# Land Use and Spatial Planning in Puncak Area Bogor

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**| Submitted: December 15, 2024 | Revised: January 14, 2025 | Accepted: August 10, 2025 |**

**| Published: September 23, 2025 |**

## ABSTRACT

Puncak area, located in Bogor, is known as one of the main tourist destinations as well as an important conservation area for the ecosystem in the Jabodetabek area. With its crucial ecological role as a water catchment and flood control area, this area faces rapid development pressures, especially for the tourism and housing sectors. This study explores changes in land use and spatial planning in Puncak area and their impacts on environmental quality and the socio-economic well-being of local residents. This article results show that the conversion of green land into built-up areas, such as housing and tourism facilities, has reduced environmental quality, increased disaster risks, and changed the socio-economic structure of the community. In addition, inconsistencies in spatial planning and weak supervision of regulatory implementation have further exacerbated this situation. Therefore, a more comprehensive and sustainable spatial management approach is needed to maintain the balance between development and environmental conservation in this area.

**Keywords:** puncak area; land use changes; environmental quality; spatial planning; sustainable development.

## INTRODUCTION

Puncak area, Bogor, is one of the strategic areas in Indonesia that has a dual role as a leading tourist destination and an important conservation area. This area functions as an ecosystem buffer for the Jabodetabek area, as well as being a major water catchment area and flood control. Its function is very crucial in maintaining ecological balance amidst the dynamics of increasingly rapid urbanization. Located in a strategic location with captivating natural scenery, Puncak area attracts millions of tourists every year. However, this popularity is also one of the triggers for significant development pressure, both for tourism purposes and residential development [1].

The increase in land conversion in the Puncak area, especially from green areas to built-up areas, has serious impacts on the environment [2]. The loss of natural vegetation has implications for the decline in environmental quality, such as soil erosion, decreased water absorption capacity, and increased microclimate temperatures. In addition, land conversion also contributes to the increasing risk of environmental disasters, such as landslides and floods that often hit this area [3]. This condition is exacerbated by the decreasing environmental carrying capacity, so that the threat to the sustainability of the ecological function of the Puncak area is becoming increasingly real [4].

On the other hand, the need for land in the Jabodetabek area continues to increase along with economic and population growth. This causes additional pressure on the Puncak area, which is considered a reserve area for development expansion. Unfortunately, the spatial planning of this area is often not supported by adequate supervision, making spatial planning regulations difficult to implement consistently [1]. This inconsistency not only reflects weaknesses in planning, but also the conflict of interest between environmental conservation goals and the economic needs of the community and business actors ([5].

The Indonesian government has actually established various policies to protect the Puncak Area, one of which is Presidential Regulation [15] concerning the Arrangement of the Jabodetabek-Punjur Strategic Area. This policy aims to improve land use and integrate sustainable development with environmental conservation [6]. However, the implementation of this regulation in the field often

pISSN 2302-4240
eISSN 2655-2086
Volume 14, Issue 3, September 2025, pp.0912-0919
DOI: http://dx.doi.org/10.32832/astonjadro.v14i3.18531 http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO

encounters obstacles, ranging from weak supervision to minimal collaboration between the government, local communities, and the private sector. In fact, the success of policy implementation is highly dependent on the involvement of all stakeholders, as well as strengthening institutional capacity in spatial management [5], [6].

Therefore, a holistic approach is needed that not only prioritizes economic development, but also ensures environmental sustainability and community welfare. Synergy between the government, academics, local communities, and business actors is a key element in overcoming various spatial planning problems in the Puncak Area. In addition, technological innovation and strengthening regulations can be a long-term solution to ensure that the Puncak Area remains a useful area, both ecologically and economically. This approach is an important step to maintain a harmonious balance between environmental conservation and the ever-growing needs of development. The author conducted an analysis to identify patterns of land use change, the level of compliance with spatial plans, and the ecological and socio-economic impacts of converting green land into built-up areas. This approach aims to provide a comprehensive picture and suggest more sustainable spatial management strategies.

This study aims to conduct a comprehensive study on Land Use and Spatial Planning in the Puncak Area, Bogor. In addition, this study will also identify obstacles in the implementation of sustainable spatial planning policies in the Puncak Area of Bogor Regency and provide recommendations for improving environmental governance. It is hoped that the findings of this study can help the government and the community to better understand the importance of sustainable spatial planning in order to maintain environmental quality and improve community welfare in a sustainable manner.

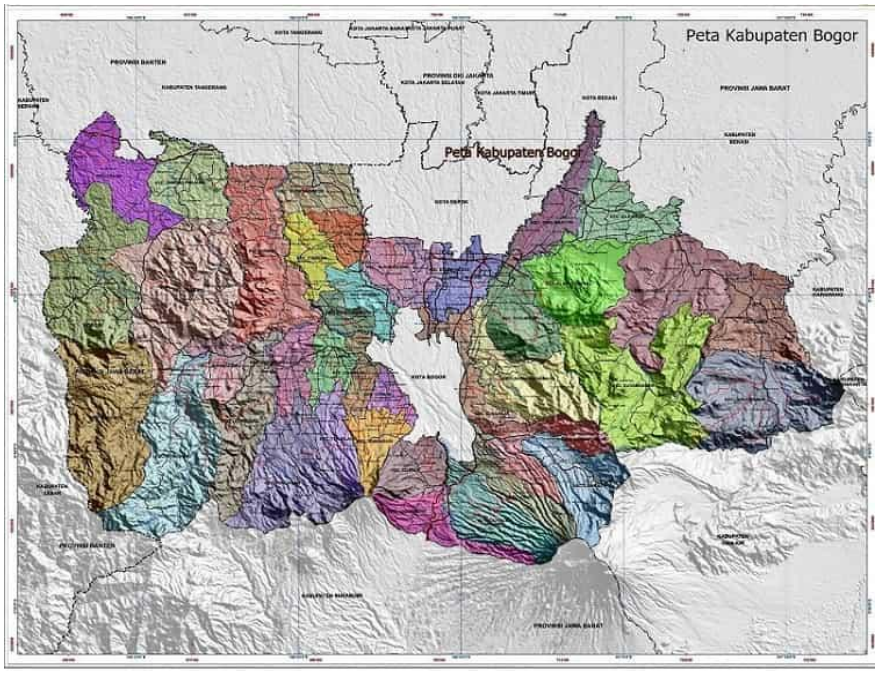


**Figure 1**. Map of Bogor Regency, West Java (source: Dakira [24])

## RESEARCH METHODS

This study uses literature analysis and secondary data evaluation methods to identify the impact of changes in spatial structure in the Puncak Bogor Area on environmental quality. Data were obtained from journals, government reports, and land use change data from year to year. Descriptive analysis was conducted to identify patterns of spatial transformation and factors that affect environmental quality, especially in land use change in the Area.

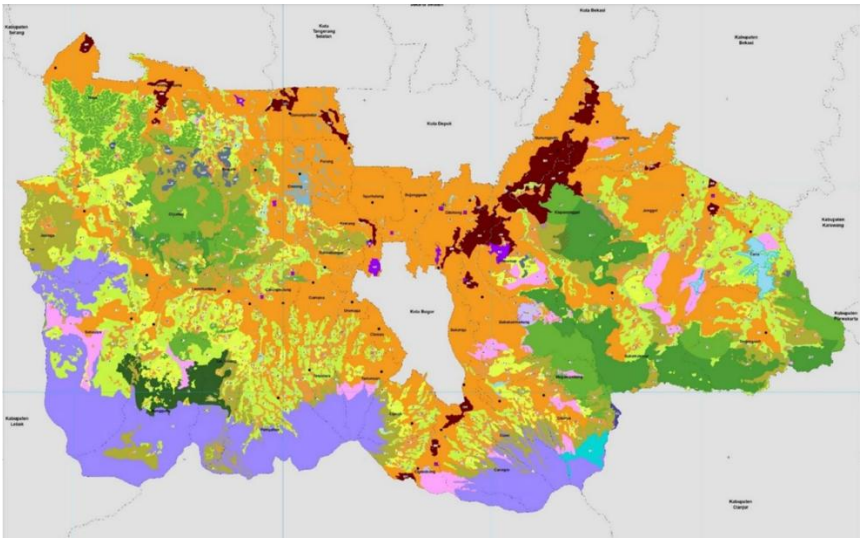

**Figure 2**. Bogor Regency Spatial Planning Map, West Java (source: Pemerintah Kabupaten Bogor [25])

## RESULT AND DISCUSSION

### Land Use Change: Impact on the Environment

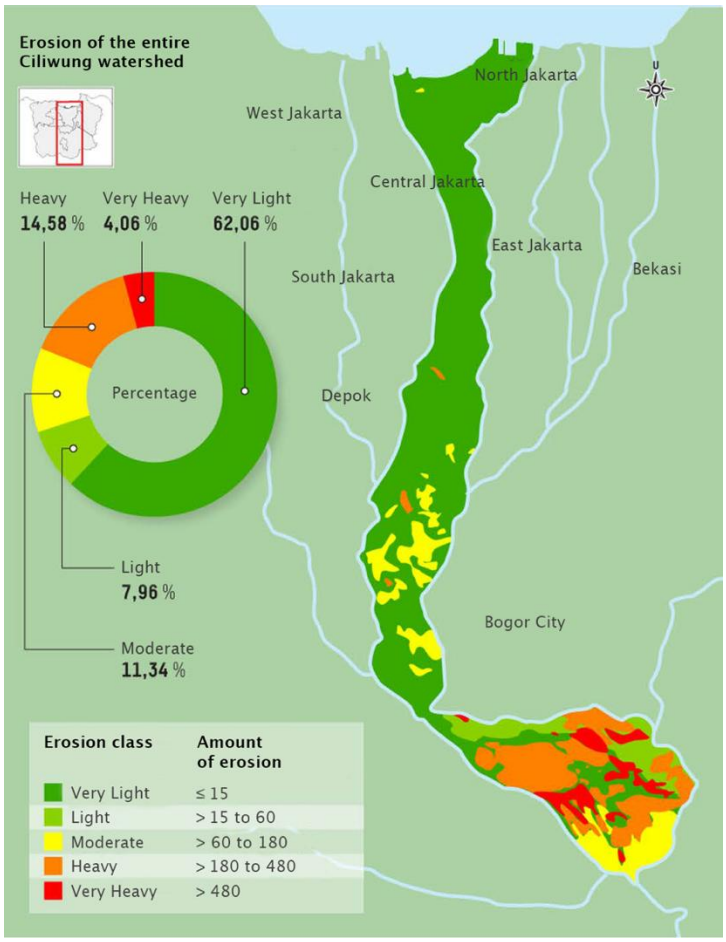


**Figure 3**. Surface flow rate and erosion of the Ciliwung watershed (source: modified from Yoga [7])

**ASTONJADRO**
pISSN 2302-4240
eISSN 2655-2086
Volume 14, Issue 3, September 2025, pp.0912-0919
DOI: http://dx.doi.org/10.32832/astonjadro.v14i3.18531 http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO

Over the past two decades, the Puncak area has undergone extensive conversion of green spaces into built-up zones, including residential areas, villas, tourist facilities, and supporting infrastructure [1]. This transformation has significantly reduced critical water catchment areas, increasing uncontrolled surface runoff and heightening flood risks. The impact extends beyond the Puncak region, affecting downstream areas such as Jakarta, which rely on the upstream ecological balance. Additionally, the loss of natural vegetation diminishes the area's carbon absorption capacity, further intensifying greenhouse gas emissions linked to development activities [3], [8]. Weak enforcement of spatial planning policies has worsened this situation, with conservation zones frequently converted into residential or commercial areas, resulting in soil degradation and ecological imbalance [9], [10].

The degradation of natural vegetation has also led to increased soil erosion, which contributes to sedimentation in rivers and deteriorates water quality in nearby regions [11]. This erosion adversely affects agricultural productivity, undermining the local economy that once depended on farming [12]. Moreover, biodiversity has declined due to the destruction of natural habitats, replaced by human-made structures incompatible with sustaining local flora and fauna. Studies highlight that many villas and tourist facilities are developed without regard for the local environment's carrying capacity, accelerating ecological damage [13], [14]. To mitigate these impacts, immediate action is required to enforce stricter spatial planning policies, improve regulatory oversight, and enhance environmental management practices.

**Inconsistencies in Spatial Planning**

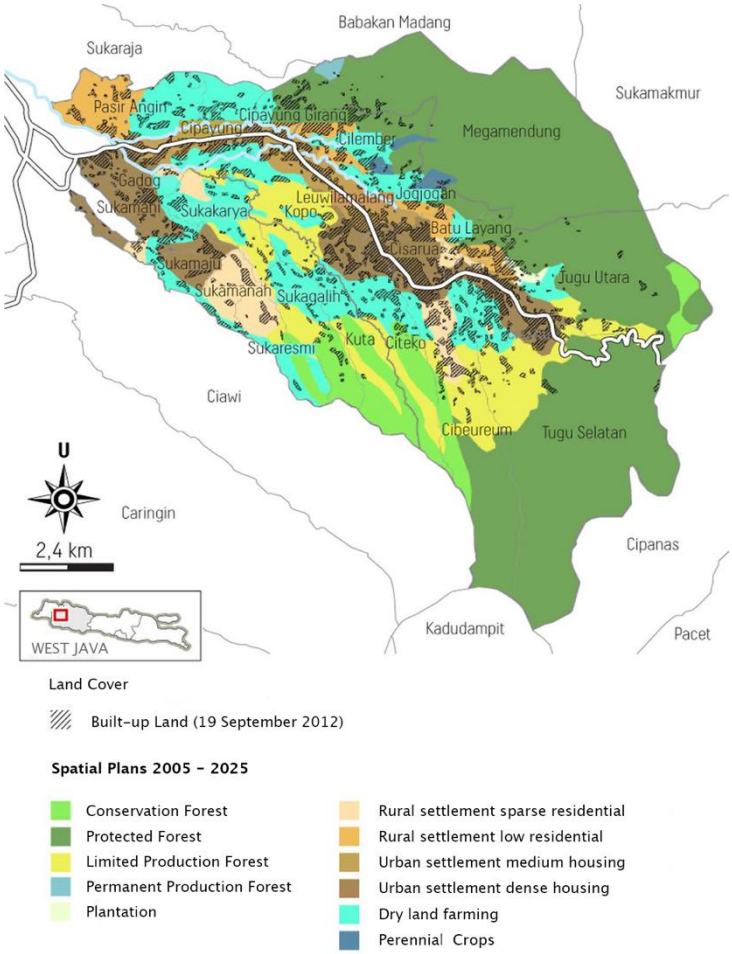


**Figure 4**. Land cover map 2012, Cisarua and Megamendung Districts, Bogor Regency, West Java (source: modified from Yoga [7])

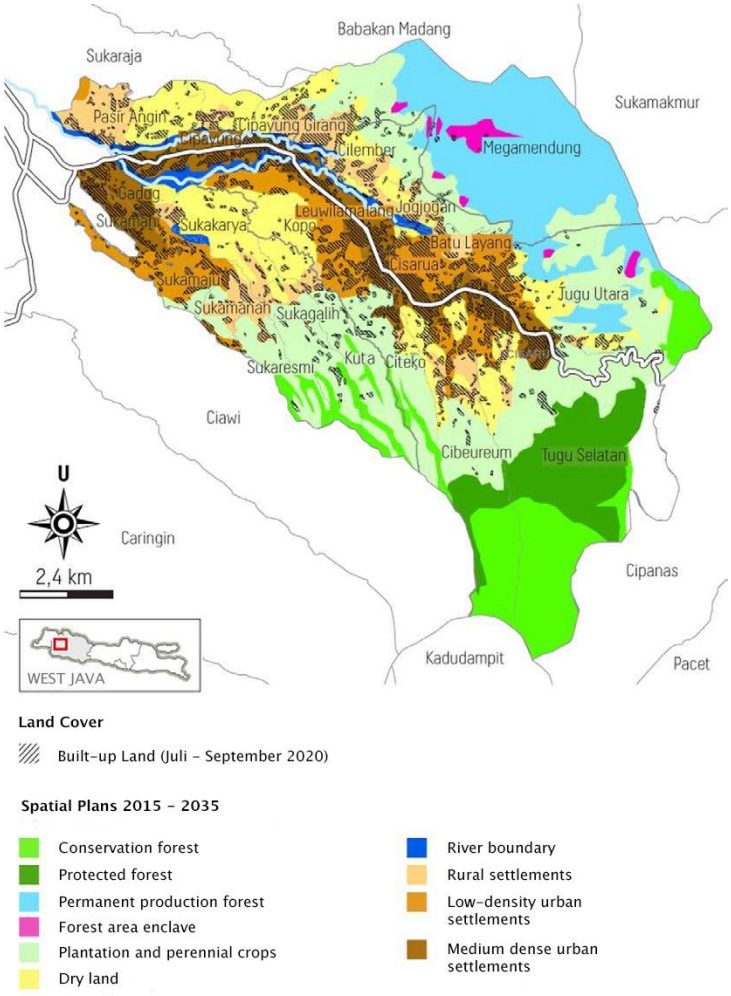


**Figure 5**. Land cover map 2020, Cisarua and Megamendung Districts, Bogor Regency, West Java (source: modified from Yoga [7]).

Spatial planning in the Puncak area is fraught with challenges, primarily due to inconsistent enforcement of regulations [9]. Despite Presidential Regulation [15] designating the Puncak area as a strategic zone requiring special protection, violations remain widespread. Weak oversight and lax law enforcement have allowed illegal developments, such as villas and commercial facilities, to proliferate, often exploiting regulatory loopholes [13]. The situation is further complicated by conflicting interests among tourism development, residential needs, and environmental conservation [2], [16]. These conflicts, combined with fragmented decision-making processes among various stakeholders, hinder efforts to achieve sustainable spatial planning.

Moreover, inadequate mechanisms to enforce compliance with spatial plans exacerbate the problem. Local governments often prioritize economic pressures over adherence to established plans [17], while public awareness of environmental conservation remains low. Many landowners convert land without considering its ecological impact, leading to ecosystem fragmentation, heightened disaster risks, and social tensions between migrants and local communities [18]. Addressing these issues requires strengthening spatial planning regulations through improved monitoring systems, digitalized licensing processes, and collaborative efforts across sectors. Such measures are essential to ensure the sustainable management of the Puncak area.

pISSN 2302-4240
eISSN 2655-2086
Volume 14, Issue 3, September 2025, pp.0912-0919
DOI: http://dx.doi.org/10.32832/astonjadro.v14i3.18531 http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO

### Application of Technology in Monitoring and Management

Advanced technologies like Geographic Information Systems (GIS) and remote sensing have become vital tools for monitoring and managing land use changes in the Puncak area. GIS facilitates the integration and analysis of spatial data, enabling the detection of land use changes over time, identification of environmentally vulnerable zones, and mapping of areas that need priority conservation [19]. High-resolution satellite imagery enhances the ability to detect unauthorized developments or land conversions that violate spatial plans, enabling prompt action by authorities [20]. When combined with big data and artificial intelligence, these technologies can predict future development patterns, providing valuable insights for creating data-driven spatial planning policies. Beyond monitoring, GIS supports innovative environmental management solutions, such as designing effective drainage systems based on water flow patterns and protecting water catchment areas.

GIS-based hydrological models are particularly effective for simulating the impacts of land use changes on flood risks, enabling adaptive infrastructure planning to address climate change challenges [8]. Additionally, drones are increasingly employed for efficient field surveys, offering accurate visual and topographic data collection in inaccessible areas [21]. These technological advancements enable real-time monitoring of the Puncak area's ecological conditions, forming a solid foundation for sustainable and precise spatial decision-making. However, implementing these technologies requires substantial investment and enhanced human resource capabilities to maximize their potential.

### Socio-Economic Impacts of Spatial Planning Management

Spatial planning in the Puncak area has brought both positive and negative socio-economic impacts on local communities. On the positive side, the growth of the tourism sector has created economic opportunities, generating employment and fostering the development of micro, small, and medium enterprises (MSMEs). Tourism activities such as accommodations, restaurants, and souvenir shops provide diverse income sources for locals, who can offer services like guiding, transportation, or selling agricultural products and traditional crafts [22]. These opportunities contribute to strengthening the local economy, enhancing living standards, and improving social conditions within the community [23].

However, the rapid development and population growth associated with urbanization and increasing tourist activity place significant pressure on regional infrastructure. Public facilities, including roads, waste management, and drainage systems, struggle to meet the demands of a larger population, often exceeding their original capacity. This has led to problems such as traffic congestion, clean water shortages, and deteriorating environmental conditions. These issues highlight the need for comprehensive and inclusive policy interventions to address socio-economic pressures and prevent further imbalances between economic growth and environmental conservation in the Puncak area [3].

## CONCLUSION

Land use and spatial planning management in Puncak Bogor Area is a major challenge involving various aspects, such as environmental conservation, economic development, and local community welfare. This area faces severe pressure from uncontrolled urbanization, which triggers land conversion, environmental degradation, and conflicts between conservation needs and development activities. The main lessons learned are the importance of strong regulations, active involvement of local communities, and the use of technology in spatial planning. By learning from the strategies in Chiang Mai, Swiss Alps, and Whistler, Puncak Area can adopt a strict zoning-based approach, conservation incentives, and policies that involve the participation of all stakeholders.

## RECOMMENDATION

To address the challenges in spatial planning and environmental conservation in the Puncak area, several recommendations are proposed. First, the Indonesian government must strengthen regulation and law enforcement by enhancing supervision of spatial planning violations and imposing strict sanctions on illegal constructions. Second, increasing community participation through education

and active involvement in spatial planning processes is essential to foster better compliance with regulations. Third, the utilization of advanced technologies, such as Geographic Information Systems (GIS) and remote sensing, should be integrated to enable real-time monitoring of land use changes. Finally, prioritizing ecosystem revitalization, including critical area rehabilitation through reforestation in areas impacted by development, is crucial to restore environmental balance and ensure sustainability in the Puncak area.

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pISSN 2302-4240
eISSN 2655-2086
Volume 14, Issue 3, September 2025, pp.0912-0919
DOI: http://dx.doi.org/10.32832/astonjadro.v14i3.18531 http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO

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