

Construction of Kedisan Pier to Increase Tourist Visits and Water Quality in Lake Batur, Bali

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Abstract: Kedisan Pier gives a new feel of traveling in Batur, with a concept like a pier in South Korea, but also provides views of Lake Batur and Mount Batur simultaneously. Tourists not only visit restaurants, hot springs, hikes, and stay overnight but can also visit the Kedisan Pier Area. The increase in tourist visits influences the condition of water quality in Lake Batur. This study aims to determine the influence of the construction of Kedisan Pier on tourist visits and the quality of Lake Batur water. This study used a *purposive* sampling method; sampling was carried out at three points representing settlements and agriculture, water bodies/middle of lakes, and dock. The samples were tested for pH and temperature in the field and COD parameters in the laboratory. Furthermore, these three parameters are compared with Class 1 lake water quality standards in Government Regulation 22 of 2021. Based on the results, it is known that the pH and COD in the three locations exceed the class 1 water quality standard, which is 10 mg / L. pH in the range of 9.2 – 9.5. Increased COD concentration compared to the quality standard at point 1 by 127%; Point 2 is 82%, and Point 3 is 144%. Domestic activities cause the high pH and COD values at these three points—the highest COD value in the Kedisan Pier area. The construction of Kedisan Pier impacts the increasing number of tourists but also causes a decrease in Lake Batur's water quality. Based on this, human awareness is needed to increase tourism while maintaining the quality of waters for the future benefit of humans, flora, and fauna. In addition, further research needs to be carried out using other microbiological and chemical parameters to see the quality of Lake Batur waters.

Keywords: Chemical Oxygen Demand; Tourism; Water Pollution.

Introduction

Global tourism has risen slowly since the COVID-19 pandemic in early 2020. The tourism sector has an important role in line with the development and contribution provided through foreign exchange receipts, regional income, regional development, and employment [1]. However, the increase in tourism also has an impact on increasing pollution. The decline in water quality is a global problem of the twenty-first century. This decrease in water quality can potentially cause a reduction in the surrounding community's health. States that one-third of the world's waters are used consumptively for agriculture, industry, households, and tourism. Water pollution is a global issue: water's declining quantity and quality impacts worldwide hygiene and sanitation. Based on the sustainable development goals (SDGs), goal number six on clean water and sanitation impacts improving the quality of global waters [2].

Stated water pollution in the Upper Lake, where the lake is the main source of drinking water for half of the population of Bhopal, India [3]. This can have an impact on flora and fauna and the health of the surrounding community. The United States utilizes two-thirds of surface water; Japan utilizes 90% of surface water, while Germany and the Netherlands use groundwater for needs. However, clean water sources are slowly declining due to industrial, agricultural, domestic, and medical waste pollution[4].

States that the waters of Lake Bandar Kayangan have an important role in human life around it. Cage and other

domestic activities cause high DO and BOD values in Lake Bandar Kayangan Pekanbaru waters [5]. In Lake Limbotu Gorontalis still included light and medium contaminants based on the pollutant index. At the same time, Pb and Cd metal pollution is still in good condition [6].

The source of pollution from Lake Batur comes from agricultural activities, settlements, and tourism, with water pollution levels classified as light pollution [7]. In addition to Lake Batur, Lake Toba which is the largest lake in Indonesia and is the ninth deepest lake in the world. Lake Toba has a major problem, namely the decline in water quality caused by hotel waste, domestic waste, agricultural waste, and aquaculture activities [8]. Activities around the lake can interfere with water quality. Deterioration in water quality can lead to an increase in the content of organic waste, such as phosphorus. Increased phosphorus content can promote the growth of aquatic plants such as hyacinths. The phosphorus, nitrite, and ammonia content has exceeded class 1 and II water quality standards based on the Government Regulation of the Republic of Indonesia Number 82 of 2001 concerning Water Quality Management. The high nitrites, phosphorus, and ammonia content are caused by household waste disposal, agriculture, and cage activities [9]. Based on the Presidential Regulation of the Republic of Indonesia Number 60 of 2021 concerning the Rescue of National Priority Lakes, where there are 15 national priority lakes, including Lake Batur and Lake Toba. Lake rescue efforts, such as the floating net cage permit

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policy (KJA), have been carried out to improve water quality in the lake [10].

In their research on Polluting Sources, Quality, and Level of Lake Buyan Water Pollution in Sukasada District, Buleleng Regency, dominated by COD and BOD parameters caused by domestic pollutants around Lake Buyan. The level of pollution based on the *storet* index is classified as heavily polluted in areas around settlements and agriculture [11]. Analyzed the potential impact of tourism on the water quality of Lake Beratan, which is contaminated by *coliform* bacteria originating from human activities [12].



Figure 1. Kedisan Jetty, Lake Batur
(Source: Update Bali III, 2023)

Some time ago, Kedisan Pier underwent a renovation, and at the end of 2022, it could operate again. Updatebali.com (February 6, 2023), Kedisan Pier on Lake Batur, has become a new and viral tourist attraction on social media. Tourists are attracted to this pier because of the position of the floating pier in the middle of the lake with views of Lake Batur and flanked by Mount Batur and Bukit Abang. The condition of Kedisan Pier on Lake Batur will become a tourist spot in Kintamani through the concept of *Port and Lake Tourism*, which is a unification of the port function as a transportation facility and a new atmosphere of the Port [13]. The situation around Lake Batur Kedisan Pier is where the waters are overgrown by aquatic plants and greenery (Figure 2). Lake Batur is a water with eutrophic conditions, especially nitrates and phosphates, which cause the growth of algae and other aquatic plants and high weed conditions along the shores of Lake Batur [14]. This article aims to discuss the influence of the construction of Kedisan Pier on tourist visits and water quality, which will benefit tourism actors in increasing awareness of the quality of Lake Batur waters.



Figure 2. The condition of the waters around Kedisan Pier
Source: Documentation (March 2023)

Research Methods

This research was conducted in Lake Batur in March 2023, with sample points determined through *purposive sampling*. Water samples representing domestic activity in Lake Batur were taken at three points. Point One is an agricultural area, Point Two is in the middle of the lake, and Point Three is Kedisan Pier. Before sampling, field data testing, namely pH and temperature, was carried out (Table 1). The sample is taken using the sample grab method, which can represent the current state of the sample.

Furthermore, the sample was preserved with sulfuric acid up to pH two and a cooling temperature of $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$. pH and temperature parameters are tested directly in the field, while BOD and COD are tested in the laboratory. Data collection is done through laboratory observation, documentation, and analysis methods. Lake Batur water samples were then tested at the UPT Analytical Laboratory of Udayana University. Then, the data was analyzed in a qualitative descriptive manner to determine the effect of the construction of Kedisan Pier on tourism and water quality.

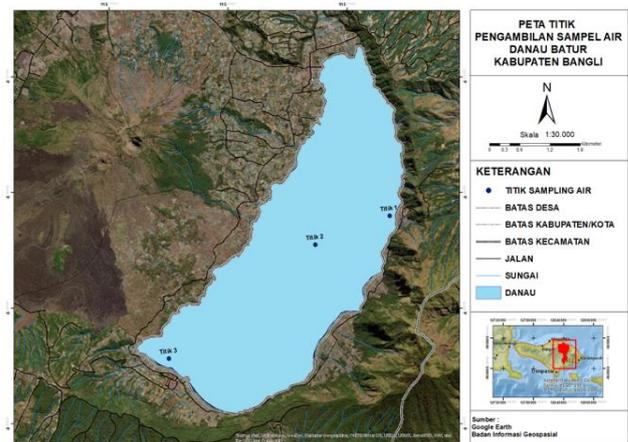


Figure 3. Lake Batur Water Sampling Location
Source: Geographic Information System (September 2023)

Results and Discussion

Figure 3 more clearly depicts the location of Kedisan Pier, Lake Batur. Physical and chemical tests, namely temperature and pH measurements, were carried out in the field. The pH at all points exceeds the lake water quality standard Class 1 Government Regulation Number 22 of 2021 for chemical parameters tested in the laboratory, namely COD. *Chemical Oxygen Demand* (COD) is the need for oxygen in water oxidizing organic compounds chemically [15].

The Effect of Kedisan Jetty Construction on Lake Batur Water Quality

Lake Batur is the largest lake on the island of Bali. Lake Batur has two attractions not owned by the other three lakes on the island of Bali, namely Mount Batur as natural tourism for climbing and burial in Terunyan Village. In addition, the Batur area displays views of lakes and mountains that are deep in one look. Restaurants and inns are also supportive around Batur.

Table 1. Test Results

Parameters	Unit	Quality Standard Class 1	Result		
			Point 1	Point 2	Point 3
temperature	°C	Dev 3	24	24	25
pH		6 – 9	9.3*	9.3*	9.2*
COD	mg/L	10	22,720*	18,176*	24,438*

Information:

1. The test was conducted at the UPT Analytical Laboratory of Udayana University.
2. Temperature and pH parameters are tested directly in the field
3. The * mark is a parameter that exceeds the quality standard
4. Quality Standards based on Government Regulation of the Republic of Indonesia No. 22 of 2021 Annex VI Part II concerning Lake Water Quality Standards for Class 1

Tourist visits to the Pier area have decreased due to damaged piers [11]. But now that the Kedisan Pier has been refurbished, in 2023, it has been opened and has become a supporting tourist attraction on Lake Batur. Kedisan Pier is a new tourism with supporting facilities such as restaurants, coffee shops, and public areas with the concept between port functions and natural tourism [13]. The construction of Kedisan Pier positively impacts the surrounding community with increasing tourist visits. Tourists visit hot springs, restaurants, and the Kedisan pier even though they do not cross the food in Terunyan Village. The concept of a pier with a beautiful view is an attraction, especially for young people. However, the scene is disturbed by pollution around the pier (Figure 2). The growth of aquatic weeds pollutes the waters of Lake Batur. The influence of domestic waste such as detergents, food waste, urine waste, and agriculture causes the rapid growth of weeds along the lakeshore. In addition to physical pollution problems such as *blooming algae*, chemical pollution is also a concern.

The pH parameters at the three points in Lake Batur exceed the Lake Water Quality Standard Class 1 Government Regulation Number 22 of 2021 by 6 – 9. The pH value affects oxygen levels in a body of water due to photosynthetic activities that produce oxygen needed by aquatic biota, thereby increasing bicarbonate ions, which can increase the pH value. High oxygen levels in the waters cause a high pH value; alkaline water conditions can cause death in aquatic biota [16].

COD value at Point 1 is 22,720 mg/L; Point 2 is 18,176 mg/L, and Point 3 is 24,438 mg/L where all points exceed the lake water quality standard Class 1 Government Regulation Number 22 of 2021 by 10 mg/L. Increase in COD pollutants in residential and agricultural areas by 127%; water bodies by 82%; and Kedisan pier by 144%. Based on research by Nursyamsi et al. (2015) [5], the increase in COD values was in line with the rise in water organic compounds. This is also in line with Sumarya et al.'s [11] research on pollution of Lake Buyan waters sourced from community activities around the lake. Activities around the lake include agriculture, settlements, and tourist areas. Research by [17] on Lake Batur shows that COD values exceed first-class surface water quality standards Bali Governor Regulation Number 16 of 2016, which is 10 mg / L. The average value of COD is 18.33 – 23.00 mg / L, resulting from cage, agricultural, and domestic activities. The high concentration of COD at all three points that exceed the quality standards of farm areas settlements caused by organic waste from human activities causes a decrease in the quality of Lake Batur waters. Previous studies also support this data. The highest concentration of COD in the Kedisan dock area is

due to increased activity, so there is an accumulation of domestic waste [18].

Research on the development and management of Lake Kerinci tourism object area, stated that the management of tourist areas in the form of supporting infrastructure such as equipping with trash cans, waste management, waste disposal channels, park management, and building and facility management could increase the number of tourists [19]. This is also supported by [20] regarding the development of Lake Talang tourism villages in the form of improving worship facilities, toilets, sewage channels, and information boards that have an impact on increasing the potential of Lake Talang tourist areas and improving the regional economy. The increase in community and tourist activities affects the decline in the quality of Lake Beratan waters. It is characterized by high coliform parameters bacteria derived from feces [12].

Conclusion

The construction of Kedisan Pier impacts increasing tourist visits but causes a decrease in the quality of waters in Lake Batur. The decline in water quality is characterized by high concentrations of COD and pH in dock areas, middle lakes, and settlements resulting from domestic activities. Based on this research data, the public is more aware that the waters of Lake Batur have decreased in quality, so it is necessary to implement solutions such as increasing awareness of tourism actors, the community, and the government in environmentally caring tourism management. This is to be a priority to overcome the global problem of water pollution as conveyed in the SDG's international goal on *Clean water and sanitation* through better sanitation, the use of agricultural fertilizers, and fish farming that is more environmentally friendly.

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