CHAPTER I
INTRODUCTION

1.1 Background

Lakes are the most miniature freshwater ecosystems on the earth's surface compared to other ecosystems. The importance of lakes for life and humans is much higher compared to their area (Sullivan & Reynold, 2003). Lakes as natural resources, have become "public property" and are used by many people with unrestricted extraction rights. These conditions encourage highly extractive use of the lake, thus leading to managing lake resources that exceed their carrying capacity (Hasim, 2017; Roumasset & Wada, 2015). The Indonesian government is certainly not remaining silent on this issue. This was proven by issuing "Peraturan Presiden Nomor 60 Tahun 2021 Tentang Penyelamatan Danau Prioritas Nasional". In this regulation, 15 lakes are the national priority to be restored and maintained in the condition of the water bodies so that they can benefit the community's welfare sustainably, one of which is Batur Lake, Bali.

Batur Lake is essential as a water supplier for the Bali area. The residents need it to support their vital activities such as horticulture, tourism, transportation, recreation, and fishing, and the most potential of all is fish culture by floating net cages technology (Arthana, 2011). The utilization of Batur Lake without management efforts has caused several problems related to the environment, such as: (1) Land-use changes or deforestation e.g. rice fields and dry land of about 23,200 ha in 2015 (Pemerintah Kabupaten Bangli, 2015) that caused sedimentation of about 8 m with a sedimentation rate of 0.21 m each year and the sedimentation volume is 5,980.47 m3 with sedimentation level of 1,993.49 m3 per year (PPPE Bali & Nusa Tenggara, 2018; KLH, 2014), (2) use of chemical fertilizers (60%), organic fertilizers in the form of compost (40%), about 15.31 kg each day, and pesticides continuously in agriculture (Sundra & Joni, 2015; Nuringtyas *et al*., 2023), (3) excessive water use as the floating net fishery which has reached 12,000 units in total with fish production of 4.984 tons in 2022 with the use of fish pellets about 23.1 kg every day each fish farmers, which means 277,200 kg in total (PPID KLHK, 2022; BPS Provinsi Bali, 2022; Nuringtyas *et al*., 2023) which caused hypertrophication with transparency 0-70 cm in 2018 about 2.25% (Laili *et al*.,

2020), (4) being the destination for waste disposal from settlements inhabited by around 4.29 million households, 1.162 million tourist from both local and abroad, and accommodations totaling at least 22 buildings that spread across seven different villages, including Kedisan, Batur, Buahan, Trunyan, Songan, Toya Bungkah, and Penelokan (PPID KLHK, 2022; BPS Kabupaten Bangli, 2020; Ernawati *et al*., 2019), (5) and lot of motorboat that use about 14 litres of fuel per trip, which shuttles tourists around the lake that contributes pollutant to the water including lead or Pb in large quantities with an average amount from six village of about 0.253 which should only be limited to first class of water quality standards about 0.01 (Sundra & Joni, 2015; Nuringtyas *et al*., 2023; Presidential Regulation of the Republic of Indonesia No. 60 of 2021 concerning National Priority Lake Saving).

The Bali government already has several programs to overcome these problems such as making an ecosystem management master plan, lake ecosystem budget plan, studying pollution load carrying capacity, designing a grand movement to save Lake Batur, and and delegating local government policies to the district level. Besides those programs, the Bali government recommended some action that should be done by collaborating with the public, including carrying out conservation in the buffer and upstream zones which are the source of the shallowing of Lake Batur, increasing public awareness and participation in the preservation of Lake Batur, rehabilitation of damaged water catchment areas, borders and waters of the Lake Batur ecosystem area, and restoring damaged water through monitoring the lake water quality and identifying aquatic biota (PPPE Bali & Nusa Tenggara, 2023). There are several aquatic biota that can be used to monitor the quality of freshwater, such as benthic macroinvertebrates, macrophytes, fish, phytoplankton, zooplankton, and phytobenthos (Santos & Ferreira, 2020; Xiong *et al*., 2020).

Plankton will be used as a biological indicator to monitor the water quality of Batur Lake because it can quickly respond to changes in the environment (due to high reproductive rates, short life cycles, and so on) and serve as an essential biomarker for measuring water quality and indicators of water pollution. There is a significant correlation between ecosystems' abiotic and biotic components and the usefulness of phytoplankton and zooplankton as bioindicators for detecting water bodies' health and nutritional status (Khushbu *et al*., 2022). Plankton such as

microalgae, copepods, and other small aquatic crustaceans are examples of bioindicator species that can monitor biochemical, physiological, and behavioral changes in aquatic environments. These species may also report cumulative effects of pollutants in aquatic ecosystems (Cuadro *et al*., 2022). Water quality monitored by plankton will be seen from its community structure.

It is important to consider the water quality available for community use in the economic, agricultural, and industrial sectors (Aliu *et al*., 2022). However, research studies regarding plankton community structure in Batur Lake, Bali, have not been conducted routinely. The research conducted by Sulawesty and Satya (2013) the samples were taken from April 2005 until February 2007, showed that Batur Lake is in bad condition, with the dominant species such as: *Synedra Ulna*, *Navicula pupula, Cosmarium conctractum,* and *Anabaena* sp. In other research conducted by Nirasari *et al*. (2018) regarding the structure of the phytoplankton community Batur Lakes, the samples were taken in 2014. The results of this research showed no dominance of phytoplankton, and the physical and chemical parameters of the waters still showed good values , so there was no pollution in the lake. The latest research was conducted by Permana *et al*. (2022) about plankton biodiversity that focused on floating net cage areas. The results of the plankton community structure showed that all of the research areas had good conditions (three sites in mesotrophic status and one site in oligotrophic status) except for the Kedisan Village (eutrophic status). From all this research, we can see that Batur Lake has had a dynamic condition over time.

Based on the research background, Batur Lake has several problems caused by human activity that lead to water quality degradation. This study will analyze water quality in Batur Lake based on phytoplankton community structure, saprobic index, and trophic diatom index. The results of this research can be used as evaluation material in the environmental management strategy for Batur Lake. This is done to implement the Sustainable Development Goals (SDGs) 6, SDG 13, SDG 14, and SDG 15. It is hoped that the water condition on Batur Lake will be better and well-maintained.

1.2 Formulation of The Problem

Based on this background, two problem formulations can be taken as follows:

1.2.1 How is the plankton community structure on Batur Lake, Bali?

1.2.2 How is the water quality in Batur Lake, Bali?

1.2.3 How many nutrients are contained in the water of Batur Lake, Bali?

1.3 Aim

The aims of this research are as follows:

1.3.1 To examine the plankton community structure on Batur Lake, Bali, based on their abundance, diversity index, evenness index, and dominance index

1.3.2 To examine the water quality condition on Batur Lake, Bali, based on the saprobic index to know the organic pollution level using real-time data from the phytoplankton and zooplankton taken there

1.3.3 Examine the nutrient contents contained in Batur Lake, Bali, to determine the eutrophication levels based on the specific pollution sensitivity index (IPS) using diatom communities, which provides information about the trophic levels of the aquatic ecosystem.

1.4 Benefit

This research can provide the latest detailed information about plankton community structure and water quality on the Batur Lake, Bali, so that it can be used as reference material for local governments and residents in developing and managing the lake area condition to implement the Sustainable Development Goals (SDGs), especially the 6th goal about clean water and sanitation, the 13th goal about climate action handling, the 14th goal about life underwater, and the 15th goal about life on land. The final goal is maintaining the lake ecosystem and community welfare.