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(Research Article)

Analysis of The Existing Condition of Cibangreng Lake Lebak Regency

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Abstract: Lakes have strategic potential and benefits that are beneficial both ecologically and economically, including as part of a region's water management system, reservoirs, water catchment areas, inland fisheries cultivation locations, part of irrigation systems, and potential as tourist attractions. Most research on lakes in Indonesia is conducted by analyzing water quality and tourism conditions in the lake. Meanwhile, this study will discuss the analysis of existing conditions by considering the type of land use in the Situ Cibangreng area, Lebak Regency, and the analysis of indications of the Situ Cibangreng area in Lebak Regency, Banten Province, West Java. The method used in this study is qualitative analysis. During the data collection stage, the research team will explore the study area through field observations to obtain a general picture of conditions within the Situ area. The survey method is carried out using Topographic Measurement Methods, Geographic Information Systems (GIS), 3.2.2 Aerial Photography with Drones/UAVs and using Spatial Data Analysis. Based on field observations, Situ Cibangreng is located in Muaradua village, Cikulur district. There are several types of land use in this area, including: 1) built-up land use: housing and road networks; 2) use of non-built land, including mixed gardens and food crop areas (rice fields). The aerial mapping results provide a detailed picture of the existing conditions of Situ Cibangreng, including inundation boundaries, surrounding land use patterns, and indications of changes in the lake's morphology. This data serves as a crucial basis for hydro-logical analysis, lake normalization planning, and zoning of the boundary area to maintain the ecological function and sustainable capacity of Situ Cibangreng.

Keywords: Aerial Photography; Cibangreng; Existing Condition; Lake; Lebak Regency.

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1. Introduction

Indonesia's diverse topography and abundant water resources are abundant. This water availability must be utilized optimally to meet raw water needs. Optimizing raw water use, especially during the dry season, requires reservoirs, both artificial and natural. Water resources are dynamically flowing and interact with other resources, so water management impacts the surrounding environment, such as agricultural land, irrigation, livestock, and so on (Fauzi & Permana, 2023). Therefore, infrastructure is needed to effectively manage this water Water structures to store water, especially during the rainy season, such as reservoirs and lakes/ponds, are needed, especially with the current climate change conditions, so that water shortages can be minimized (Sari et al., 2024).

Lakes provide high levels of biodiversity at the genetic, species, population, functional group, and food web levels. Lakes also play a role in mitigating the impacts of climate change through carbon sequestration and hydrological buffering, sediment and nutrient retention and processing, and supporting various activities in the fisheries, transportation, recreation, and tourism sectors (Tanjung et al., 2024). Lakes and swamps, as part of the watershed (DAS) system, serve important functions, including water retention for flood control, water resource

conservation (groundwater supply), local economic development, and recreation. In flood mitigation, lakes play a crucial role as water retention basins, reducing runoff and retaining water. Maintaining the quality of lakes' area and depth is an integral part of flood mitigation efforts. Lakes, which are natural reservoirs, serve as water reservoirs or catchment areas, groundwater reserves, urban air conditioning, flood control, water sports tourism, wildlife habitats, cultivation media, and enhancing urban beauty. This demonstrates the importance of lakes, as they have ecological, economic, educational, and aesthetic value (Mohamad et al., 2021).

Based on PUPR regulation no. 28/PRT/M/2015 concerning the determination of river boundary lines and lake boundary lines. That a lake is a part of a river whose width and depth naturally far exceed other sections of the river concerned In relation to the definition of a lake, it is specifically stated that a lake is classified as a surface water source, which is a term in Sundanese which means a natural or artificial lake but the size of the lake is relatively small compared to a lake A lake is a water reservoir above the surface of the ground that is formed naturally or artificially whose water comes from the ground or surface water as a hydrological cycle which is one form of protected area.

Urban lakes are crucial ecological and recreational assets within urban areas, significantly enhancing urban resilience (Wang & Cheng, 2024). Lakes have strategic potential and benefits that are useful both ecologically and economically, including as part of the water management system in a region, water reservoirs, water catchment areas, inland fisheries cultivation sites, part of the irrigation system and the potential to become tourist attractions. In an effort to improve and make healthy all ecological components (flora and fauna) and hydrological systems (water systems), lakes or situ must be able to carry out their natural functions, namely being able to hold water that can be used for community needs, absorb rainwater to replenish groundwater and develop into a natural and sustainable lake ecosystem. The function of lakes is to supply air to downstream areas, provide irrigation, control flooding, and provide recreation. If properly managed, lakes will function optimally as life support. According to the Directorate General of Water Resources, West Java province has 182 lakes (Mohamad et al., 2021). Based on data released by the Indonesian Institute of Sciences (LIPI) in 2020, Indonesia is estimated to have more than 1,575 lakes, consisting of 840 large lakes and 735 small lakes (situ) (Dianto et al., 2020). Many lakes in Indonesia are damaged by sedimentation, pollution, eutrophication, and declining water quality and quantity. Meanwhile, Indonesian lakes are primarily used for hydroelectric power generation, agriculture, fisheries, clean water sources, culture, religion, and tourism (Soeprobowati, 2015).

There are 137 lakes spread throughout Banten recorded as assets on the Asset Inventory Card (KIB) of the Banten Province Regional Financial and Asset Management Agency (BPKAD). Most of these lakes are assets transferred from West Java Province after the province was established, along with inventories from other agencies. Given the importance of securing Banten Province's regional assets (BMD), it is crucial to certify Situ Cibangreng to provide legal certainty; provide legal protection to land rights holders; enforce orderly administration; and secure Banten Province's BMD assets. This effort also serves to save and preserve the lakes in the Banten region. Like other inland water resources, lakes have strategic potential and benefits that are useful both ecologically and economically, including as part of the water management system in a region, water reservoirs, water catchment areas, inland fisheries cultivation sites, part of the irrigation system and the potential to become tourist attractions.

2. Literature Review

This section presents a comprehensive review of relevant previous research and theoretical foundations related to the existing analysis of a site. 1) reseratch about the benefit of the lake, To ensure optimal and sustainable functioning of reservoirs and lakes, management efforts must focus on safeguarding the reservoirs and lakes, as well as the surrounding areas. Lakes and reservoirs are crucial components of the balance of land use, water use, air use, and other resource use systems. A lake is a container of standing water on the surface of the ground that is formed naturally or artificially which is used as a source of raw water originating from the ground, rainwater and/or other water sources (Ministry of ATR/BPN 2019). In its management, the lake has the main function of storing water and preventing flooding (Saputra et al., 2023). 2) research on the Identification of Existing Conditions of Situ Cidanti to Meet Water Needs for the Community in Gunung Sari Village, in the study explained that Situ Cidanti is used for irrigation, fisheries, livestock, and raw water needs for the community

of Gunung Sari Village. The results of the field investigation showed damage to Situ Cidanti, especially in the outlet work section, the distribution pipes are still incomplete, the lake is not equipped with spillways, and the road access has not been paved (Sari et al., 2024). 3) research about Analysis Of The Physical Potential Of Situ Gunung Natural Tourism As A Tourist Destination In Kadudampit District, Sukabumi. This research explain that based on the analysis of the Situ Gunung Nature Tourism map, it shows that most of the area is still covered by forest, with significant potential. Forests protect the land surface, store water, maintain soil fertility, and reduce the risk of erosion. Forests have their own appeal as natural tourist attractions, serving as camping grounds and for other outdoor activities. They also serve as habitats for flora and fauna, contributing to the preservation of the region's endemic flora and fauna (Nurjannah, 2020). 4) a research that explain that lake is a naturally or artificially formed body of water above the surface of the land, its water originating from the ground or surface water as part of the hydrological cycle, and is also a protected area. Meanwhile, the lake boundary or lake boundary is the area of land surrounding and at a certain distance from the edge of the lake body that functions as a protective area for the lake. In the current condition, the lakes in West Java have been disrupted due to human activities in the surrounding area, such as land occupation/building intervention, waste and sedimentation that are pressing on the lake body (Wolok et al., 2024). 5) There is a study that aims to assess the water quality in 5 (five) lakes in Cimahi City so that various policies can be formulated to improve the condition of the lakes. The purpose of the study is to inventory the water quality and the status of the lakes. Lake revitalization is currently a concern of the Ministry of Environment and Forestry of the Republic of Indonesia. This is evidenced by the issuance of Regulation of the Minister of Public Works and Public Housing of the Republic of Indonesia Number 28/PRT/M/2015 concerning the Determination of River and Lake Boundaries (Wardhani et al., 2023). 7) There is also research that aims to identify the incompatibility of land use in South Tangerang City with spatial planning, especially at the Situ Ciledug location, as evaluation material and material for subsequent policy making (Choiriyyah et al., 2023).

Based on various previous studies that are relevant to this research, there has been no research that discusses the existing analysis of Situ Cibangreng in Lebak Regency. Most research on lakes in Indonesia has been conducted by analyzing water quality and tourism conditions in the lake. Meanwhile, this study will discuss the analysis of existing conditions by considering the type of land use in the Situ Cibangreng area of Lebak Regency, and an analysis of the area indications of Situ Cibangreng in Lebak Regency, Banten Province, West Java.

3. Proposed Method

The method used in this research employs qualitative analysis. During the data collection phase, the research team will explore the study area through field observations to gain a sense of the conditions within the Situ area. The team will write down and record anything deemed relevant to a deeper understanding of the study area. Equally important, the team will conduct numerous interviews and discussions with stakeholders to gather their input on the condition of the study area. This data collection can include both primary and secondary data. This research requires data obtained using two techniques: primary data collection and secondary data collection. (1) Primary Data: Primary data collection was conducted directly and was carried out as follows: Field observations of the research object profile (Situ Cibangreng, Lebak Regency, Banten Province, West Java), including physical data of the area, existing facilities, etc. Documentation was obtained from direct surveys of the research object. And Interviews were conducted with local residents, tourists, traders, and employees of relevant government agencies. (2) Secondary Data: Secondary data was collected from several related research institutions and various relevant sources such as books, journals, government documents, and internet sources.

Description of the Research Location

Lebak Regency is a regency in Banten Province, with its capital in Rangkasbitung District. Geographically, Lebak Regency is located between 105°25' and 106°30' east longitude and 6°18' and 7°00' south latitude. It covers an area of 291,230 hectares. Cibangreng Lake is geographically located at 6°25'29.99"S South Latitude and 106°8'55.64"E East Longitude. Administratively, it is located in Muaradua Village, Cikulur District, Lebak Regency. Cibangreng Lake is a natural lake, formed by nature. Its function is to irrigate the surrounding gardens and rice fields, as well as a water source

for household needs. Some residents earn their living as farmers, both in agriculture and plantations, utilizing the water source from Cibangreng Lake for irrigation. According to the 2021 Goods Inventory Card (KIB), the area of Cibangreng Lake, as recorded in the document, is 5,000 m^2, or 0.5 hectares.

Situ Cibangreng has 2 inlets (water inlets) and 2 outlets (water outlets) which function to regulate the circulation of incoming and outgoing water so that the lake continues to function as a source of agricultural irrigation, control of minor floods, and support for the local ecosystem.

Survey Method

Topographic Measurement Methods

A topographic survey is a method for determining the position of man-made and natural features on the land surface. Topographic surveys are also used to determine terrain configuration. The purpose of a topographic survey is to collect the data needed to create a topographic map. A topographic map displays the character of vegetation using similar markers, such as the horizontal distances between features and their respective elevations above a specific datum.

Aerial Photography with Drone/UAV

Geomatics is an integrated approach to measuring, analyzing, and managing the description and collection of information about the physical earth and its environment, often referred to as spatial data. It has played a crucial role since the beginning of human civilization. It began with measuring and marking boundaries on private land. Over time, the importance of geomatics has increased, with the growing demand for maps and other types of spatial information and the expanding need to establish accurate lines and to assist with construction projects. Today, the role of measuring and monitoring our environment is becoming increasingly important, due to the increasing human population, the increasing price of land, the depletion of our natural resources, and the decline in the quality of our land, water, and air.

Geographic Information System (GIS)

A Geographic Information System (GIS) is generally a specialized information system that manages data containing spatial information. A GIS is also a type of software that can be used to input, store, manipulate, display, and output geographic information and its attributes. Geographic information is data placed in the context of space and time. A Geographic Information System (GIS) is a computer-based system typically used to store, manipulate, and analyze geographic information. Before the advent of Geographic Information Systems (GIS), information about the Earth's surface was presented in manually created maps. GIS allows computer processing of these map components, resulting in digital maps.

Spatial Analysis

The role of spatial planning is essentially to achieve optimal resource utilization, thereby preventing environmental damage and increasing social harmony. From the perspective of regional planning and development, land use is a form of human effort in utilizing natural resources/land, which includes business components. Within the scope of spatial planning, land use in the boundary area becomes an inseparable part of the concept of space in development (Junus & Mamu, 2019).

4. Results and Discussion

There are 2 (two) factors that can cause a difference in the area of the lake between the data on the Goods Inventory Card (KIB), namely Internal and external factors. Internal factors include the measurement techniques used (methods and tools); and errors in inputting measurement data. While in External Factors, among others, due to Natural Factors, namely sedimentation, Non-Natural Factors (Society), namely: 1) Abuse of land ownership rights or recognition of land that is not theirs; 2) The absence of clear lake boundary markers resulting in massive land grabbing in the lake boundary area; 3) Lack of awareness of all parties about the importance of lakes to support environmental ecosystems; 4) The increasing need for community land causes misuse of space utilization, where the lake boundary land is a protected area but in the existing form of cultivated land; 5) Lack of awareness of all parties about the importance of lakes to support environmental ecosystems.

Figure 1. Physical Image of Situ Cibangreng in 2024.

Types of Land Use in the Cibangreng Lake Lebak Regency area

Based on initial information from field observations, Situ Cibangreng is located in Muaradua village, cikulur district. several types of land use are found in the area, including: 1) built-up land use: residential buildings and road networks; 2) non-built-up land use, including mixed gardens and food crop areas (rice fields).

Figure 2. Existing Condition of Situ Cibangreng.

Surveys show that during the rainy season, the Cibangreng Lake reaches its highest water level of 2 meters and has two inlets and two outlets. For more details, see the following image.

Based on field observations at the study site, Situ Cibangreng has various types of land use. For more details, see the following table.

Table 1. Conditions of Land Use Around Situ Cibangreng.

No	Land Utilization	Existing Photo
1	Settlement	
2	Ricefield	
3	Mixed Garden	
4	Road Network	

* Source: Team Survey Results in 2025

Measurement Results

Field Measurement

Measurements were conducted at Situ Cibangreng, Muaradua Village, Cikulur District, Lebak Regency. To establish boundaries and measure the lake, an inventory and identification of the ownership status of the land directly adjacent to the lake were first conducted. The inventory survey identified the land directly adjacent to the lake as follows.

Table 2. Owner of the Land Bordering Situ Cibangreng.

No	Field Owner	Sources	Land [m²]
1	Anak	SPPT	134
2	M Syahril	Certificate	3.847
3	Nurhayati	SPPT	1.154
4	Ruminah		
5	Suherti	SPPT	134
6	Susilawati	SPPT	134

After conducting an inventory and identifying the land status, the boundaries of the land and the lake were marked and measured. The measurement method used was a GPS

RTK (Regional Land Use Network) system with a positional accuracy of approximately 1-5 cm, provided that phase ambiguity could be correctly determined.

The GPS RTK measurements revealed an area of Situ Cibangreng of 5,929.951 m². There is a gap between the measured area and the data on the Goods Inventory Card (KIB). Further details can be found in the following table.

Table 3. Comparison of Measurement Area and Inventory Card Area.

No	Lake	Area Based on Measurement Results (m2)	Area Based on Inventory Card (m2)	Difference (m2)
1	Cibangreng	5.929,951	5.000,000	929,951

The difference in the area of the lake from the measurements and the KIB data at Situ Cibangreng is 929,951 m². Meanwhile, the results of the area depiction can be seen in Figure 3 as follows

Figure 3. Situation Map of Cibangreng Situ.

Longitudinal and Transverse Measurements

Cross-sections and longitudinal sections of Situ Cibangreng were compiled based on topographic surveys conducted in and around the lake. Data were collected at several observation points representing the physical conditions of the water and the lake's bottom contour. Measurements indicate that the lake's bottom slope is relatively gentle in the center and begins to steepen toward the western and southern edges, which constitute the main water catchment area.

The cross-sections show that the lake's maximum depth reaches approximately 3 meters in the center, with a bottom elevation of approximately 32 meters, while the average water level is approximately 27 meters. The bottom slope pattern indicates the presence of fine sediment deposits on the northern edge, indicating silting due to surface runoff from surrounding plantations and agricultural lands. The longitudinal sections, on the other hand, follow the main flow direction from west to east, indicating a relatively stable decrease in bottom elevation. Water depth fluctuates between 0.5 and 3 meters, indicating that the bottom is still capable of accommodating the volume of water required for its hydrological function. From the cross-sectional and longitudinal analyses, it can be concluded that Situ Cibangreng still has good water holding capacity, but is beginning to experience sedimentation in some areas of the banks. Therefore, regular normalization and sedimentation control activities are necessary, particularly at the inlet on the west side and the outlet on the east side

of the lake, to maintain the stability of the lake's function as a water reservoir, flood control, and water resource for the surrounding community.

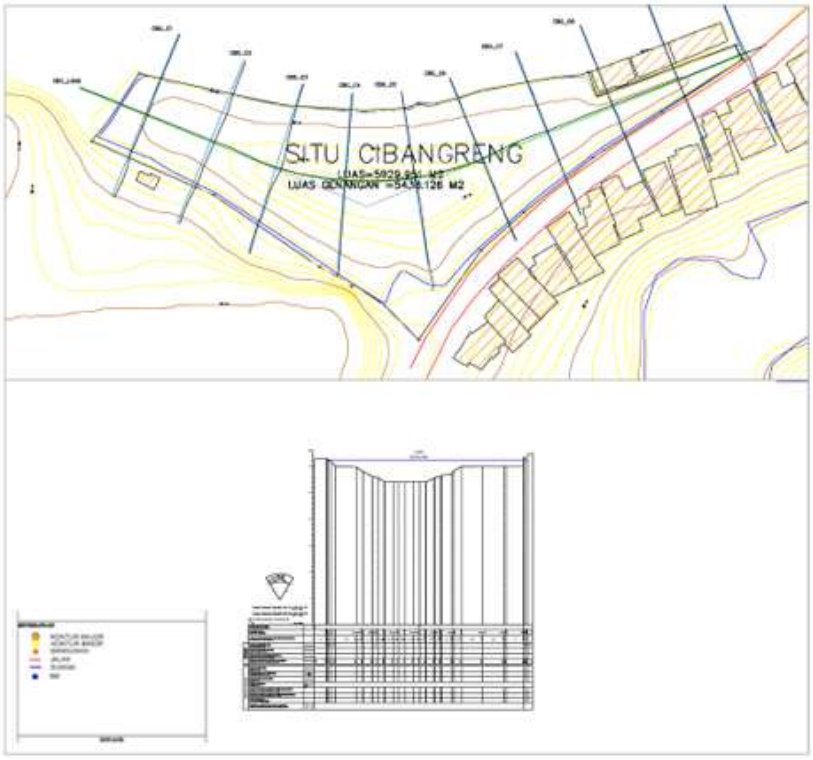

Figure 4. Situ Cibangreng Longitudinal Cut.

Soucres: Measurement Results in 2025

Figure 5. Cross Section 1 of Situ Cibangreng.
Soucres: Measurement Results in 2025

Aerial Mapping Results

Aerial mapping of Situ Cibangreng was conducted using drone technology using aerial photogrammetry to obtain high-resolution spatial imagery. Data collection was conducted under clear weather conditions to achieve optimal visual results, with an average flight altitude of 100 meters above ground level and a horizontal accuracy of ±5 cm. The aerial mapping results provide a detailed picture of the existing condition of Situ Cibangreng, including inundation boundaries, surrounding land use patterns, and indications of changes in the lake's morphology. This data serves as a crucial basis for hydrological analysis, lake normalization planning, and zoning of the boundary area to maintain the ecological function and sustainable capacity of Situ Cibangreng. The concept of digital photogrammetry processing is to use a single mathematical formula to transform 2D photos into 3D geometry. At least two photos are required so that the 3D geometry of the object can be calculated using perspective projection transformation formulas. A brief summary of the mapping product processing process is as follows:

1) Contour : UAV Data → DSM (Digital Surface Model) → DTM (Digital Terrain Model) → Contour/Topography.
2) 3D Model: Orthophoto (Aerial Photo) → Contour/Topography → 3D Model

The results of the aerial mapping can be seen in Figure:Figure. Digital Surface Model (DSM) Map of Situ Cibangreng (Souce : Measurement Results in 2025)

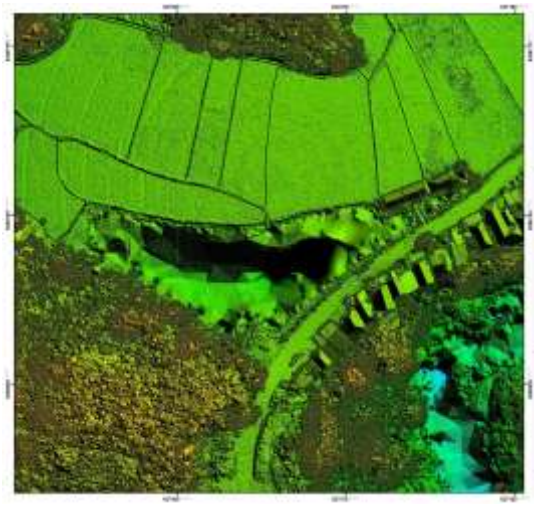

Figure 6. Digital Surface Model (DSM) Map of Situ Cibangreng.

Figure 7. 3D Model of the Cibangreng Situ Site.

Spatial Analysis

Spatial analysis is a method of identifying the location and extent of lakes based on spatial structure and spatial patterns. Generally, in the spatial structure, lake locations are listed as other network infrastructure, as water resources, and in the spatial pattern, they are mapped as lake/lake areas or protected areas with local protection.

Spatial pattern analysis involves a location identification process, where a lake represents a water resource (lake) or a protected area with local protection. The method used in this process is to overlay the lake location with the Lebak Regency spatial plan map and the Banten Province currency map. The input used is Lebak Regency Regional Regulation No. 7 of 2023 concerning the Lebak Regency Spatial Plan for 2023-2043 and Banten Province Regional Regulation No. 1 of 2023 concerning the Banten Province Spatial Plan for 2023-2043. For more details on the results of the spatial pattern analysis, see Table below.

Typographic Modeling Analysis

Topographic analysis was conducted by identifying and overlaying the measurement maps onto topographic maps obtained from processing aerial photography data. The modeling results indicate that the topography in the Situ Cibangreng area is dominated by flat to gently sloping landforms with elevations ranging from ±25 to 40 meters above sea level (masl). The center of the lake is a natural basin that serves as the main water reservoir, while the edges show mild slopes ranging from 2–8%. This condition indicates that Situ Cibangreng was formed naturally from a topographic depression that receives surface runoff from the surrounding water catchment area. Areas in the west and south show relatively close contours indicating a more significant difference in elevation. This modeling also helps in identifying flood-prone zones and areas potentially experiencing mild erosion around the lake boundaries. For more details, see from the figure 8.

Tabulating analysis results is a way to simplify the presentation of the overall analysis results and to see the interrelationships between them. For more details, the tabulation of the analysis data from the activity "Completeness of the Legality of the Situ Cibangreng Land Plot in the Context of Securing the Administration of Regional Property in the Lebak Regency Area" is as follows

Table 4. Situ Location Analysis Table based on Spatial Pattern Plan.

No	Spatial Planning	Cut on the Map	Area Function
1	Lebak Regency Regional Regulation Number 7 of 2023		Flood Control and Water Resources
2	Banten Provincial Regulation No. 1 of 2023		Flood Control

Table 5. Tabulation Table of Lake Area Analysis Results

Area based on KIB (m^2)	Area Measurement Results (m^2)	Differences (m^2)	Spatial (RTRW . Lebak Regency)	Spatial (RTRW Pro. Banten)	Topographic Modeling (m^2)
5.000	**5.929,951**	**929,951**	**Flood Control and Water Resources**	**Flood Control**	**The area of the lake inundated by topographic modeling is 5.438,126 m^2**

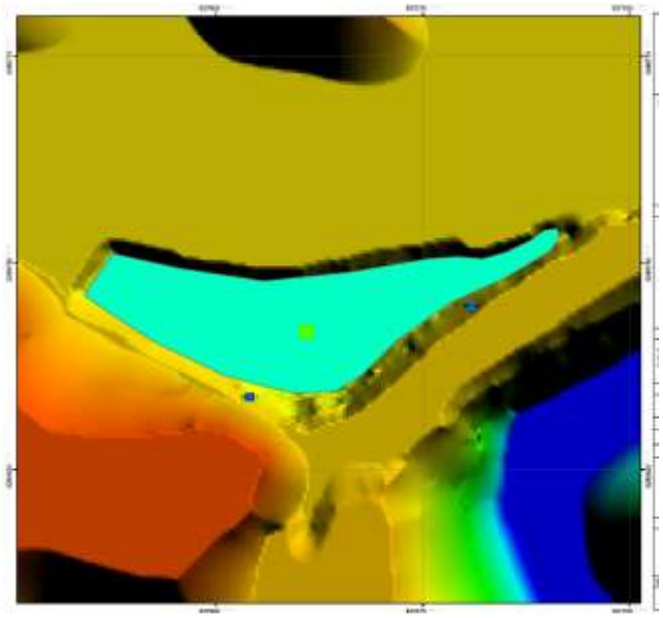

Figure 8. Topographic Map of Cibangreng Lake.

5. Comparison

Previous research on lakes in Indonesia mostly discussed the tourism potential of lakes in a region, such as research on the development of tourism at Lake Sidomukti into an ecotourism area. (Wijayanti et al., 2022), Research on the concept of spatial planning of Situ Bagendit as a natural tourism area with a protected function in Garut Regency (Darsiharjo, 2016), Revitalization of Situ Tipar as a New Tourist Attraction in Depok City (Mohamad et al., 2021), and research on the lake that examines the water quality in the lake (Widyana & Widiyastuti, 2013) (Wardhani et al., 2023), and research on lake management which explains that although "Situ" plays a vital role in maintaining the balance of urban water systems, they have not received sufficient attention in the planning of the government (Pambudi, 2021). There has been no scientific study regarding the analysis of existing lakes in Lebak Regency, Banten Province, especially regarding Cibangreng Lake.

6. Conclusions

Administratively, Situ Cibangreng is located in Muaradua Village, Cikulur District, Lebak Regency. The area of Situ Cibangreng, as recorded in the KIB (Product Inventory Card) document, is 5,000 m² or 0.5 hectares. Initial field observations indicate that land use directly adjacent to the lake includes settlements, rice fields, road networks, and mixed plantations.

Accessibility from Rangkasbitung to Situ Cibangreng is supported by arterial and collector roads in good condition. Transportation from Rangkasbitung to Situ Cibangreng District includes the Warunggunung bus route, going from Sampay Market to Gunung Kencana to Malimping. Situ Cibangreng is located next to Jl. Raya Syech Nawawi, making it easily accessible.

The area of Situ Cibangreng, based on the KIB (Inventory Card) is 5,000 m². GPS RTK measurements indicate an area of 5,929,951 m². The difference between the measurements and the inventory card data is 929,951 m². Based on field measurements and recent spatial modeling conducted through topographic surveys and aerial mapping (drone mapping), the actual area of Situ Cibangreng differs from the area stated in the Decree of the Minister of Public Works. There are several types of land use in this area, including: 1) built-up land use: housing and road networks; 2) use of non-built land, including mixed gardens and food crop areas (rice fields). The aerial mapping results provide a detailed picture of the existing conditions of Situ Cibangreng, including inundation boundaries, surrounding land use patterns, and indications of changes in the lake's morphology. This data serves as a crucial basis for hydrological analysis, lake normalization planning, and zoning of the boundary area to maintain the ecological function and sustainable capacity of Situ Cibangreng.

Functionally, Situ Cibangreng serves as a natural reservoir, helping control water volume during the rainy season, thereby reducing the potential for flooding in the surrounding area. Furthermore, during the dry season, the lake provides water for agricultural irrigation, maintaining aquatic ecosystems, and supporting the socio-economic activities of the surrounding community.

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