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Land Use Change Analysis in Jatinangor, West Java Using Satellite Imagery (2014–2025)

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***Abstract*—** *Land use changes in an area can develop based on population growth, infrastructure development, or the needs of the local community. The study area is Jatinangor District, which is also one of the buffer areas of Bandung City, therefore, in recent years it has experienced quite significant land use changes. This study aims to determine and identify changes in the area and distribution of land use during the period 2014-2025. The study uses Google Earth satellite image data (2014 and 2025) processed using ArcGIS software. The data processing process uses image interpretation elements with modified land use classifications. The results of the study show that there are quite significant changes in land use between 2014 and 2015, namely a decrease in forest area from 570.94 hectares (22.46%) to 469.20 hectares (18.46%), agricultural area from 1018.51 hectares (40.07%) to 869.94 hectares (34.23%), and an increase in built-up area from 944.18 hectares (37.15%) to 1193.22 hectares (46.94%), as well as other land uses from 8.11 hectares (0.32%) to 9.38 hectares (0.37%). These findings suggest that during this period there was an increase in the built-up areas related to population growth, economic growth, infrastructure development, and increasingly dispersed community activity centers. Therefore, special attention is needed in the long-term planning of the Jatinangor area to maintain the quality of spatial and regional planning in the future. The local government and residents of the Jatinangor area must work together to maintain sustainable land use.*

***Keywords*—** *Google Earth, Jatinangor, Land Use, Remote Sensing, Satellite Imagery.*

I. INTRODUCTION

Land use is the human utilization of the Earth's surface, demonstrating the interaction between social and economic activities and the physical environment within a particular area [1,2]. Land use patterns can evolve dynamically in line with population growth, infrastructure development, and changing needs within an area [3,4]. Land use can be a key indicator in seeing changes or dynamics within an area, for example, natural land such as forests becoming settlement areas, industrial areas, or other built-up areas.

Land use changes often occur in various regions, both in developed and developing countries such as Indonesia [5,6]. Population growth, urbanization, and the expansion of residential areas, industrial areas, and educational centers or facilities are some of the factors driving land use change. In Indonesia, this phenomenon can occur in various buffer zones of large cities where changes in land use can increase along with limited land for people to live in [7,8].

Land use changes that are not properly monitored and regulated can result in various environmental problems [9,10] that have an impact on social problems within the area. Some environmental problems that occur include increased surface runoff, decreased soil infiltration capacity, and decreased environmental quality [11–13]. In addition, changes in land use can disrupt the sustainability and balance of existing ecosystems.

Jatinangor District, West Java Province, is an area that has developed rapidly in recent years, evidenced by the construction of several educational areas or facilities (Universitas Padjadjaran, Bandung Institute Technology, Ikopin, and IPDN), settlement areas, industrial areas, and infrastructure [14,15]. These developments are interrelated and influence changes in land use. For example, the development of educational areas or facilities increase the demand for housing, leading to the expansion of settlement areas in Jatinangor and its surroundings. These land use changes gradually reduce agricultural and vegetated areas.

Based on these considerations, a study on land use changes in the Jatinangor area is considered very important to provide spatial information on land use dynamics that have occurred in recent years. This information is expected to be used as evaluation material for regional development directions, as well as recommendations for environmental management and regional planning to benefit the local community. In addition, this study is expected to help identify and understand potential future trends in land use changes so that their impacts on the environment and society can be prevented or minimized

Studies on land use and earth science can be conducted using a remote sensing and Geographic Information System approach [16,17]. Satellite imagery-based remote sensing is an effective method for monitoring land use change over long periods and across large areas [18–21]. Satellite imagery can be used to identify land use types periodically and consistently, allowing changes over a specific period to be analyzed quantitatively [22]. This method has been widely used in land use change studies in various regions because it is considered efficient, objective, and capable of covering a wide area.

II. METHODOLOGY

This study was conducted in Jatinangor District, Sumedang Regency, West Java Province, which is administratively located at coordinates 6°53'43.3" S – 6°57'41" S and 107°45'8.5" E –107°48'11" E. Jatinangor has a hilly morphology composed of Quaternary volcanic rocks in the northern part, and gentle slope - flat morphology composed of lake deposits in the southern part [23,24]. Land use in Jatinangor is diverse as a result of intensive

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development in the area. Therefore, the Jatinangor area is considered suitable for further study.

This study uses primary data obtained from Google Earth satellite imagery acquired in May 2014 and August 2025. These two image data were chosen because they are considered to represent the dynamics or changes in land use that have occurred in the last 10 years in the Jatinangor area. In addition, clear image quality without cloud cover is also an important consideration. All spatial data were referenced to the same coordinate system and then processed, analyzed, and interpreted further.

Satellite image data processing was carried out using ArcGIS 10.8 software. This software is used for digitizing, sharpening images, classifying land use, and analyzing data. This software was also used to layout the image processing results into land use maps.

The image data processing stage includes importing satellite images from 2014 and 2025 into ArcGIS software and then clipping them along the boundaries of the study area. The satellite imagery is then identified and delineated into land use classes based on image interpretation elements such as color, tone, texture, pattern, association, etc. After the imagery is divided into land use classes, the area of each class was calculated.

Land use classification in this study was carried out by modifying the land use classification of previous researchers [17,25–27], which was mostly divided into forests areas, agricultural areas, built-up areas, and other land uses. These land use classes were established to help identify natural land such as forests or agricultural areas, into human-modified areas, such as settlements and roads. Land use analysis was carried out by comparing the area of each land use class in 2014 with 2025 to obtain the percentage of land use changes.

III. Result and Discussions

A. Satellite Imagery of Jatinangor Area

Google Earth satellite images of the Jatinangor area in 2014 and 2025 show a clear surface view of land use in the area over the past 11 years. Both the 2014 and 2025 images show good quality, without cloud cover, making land use identification easier. The images also clearly demonstrate changes in land use between the two observation years.

In the 2014 satellite image, the Jatinangor area is still dominated by forest areas (dense vegetation) and agricultural areas, especially in the eastern and northern parts of the study area. Built-up areas are mostly concentrated in the central to southern parts of the study area, with settlement patterns spread throughout the area. A closer look reveals that agricultural areas are still quite numerous, appearing as rice paddy fields, indicating that human activity is already widespread.

The 2025 satellite image shows clear visual changes compared to the 2014 satellite image. This can be observed from the expansion of built-up areas in several locations, especially in the northern, eastern, and central parts of the study area. Settlements appear more numerous and more widely distributed across Jatinangor. In addition, toll road construction is visible in the northern and western parts of the study area. Meanwhile, the industrial areas in 2025 do not show significant changes compared to 2014.

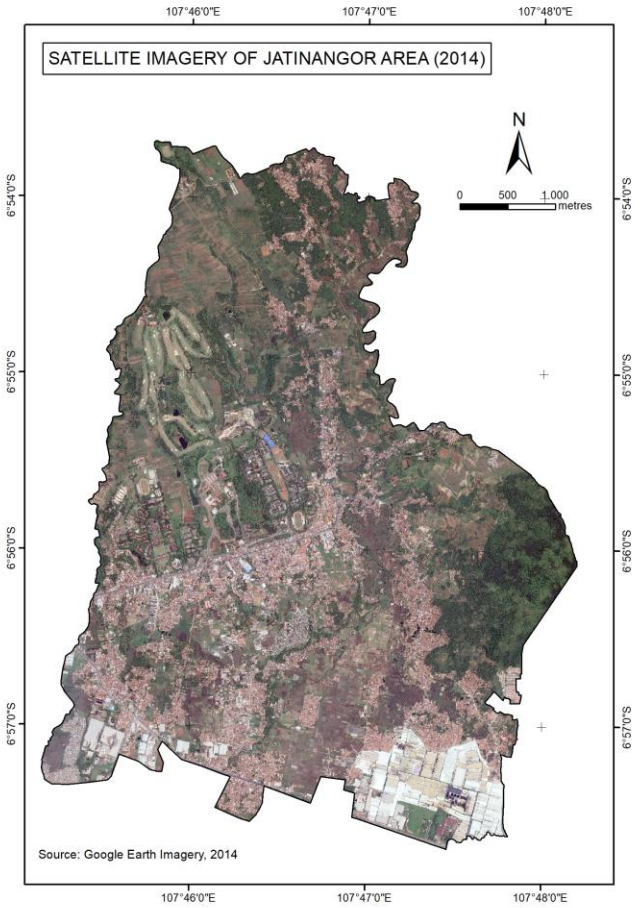

Fig. 1. Satellite image of Jatinangor area (2014).

Based on the Fig. 1 and Fig. 2, there is a fairly clear change between the 2014 and 2025 satellite images, namely an increase in built-up areas such as settlements and infrastructure, accompanied by a decrease in natural land such as forests. This change is indicated by the reduction of green areas indicating dense vegetation and agricultural areas as well as the increase in reddish-brown areas indicating settlements and white areas indicating toll roads.

In addition to changes in area, satellite imagery also shows changes in the spatial pattern of land use in the Jatinangor area. In 2014, the distribution of built-up areas, such as settlement areas, were concentrated in the central part of the study area. However, settlement areas expanded and became more widespread in 2025. The construction of toll roads also reflects the increasing need for transportation infrastructure to support development in Jatinangor and its surrounding areas.

The results of the identification and interpretation of these satellite images provide important data for further land use class analysis. Therefore, the results of the area calculations for each land use class will be discussed in the following section. Both the 2014 and 2025 satellite images provide essential data for analyzing the dynamics, direction, and patterns of future land use development in the Jatinangor area.

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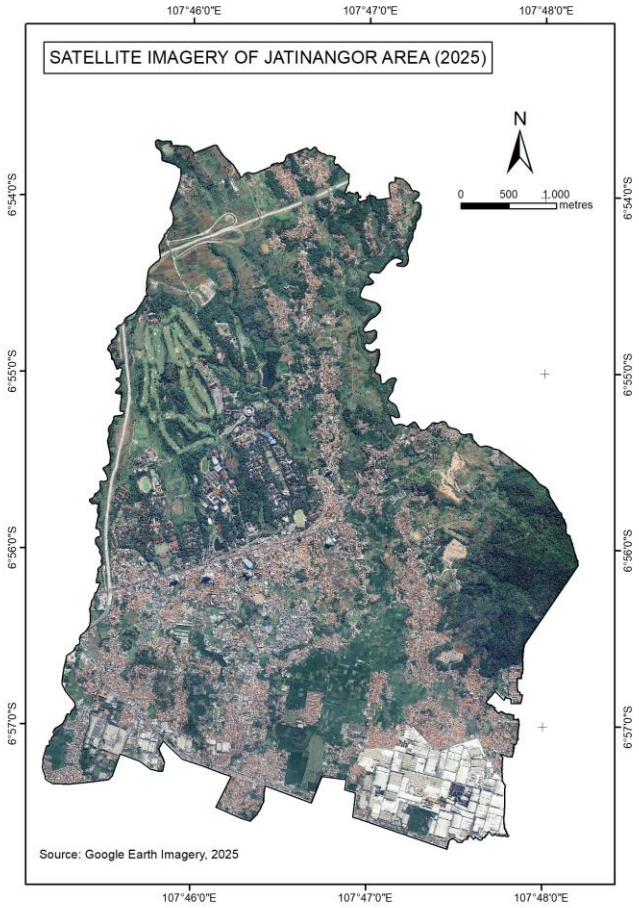

Fig. 2. Satellite image of Jatinangor area (2025).

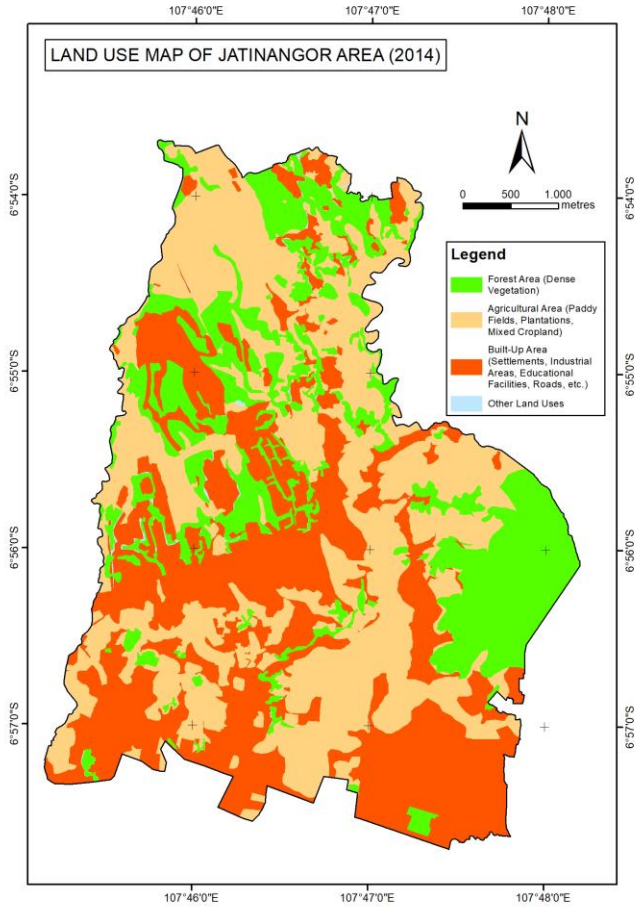

Fig. 3. Land use map of Jatinangor area (2014).

B. Land Use of Jatinangor Area

A clear analysis of land use in the Jatinangor area can be carried out by comparing two satellite images from 2014 and 2025. In both years, changes in the area and distribution of land use can be observed and analyzed. In general, land use classes can be divided into three main classes, namely forest area (dense vegetation), agricultural area (paddy fields, plantations, mixed cropland), and built-up area (settlements, industrial areas, educational facilities, roads, etc.). Areas that are not included in the three classes are categorized as other land use class. Land use changes in 2014 and 2025 indicate the dynamics of regional development, which are influenced by human activities and infrastructure development.

Based on satellite image analysis in 2014 (Fig. 3), land use in the Jatinangor area consists of forest area with an area of 570.94 hectares (22.46%), agricultural area with an area of 1,018.51 hectares (40.07%), and built-up area with an area of 944.18 hectares (37.15%). In 2014, agricultural areas had fairly wide coverage area in the northern and central parts of the study area, adjacent to built-up areas distributed across the central to southern parts of the study area. Meanwhile, forest areas were mostly found in the northern and eastern parts of the study area.

Satellite image analysis in 2025 (Fig. 4) shows several significant changes compared to 2014. Changes occurred in almost all land use classes, namely forest areas decreased to 469.20 hectares (18.46%), agricultural areas also decreased to 869.94 hectares (34.23%), while built-up areas increased significantly to 1,193.22 hectares (46.94%). These changes indicate substantial land conversion from natural land to built-up areas on a relatively larga dcae.

Identification and interpretation of satellite imagery in 2014 and 2025 show that changes in land use in the Jatinangor area are strongly influenced by activity centers carried out by local communities. The results indicate the expansion of built-up areas, such as settlement and industrial areas, which are often close to the road network. In addition, the significant decrease in forest areas indicates increasing pressure and urgent needs related to settlement provision and infrastructure development. The reduction in agricultural areas reflects a decline in agrarian function in the Jatinangor area and when examined further, suggests a shift in the character of the local community. Other land use classes with very small areas (less than 0.5%) in 2014 and 2025 do not show significant changes, despite a slight increase in area. However, the results of satellite image processing and analysis in this study do not yet assess the accuracy of the results, so further study is needed to verify them.

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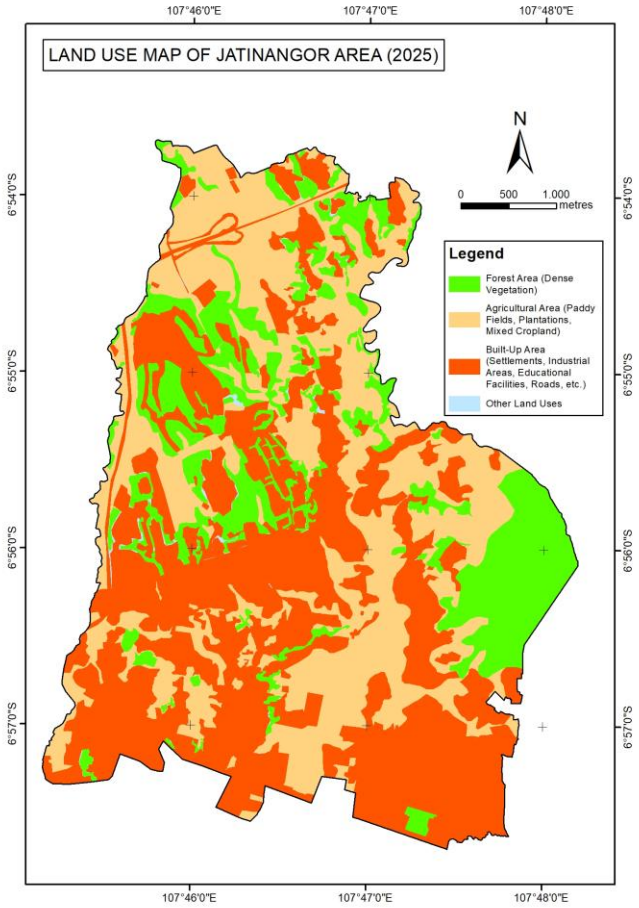

Fig. 4. Land use map of Jatinangor area (2025).

In general, the Jatinangor area experienced significant land use changes during 2014-2025, marked by the dominance of built-up areas. Therefore, special attention is needed in the long-term planning to maintain the quality of spatial and regional management in the future. The local government is required to monitor land use sustainability in the Jatinangor area in response to significant land use changes. The local communities are also expected to manage land use around their settlement areas more responsibly.

TABLE I. Land use of the study area (2014 and 2025)

Land Use	Area	
	2014	2025
Forest Area	570.94 Ha (22.46%)	469.20 Ha (18.46%)
Agricultural Area	1018.51 Ha (40.07%)	869.94 Ha (34.23%)
Built-up Area	944.18 Ha (37.15%)	1193.22 Ha (46.94%)
Other Land Use	8.11 Ha (0.32%)	9.38 Ha (0.37%)

IV. Conclusion

The results of this study indicate that significant land use changes occurred in the Jatinangor area between 2014 and 2025. This can occur due to several factors such as population growth, economic growth, and infrastructure development. These findings also indicate that satellite imagery can help analyze the dynamics or changes in land use in the Jatinangor area effectively. However, further research is needed to test the accuracy of the satellite image processing results. The land use map as a result of this study is expected to be one of the important parameters considered in creating and regulating policies on future spatial and regional management in Jatinangor.

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