land is suitable for protection. It should be managed toward water and soil conservation principles, including appropriate civil engineering and necessary growing trees that meet the water and soil conservation principles.

Current Development

For now, the concept of forestland and forest cover adequacy has not yet been implemented, even though the procedures for determining and revising the determination of forest adequacy have been prepared under Ministry Regulation No. 7/2021. Despite all various reasons, the proposed Rule-Based implementation of forestland and forest cover adequacy is a sign of geospatial information roles to support national development, along with the Golden Indonesia Vision 2045 principles of THIS: T (thematic), H (holistic), I (integrated), and S (spatial) (RPJPN 2025-2045). Obstacles can arise from methods that are difficult to quantify or represent spatially, like understanding the environment's carrying and holding capacity. In such situations, assumptions could be applied to create new options or update rule-based.

Conclusion

Strengthening the concepts, methods, and procedures for calculating forest adequacy is essential. Science-based support is necessary to account for variations in bio-geophysical characteristics, environmental carrying capacity, watershed specifics, diversity of flora and fauna, government administrative boundaries, and the current conditions of forests, particularly concerning prior development policies. In this regard, adequate geospatial data and information are crucial.

Regional governments play a significant role in forest management within land designated as APL (*area penggunaan lain*). Since some APLs may still forested, the authorities can together regulate conservation outside the forestland to optimize environmental services and social, economic, and cultural benefits. Central, provincial, and district/regency governments, alongside other stakeholders, can incentivize those who restore, maintain, or preserve forests, thereby increasing forest cover within and outside designated forestland. Moreover, the economic value of carbon can serve as a mechanism for maintaining forest cover in APL, combined with regional fiscal transfer systems based on forestry performance. Implementing forestland and forest cover adequacy policies aims to transform the land into a cohesive landscape unit that operates within its capacity. This approach also enhances the role of forests in supporting economic, social, and ecological functions, especially regarding water, food, and energy security.

The Forestry Spatial Plan Policy outlined in the RPJPN 2025-2045 signifies a crucial turning point for all Indonesian foresters. It is imperative to urgently adopt optimal and competitive spatial allocation policies for effective forest governance to ensure the availability of water, food, and energy by 2045. Indonesia has already begun this journey, and 2030 presents a significant opportunity for foresters to generate constructive ideas in preparation for the RKTN 2030-2050. With effective, efficient, and

integrated spatial allocation, the developmental goals for Golden Indonesia 2045 can be realized.

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