



Balancing urban growth and environmental sustainability through spatial planning: A Policy and land use analysis

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ABSTRACT

Background: Spatial planning is an essential component of regional development, particularly in areas that serve as centers of governance and economic activity. Challenges in sustainable spatial management arise as population growth increases the demand for public facilities, housing, and green open spaces. This study analyzes spatial planning policies with a focus on land use, infrastructure, and environmental impacts. Using a participatory approach, it aims to identify problems and explore potential strategies for more effective spatial planning development. **Methods:** This study applies a comprehensive literature review method, with data sourced from previous studies and land use maps. The discussion is presented descriptively, referencing relevant scientific literature and reliable sources. **Findings:** The results are expected to provide recommendations for sustainability-oriented decision-making and contribute to improving the quality of life of urban communities. These efforts are essential to balance development with environmental conservation while also enhancing the attractiveness of urban areas for investment and tourism. **Conclusion:** Analysis shows that residential land experienced a substantial increase, from 171.44 hectares to 348.17 hectares, reflecting high demand for housing driven by population growth and infrastructure development. Conversely, dry land decreased drastically from 1,566.23 hectares to 305.41 hectares, indicating significant conversion of land for non-agricultural purposes. The reduction of green open land and dry land poses serious risks to food security and environmental quality. **Novelty/Originality of this article:** This study emphasizes the importance of implementing sustainable spatial planning policies that balance infrastructure and residential development with ecological preservation and agricultural sustainability. With appropriate strategies, land use can be directed to support sustainable and resilient urban growth.

KEYWORDS: land use change; spatial planning; sustainable spatial planning; urban development.

1. Introduction

Spatial planning is a key concept in regional planning that focuses on sustainable land use management to improve the quality of life for the community. Cibinong District, the capital of Bogor Regency, has experienced significant development dynamics over the past decade. Rapid population growth and urbanization make Cibinong District one of the areas with complex spatial planning challenges. According to data from the Central Statistics Agency/*Badan Pusat Statistik* (BPS) of Bogor Regency, in 2009, the population of Cibinong District was approximately 157,000, while in 2019, this figure increased to over 200,000, indicating significant growth within ten years (BPS, 2020).

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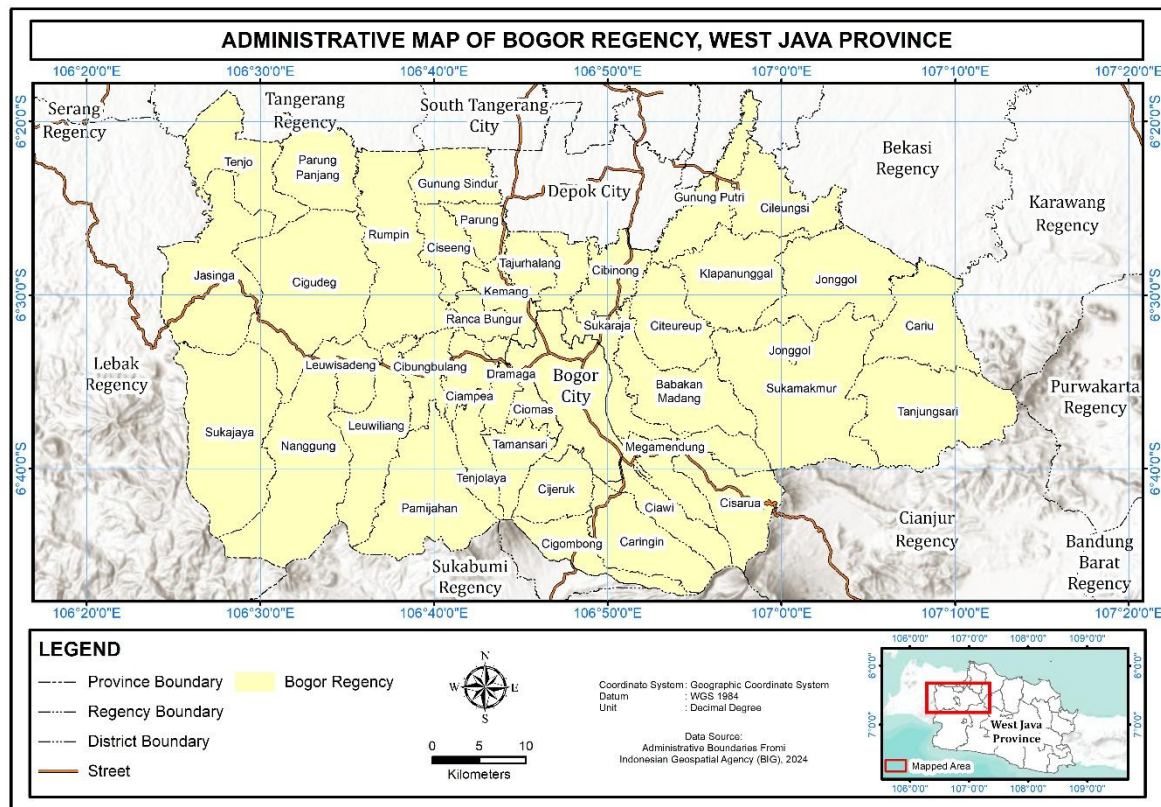


Fig 1. Administrative map of Bogor Regency, West Java Province

During this period, land use conversion from agricultural to residential and commercial areas increased dramatically. Data from the Bogor Regency Spatial Plan/*Rencana Tata Ruang Wilayah* (RTRW) shows that in 2009, agricultural land accounted for 40% of total land use, while in 2019, this proportion decreased to only 25% (Bappeda Bogor Regency, 2020). These changes impacted not only the availability of agricultural land but also infrastructure, accessibility, and environmental quality in Cibinong District. Environmental conditions also underwent significant changes during this period. Issues of air and water pollution, as well as ineffective waste management, became major problems faced by the community.

A report from the Ministry of Environment and Forestry/*Kementerian Lingkungan Hidup dan Kehutanan* (KLHK) stated that increased industrial and residential activity contributed to the decline in environmental quality in the area (KLHK, 2021). Therefore, it is important to analyze comparatively how spatial planning in Cibinong District changed between 2009 and 2019 to understand the factors influencing these dynamics and their impact on the community. This study aims to evaluate the comparative conditions of spatial planning in Cibinong District between 2009 and 2019. This research will identify changes in land use, infrastructure, and their impacts on the environment and community quality of life. Using quantitative and qualitative data analysis approaches, this study is expected to provide a comprehensive overview of spatial developments in Cibinong District and policy recommendations that are more responsive to community needs.

2. Methods

This study applies a descriptive qualitative approach supported by quantitative analysis to examine spatial planning and land use changes during the period 2009–2019. This study primarily relies on secondary data obtained from land use maps, government regulations, and statistical reports issued by the Central Statistics Agency and related institutions. In addition, scientific literature, policy documents, and environmental reports

were reviewed to provide a theoretical basis and policy context for understanding spatial planning and land use dynamics.

The collected data was processed by categorizing land use into several classes, namely water bodies, scrubland, industry, mixed gardens, open land, settlements, plantations, swamps, rice fields, and dry fields. Data from 2009 and 2019 was tabulated and compared to identify changes in area and proportion, enabling this study to reveal dominant trends in land conversion. The analysis was descriptive, combining literature-based interpretation with comparative quantitative assessment to explain the driving factors behind the observed changes, such as urbanization, infrastructure expansion, industrial development, and spatial planning policies.

To ensure the validity of the findings, this study used cross-checking techniques using various sources, including government documents, statistical databases, and peer-reviewed studies. Reliability is reinforced by maintaining consistency in land use classification and referring to national spatial planning regulations as the main analytical framework. As this study is based entirely on publicly available secondary data, it does not involve ethical issues related to confidentiality or personal information, and all sources are transparently cited to ensure academic integrity.

3. Result and Discussion

3.1 Spatial planning concept

Spatial planning is a spatial arrangement system aimed at creating order in land use and the utilization of natural resources. According to Tjokrowinoto (2017), spatial planning can be defined as an effort to organize the use of space effectively to support economic, social, and environmental activities. In this context, spatial planning relates not only to physical planning but also to consideration of interacting social and environmental aspects. In general, spatial planning refers to the arrangement and management of space within an area to achieve sustainable development goals. According to Government Regulation of the Republic of Indonesia No. 15 of 2010, spatial planning is a system that regulates the use of space, including land, sea, and air. This regulation encompasses land use for various activities such as housing, agriculture, industry, and environmental conservation.

The primary objective of spatial planning is to improve the quality of life for the community by providing functional and comfortable spaces. This aligns with the view of Dong et al. (2020) and Fu et al. (2024), who stated that spatial planning aims to achieve a balance between economic, social, and environmental development and conservation. The principles of spatial planning include sustainability, efficiency, social justice, and community participation. Community involvement in the planning process is crucial to ensure that their needs and aspirations are accommodated in spatial planning policies. Good spatial planning will have a positive impact on the development of a region. For example, Der Sarkissian et al. (2022) and Magsi et al. (2022) emphasized that thorough planning can reduce the risk of land use conflicts, prevent environmental damage, and improve infrastructure quality. Furthermore, spatial planning is also crucial for anticipating the impacts of climate change, where spatial planning must be designed to strengthen regional resilience to natural disasters and environmental fluctuations.

3.2 Land use change theory

Land use change is a dynamic process reflecting the transformation of land use from one type of use to another, influenced by various social, economic, and environmental factors. According to Connolly et al. (2021) and Humbal et al. (2023), this change is often driven by factors such as population growth, urbanization, and rapid infrastructure development. Land use change theory helps understand the mechanisms and patterns of change that occur in a region. Several factors influencing land use change can be grouped into physical, social, and economic categories. Physical factors include geography, climate,

and soil quality. Meanwhile, social factors include population growth, migration, and changes in community behavior. On the economic side, growth in the industrial, housing, and agricultural commodity sectors contributes to land use change (Allan et al., 2022; Raihan & Tuspekova, 2022; Quirinno et al., 2024). For example, rapid urbanization in Cibinong District has resulted in land use conversion from agricultural to residential and commercial areas.

Several models have been developed to explain and predict land use change. Land-use change models, such as cellular automata and Markov models, are used to analyze land-use change dynamics based on historical data and current trends (Belay et al., 2024; Ghalehtemouri et al., 2022; Guan et al., 2011). These models help planners formulate scenarios and strategies for sustainable land-use management. Land-use change has a significant impact on the environment and people's quality of life. Unplanned land use can cause environmental damage, such as deforestation, soil degradation, and pollution. According to a report from the Ministry of Environment and Forestry (KLHK, 2021), land-use change in urban areas often results in the loss of green open space and an increased risk of natural disasters. The social impacts of these changes include increased population density, shifts in local economies, and other social issues, such as poverty and inequitable access to public services.

3.3 Regional spatial planning in Indonesia

Spatial planning in Indonesia is a system that regulates the use of space to achieve sustainable development goals. In this context, spatial planning focuses not only on physical aspects but also considers social, economic, and environmental interactions. Spatial planning in Indonesia is governed by various regulations and policies aimed at creating a balance between economic growth and environmental preservation. Spatial planning policy in Indonesia is governed by Law No. 26 of 2007 concerning Spatial Planning, which serves as the basis for spatial planning and management at various levels of government. This law regulates spatial planning, environmental protection, and community empowerment in the planning process. According to Soemarno (2018), this policy aims to ensure efficient and sustainable use of space and encourage public participation in decision-making.

The Regional Spatial Plan (RTRW) is a planning document that regulates spatial use at the provincial, district, and city levels. The RTRW covers various aspects of land use, including residential zones, industry, agriculture, and green open spaces. According to Bappenas (2020), a good RTRW must reflect community needs and changing socio-economic conditions, and be flexible in responding to dynamic developments. The implementation of the RTRW often faces challenges, such as conflicts of interest, lack of coordination between sectors, and limited resources. The government plays a central role in spatial planning management, both at the central and regional levels. The Ministry of Agrarian Affairs and Spatial Planning/National Land Agency (ATR/BPN) serves as the institution that oversees and coordinates the implementation of spatial planning throughout Indonesia. In carrying out its duties, the government also involves the community and other stakeholders in the spatial planning and management process (Anthony Jr, 2024; Rijal, 2023; Saleh et al., 2022). Community involvement is expected to create policies that are more inclusive and responsive to local needs.

3.4 Case study of spatial planning

Cibinong District, as the capital of Bogor Regency, faces significant challenges in spatial planning management. With rapid population growth and increasing infrastructure development, land use in the area has undergone significant changes over the past decade. This study aims to analyze spatial planning changes in Cibinong District, focusing on a comparison between conditions in 2009 and 2019. Cibinong District has a long history as the administrative and commercial center of Bogor Regency. According to data from the Central Statistics Agency (BPS) (2020), Cibinong District has experienced rapid

urbanization due to migration from surrounding areas. This has contributed to population growth and changing infrastructure needs, including housing, educational facilities, and health care. During the same period, agricultural land in the area has been increasingly pressured by residential and commercial developments (Halder et al., 2021; Qu et al., 2021).

Spatial planning policies in Cibinong District are regulated by the Bogor Regency Spatial Plan (RTRW). This RTRW regulates land use zoning, including agricultural land, residential areas, and green open spaces. However, many policies are not fully implemented, leading to illegal and unplanned land use shifts (Bappeda Bogor Regency, 2020). Between 2009 and 2019, agricultural land decreased drastically due to conversion to residential and commercial areas, negatively impacting local food security (Erasu Tufa & Lika Megento, 2022; Stavi et al., 2022). A comparison of land use between 2009 and 2019 shows a significant decrease in agricultural land and an increase in land use for housing and industry. Data from the Statistics Indonesia (BPS) (2020) shows that agricultural land shrank from 40% to 25% of total land use, while residential areas increased sharply. These changes not only impact the availability of agricultural land but also the quality of the environment and infrastructure in Cibinong District (KLHK, 2021). Issues of pollution, waste management, and the lack of green open spaces are the main problems faced by the community due to these changes.

3.5 Discussion

Bogor Regency Regional Regulation Number 19 of 2008 concerning the Regional Spatial Plan (RTRW) of Bogor Regency for the period 2005-2025 was revised in 2015. This revision resulted in Bogor Regency Regional Regulation Number 11 of 2016 which regulates the RTRW of Bogor Regency for the period 2016-2036. Based on the provision that the RTRW is reviewed every five years, the next review of the RTRW of Bogor Regency will be conducted in 2021. Bogor Regency itself is an area that has a hierarchy of urban development and development, which is connected through a network of activities between rural and urban areas, both within the region and with external areas, such as Jakarta, Bogor, Depok, Tangerang, Bekasi, Puncak, and Cianjur (Jabodetabekpunjur). This indicates that Bogor Regency will continue to experience rapid development, especially in terms of population growth and increasing land needs.

Land use patterns and management in Cibinong District have certainly changed between 2009 and 2019. Land use data in Cibinong District, Bogor Regency, are presented in Table 1. The Table 1 illustrates a comparison of land use in Cibinong District between 2009 and 2019. It clearly shows a significant increase in settlement areas, while moorland and mixed gardens experienced notable decreases. Rice fields, bushland, and industrial areas demonstrate moderate growth, whereas open land nearly disappeared due to conversion into other land uses. Overall, the figure highlights the dominance of urban expansion over agricultural and open land during the ten-year period.

Table 1. Land use data for Cibinong District, Bogor Regency

Land Use	2009		2019	
	Area (Ha)	Percentage (%)	Area (Ha)	Percentage (%)
Water Body	59.69	1.28	62.48	1.34
Bush	20.87	0.45	221.60	4.76
Industry	26.42	0.57	173.21	3.72
Mixed Garden	1060.64	22.76	267.94	5.75
Open Land	122.43	2.63	-3.25	-0.07
Settlement	1620.80	34.78	3280.34	70.40
Plantation	0	0.00	3.72	0.08
Swamp	11.09	0.24	0	0.00
Ricefield	171.44	3.68	348.17	7.47
Moor	1566.23	33.61	305.41	6.55
Grand Total	4659.65	100.00	4659.65	100.00

Bushland expanded considerably from 20.87 ha (0.45%) to 221.60 ha (4.76%). Meanwhile, open land decreased entirely, with a negative value, reflecting full conversion to other uses. Overall, the dominant trend is the large-scale expansion of settlement areas, which has reduced the extent of moorland and mixed gardens. At the same time, rice fields, industrial areas, and bushland show moderate increases, highlighting a strong urbanization process in the district over the ten-year period.

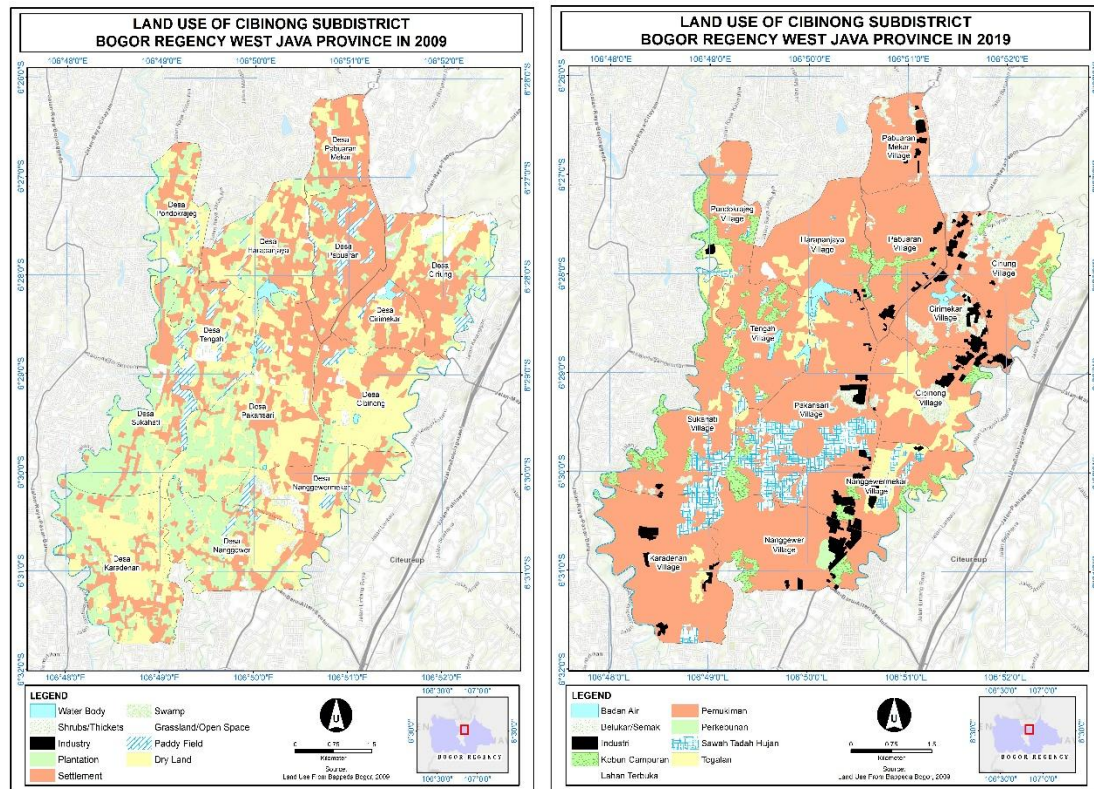


Fig 2. Land use in Cibinong District in 2009 and 2019

3.5.1 Water body

Land use for water bodies in Cibinong District is a crucial aspect of water resource management and environmental sustainability. Water bodies, such as rivers, lakes, and reservoirs, serve as sources of clean water and play a vital role in maintaining ecosystem balance. Data shows that in 2009, the water body area in Cibinong District reached 59.69 hectares, while in 2019, this area increased to 62.48 hectares. In 2009, land use for water bodies in Cibinong District covered approximately 59.69 hectares. During this period, the water bodies in this area primarily consisted of the Ciliwung River and several reservoirs built for irrigation and clean water supply. According to the Bogor Regency Spatial Plan (2009), this area functions as a water catchment area that is crucial for maintaining the quality and availability of water sources. However, over the years, water bodies in Cibinong have also faced challenges, including pollution from domestic waste and poorly managed industrial activities, which have the potential to degrade water quality (Akhtar et al., 2021; Alifah et al., 2024; Zahoor & Mushtaq, 2023).

According to the latest data, in 2019, land use for water bodies in Cibinong District increased to 62.48 hectares. While this increase in water body area reflects government and community efforts to protect and conserve water resources, this increase is evidenced by several rehabilitation projects undertaken to improve the condition of existing water bodies, as well as the addition of new areas designated as reservoirs or retention basins. The Bogor Regency Public Works and Spatial Planning Agency (2019) noted that several water bodies have been repaired and utilized effectively for irrigation and clean water supply, positively impacting environmental quality and community well-being. Despite the

increase in water body area, challenges remain, particularly regarding water quality. Increasing urbanization and land conversion for residential and industrial purposes have the potential to increase water body pollution. Furthermore, sedimentation and a decrease in the water body's capacity are also issues that require attention (Angghita et al., 2024; Gonzalez Rodriguez et al., 2023; Ugwu et al., 2022). Therefore, proper and sustainable management of water bodies in Cibinong District is essential to ensure clean water availability and ecosystem preservation.

3.5.2 Bush

Bushland is a type of land use that plays an important role in maintaining biodiversity, as a habitat for various flora and fauna species, and in the process of absorbing carbon dioxide. In Cibinong District, there was a significant change in the area of bushland from 2009 to 2019, namely from 20.87 hectares to 221.60 hectares. In 2009, the area of bushland in Cibinong District was recorded at 20.87 hectares. During this period, shrubland mostly formed naturally in poorly managed areas, such as riverbanks and difficult-to-access areas. According to data from the Central Statistics Agency (BPS) (2010), the existence of this shrubland is important as a buffer zone to protect soil and water quality, as well as a habitat for various local species. However, the condition of shrubland at that time began to be threatened by land conversion for infrastructure and residential development. In 2019, shrubland in Cibinong District experienced a very significant increase to 221.60 hectares.

This increase can be attributed to several factors, including local government efforts in environmental conservation and rehabilitation of previously degraded areas. Reforestation projects and the return of land to shrubland or scrubland help improve soil quality and provide ecological benefits, such as reduced erosion and increased water absorption (Bogor Regency Environmental Agency, 2019). Furthermore, growing public awareness of the importance of scrubland for environmental sustainability has also contributed to the increase in this area. Although scrubland/shrubland in Cibinong District has experienced a significant increase, challenges remain, particularly related to rapid land conversion due to urbanization. Uncontrolled development can threaten scrubland, which serves as a buffer zone and natural habitat. Therefore, more effective policies are needed for the management and protection of scrubland to ensure ecosystem sustainability and mitigate the negative impacts of land-use change.

3.5.3 Industry

Industrial land use in Cibinong District has shown significant growth over the past decade, reflecting the region's economic growth and infrastructure development. Data shows that the area of land used for industrial purposes increased from 26.42 hectares in 2009 to 173.21 hectares in 2019. In 2009, industrial land use in Cibinong District was recorded at 26.42 hectares. During this period, industrial areas remained limited, with most small and medium-sized industries operating in unintegrated locations. According to a 2009 report from the Bogor Regency Regional Development Planning Agency (Bappeda), industry in Cibinong was dominated by locally based businesses, such as handicrafts and food processing. However, challenges in industrial development, such as limited infrastructure access and a lack of government support, have prevented the sector from growing optimally. In 2019, industrial land use in Cibinong District increased dramatically to 173.21 hectares.

This increase reflects local government policies encouraging the development of industrial areas through the provision of better infrastructure, such as access roads and other supporting facilities. According to the Bogor Regency Industry and Trade Office (2019), the development of industrial areas in Cibinong has also been accompanied by increased investment from the private sector, encompassing various industries, such as manufacturing, logistics, and information technology. Furthermore, improved spatial planning has enabled more efficient and planned allocation of industrial land, thus

facilitating local economic growth. While the increase in industrial land has significantly contributed to economic growth in Cibinong District, it also poses challenges, particularly related to environmental impacts. Rapid industrial development can lead to pollution problems, increased traffic volumes, and changes in land use that impact local communities. Therefore, it is crucial to implement sustainable industrial practices and ensure that industrial sector growth does not compromise environmental quality and public health.

3.5.4 Mixed garden

Land use for mixed-crop gardens in Cibinong District has shown a significant downward trend over the past decade. Data shows that the area of land used for mixed-crop gardens decreased from 1,060.64 hectares in 2009 to 267.94 hectares in 2019. This decline reflects changes in land use patterns caused by various factors. In 2009, mixed-crop gardens in Cibinong District covered a significant area, reaching 1,060.64 hectares. These mixed-crop gardens generally consist of various types of crops, including vegetables, fruits, and perennials, planted together. This provides the advantage of diversifying agricultural output and increasing farmer incomes. According to the Bogor Regency Statistics Agency (BPS) (2010), mixed-crop gardens are a primary source of livelihood for the people of Cibinong, given that agriculture is a crucial sector in the local economy.

However, in 2019, the area of mixed-crop gardens decreased drastically to 267.94 hectares. This decline is due to several factors, including land conversion for infrastructure development, housing development, and the ever-expanding industrial area in Cibinong District. Development projects initiated by the local government and private investment have also contributed to the reduction in areas previously used for agriculture. The Bogor Regency Agriculture Office (2019) noted that many farmers have shifted from mixed-use farming to more profitable businesses, leading to changes in land use. The reduction in land area for mixed-use farming can negatively impact local food security and the economic sustainability of farmers. The reduction in agricultural area leads to a decline in local food production and reduces sources of income for farmers. Furthermore, the loss of mixed-use farming also impacts biodiversity and environmental quality in the area. Therefore, efforts are needed to protect remaining agricultural land and develop policies that support the sustainability of the agricultural sector in Cibinong District.

3.5.5 Open land

Open land is a crucial component of a region's spatial planning because it serves as green space, water absorption, and habitat for biodiversity. In Cibinong District, open land use showed a drastic decline from 2009 to 2019, from 122.43 hectares to just 3,253 hectares. This decline reflects significant changes in land use and its impact on the environment. In 2009, the area of open land in Cibinong District reached 122.43 hectares. During this period, open land functioned as public green space, water catchment areas, and as spaces for agricultural activities and community recreation. According to a report from the Bogor Regency Central Statistics Agency (BPS) (2010), open land in Cibinong is crucial for maintaining environmental quality, reducing flood risk, and improving the community's quality of life. However, in 2019, the area of open land in Cibinong District experienced a significant decline to just 3,253 hectares. This decline is due to several factors, including rapid urbanization and land conversion for residential development, infrastructure, and industrial areas.

Massive development projects in Cibinong, driven by population growth and the need for more housing, have resulted in the loss of many previously existing open areas. The Bogor Regency Public Works and Spatial Planning Agency (2019) noted that infrastructure and residential developments significantly dominate land-use changes, resulting in the erosion of green open spaces. This drastic reduction in open spaces can have serious impacts on local ecosystems, such as increased flood risk, decreased air quality, and reduced biodiversity. Furthermore, the loss of green open spaces reduces the community's quality

of life by reducing their access to areas for physical activity and recreation. Therefore, it is crucial to develop policies to protect open land and green spaces in Cibinong District to maintain ecosystem balance and improve the community's quality of life.

3.5.6 Settlement

Land use for residential use in Cibinong District has experienced significant growth in the last decade. The area of residential land increased from 1,620.80 hectares in 2009 to 3,280.34 hectares in 2019. This increase reflects the dynamics of population growth and rapid economic development in the region. In 2009, the area of residential land in Cibinong District was recorded at 1,620.80 hectares. During this period, settlements in Cibinong were dominated by traditional housing with some newly developed modern housing. According to a report by the Central Statistics Agency (BPS) (2010), residential land at that time was still limited, with many areas dominated by agricultural and open land. The availability of basic infrastructure such as roads, clean water, and electricity has also begun to improve, although it is still not evenly distributed throughout the region. However, in 2019, residential land in Cibinong District experienced a very significant increase to 3,280.34 hectares. This growth is primarily driven by rapid urbanization, with many residents from surrounding areas migrating to Cibinong in search of jobs and a better life.

Data from the Bogor Regency Housing and Settlement Agency (2019) shows that many private developers have begun investing in subsidized housing and commercial developments, significantly contributing to the expansion of residential land. Furthermore, improvements in transportation infrastructure and public facilities have also contributed to the area's increasing attractiveness as a residential location. While residential growth offers economic and social benefits, challenges also arise, such as increased population density, which can lead to traffic congestion, a lack of adequate infrastructure, and potential environmental degradation. Unplanned development can potentially lead to negative impacts, such as the reduction of green open space and an increased risk of flooding due to the closure of land that serves as water catchment areas. Therefore, better spatial planning is needed to ensure sustainable growth and a balance between residential development and environmental aspects.

3.5.7 Ricefield

Residential land use in Cibinong District has seen significant growth over the past decade. Residential land area increased from 171.44 hectares in 2009 to 348.17 hectares in 2019. This growth reflects changing demographic dynamics and rapid infrastructure development in the region. In 2009, residential land area in Cibinong District was recorded at 171.44 hectares. During this period, the majority of the settlements consisted of traditional houses, with some housing developments being initiated by private developers. According to the Bogor Regency Central Statistics Agency (BPS) (2010), residential land in Cibinong was still dominated by agricultural and open areas, with inadequate public facilities and basic infrastructure. This resulted in several areas in Cibinong being classified as underdeveloped, outlying areas. However, in 2019, residential land area in Cibinong District increased to 348.17 hectares. This increase was driven by factors such as continued urbanization, economic growth, and investment in the property sector.

Data from the Bogor Regency Housing and Settlement Agency (2019) shows that housing development, both subsidized and commercial, is increasing to meet the demand for decent housing. Furthermore, improvements in transportation infrastructure, including road accessibility and public facilities, have also driven residential growth in the area, making it an attractive option for residents migrating to the area. While residential land growth offers benefits in the form of increased housing access, challenges also arise. Increased population density can lead to problems such as traffic congestion, the need for better public facilities, and environmental impacts. The reduction in green open space as a result of residential expansion can reduce the quality of the environment and the ecological

function of the area. Therefore, it is important for local governments to implement sustainable spatial planning policies, ensuring that residential growth not only meets housing needs but also maintains environmental balance and the community's quality of life.

3.5.8 Moor

Dryland use in Cibinong District has experienced a significant decline over a ten-year period, from 1,566.23 hectares in 2009 to 305.41 hectares in 2019. This decline reflects changes in land use patterns caused by various factors, including urbanization and land conversion. In 2009, dryland in Cibinong District reached 1,566.23 hectares. This dryland serves as an area for growing various types of crops, such as vegetables, rice, and other secondary crops. According to the Bogor Regency Central Statistics Agency (BPS) (2010), dryland is an important part of subsistence agriculture, providing income for many local farmers. The presence of dryland also contributes to food security in the area. However, in 2019, the area of dryland decreased drastically to only 305.41 hectares.

This decline is caused by several main factors, namely land conversion for residential and infrastructure development, as well as pressure from population growth, which drives the need for larger residential spaces. The Bogor Regency Agriculture Office (2019) noted that many farmers are shifting from dryland to other agricultural activities or even abandoning agriculture altogether, due to the inability to compete with rising land prices due to urban development. This decline in dryland area has serious impacts on food security and agricultural sustainability in Cibinong District. The reduction in agricultural land can lead to increased dependence on food supplies from outside the region, potentially increasing food insecurity at the local level. Furthermore, the loss of dryland has the potential to reduce biodiversity and disrupt the balance of local ecosystems. Therefore, efforts are needed to protect remaining agricultural land, as well as develop policies that support sustainable agriculture and protect agricultural land from conversion to non-agricultural land.

4. Conclusion

Land use changes in Cibinong District between 2009 and 2019 showed significant trends, reflecting the dynamics of rapid demographic, economic, and urban growth. The analysis revealed a substantial increase in residential land, from 171.44 hectares to 348.17 hectares, indicating high demand for housing due to population growth and infrastructure development. Meanwhile, dryland areas experienced a drastic decrease, from 1,566.23 hectares to 305.41 hectares, indicating significant land conversion for non-agricultural purposes. Meanwhile, land for industrial use and water bodies also experienced changes, with the increase indicating a shift in economic focus from agriculture to industrialization and urbanization. The decline in green open land and dryland areas could have serious impacts on food security and environmental quality in Cibinong. Therefore, it is crucial for the government and stakeholders to implement sustainable spatial planning policies that not only address the need for infrastructure and residential development, but also maintain ecosystem balance and agricultural sustainability. With right steps, it is hoped that land use in Cibinong District can be directed to support sustainable and quality growth.

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Author Contribution

The author independently conducted the research, including the design, data collection, analysis, and manuscript preparation.

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The author declare no conflict of interest.

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