CHAPTER I
INTRODUCTION

1.1. Background

Water is a vital resource that sustains both human life and ecological balance. However, freshwater ecosystems such as rivers and lakes are increasingly threatened by sewage discharge, agricultural runoff, and urban stormwater, which elevate nutrient loads and deteriorate water quality (Bhat & Qayoom, 2016). These contaminations not only deteriorate water quality but also endanger aquatic life, ecosystem function, and public health (Kornijów, 2024). Artificial lakes or man-made water bodies created through excavation or damming often lack permanent natural inflows or outflows, making them reliant on surface runoff and campus drainage systems (Zhou et al., 2021). These characteristics make them more susceptible to water stagnation, sediment buildup, and nutrient accumulation, especially when surrounded by intense anthropogenic activity. Without proper maintenance, such lakes face an elevated risk of eutrophication, declining water quality, and the eventual loss of ecological and recreational functions (Gibbs & Hickey, 2012).

A significant factor contributing to water quality degradation is eutrophication, a process caused by the excessive inflow of nutrients into aquatic ecosystems (Kornijów, 2024). Eutrophication not only degrades water quality but also disrupts aquatic ecosystems, threatening biodiversity and ecosystem functions (Akinnawo, 2023). At Universiti Tun Hussein Onn Malaysia (UTHM), several artificial lakes, including Pembangunan Lake, Kemajuan Lake, Teknologi Lake (FKAAB), and Teknologi Lake (FPTV), were constructed as retention ponds to manage stormwater, reduce flood risk, and improve campus aesthetics. According to Azman et al. (2024), these lakes are hydrologically connected through a campus drainage network that channels runoff from the upstream lakes (Pembangunan Lake and Kemajuan Lake) to the downstream ones (Teknologi Lake (FKAAB) and Teknologi Lake (FPTV)). This configuration makes the downstream Teknologi Lake (FPTV) more prone to receiving cumulative pollutant loads from upstream lakes and surrounding land uses. Although all four lakes are man-made, their surrounding

land uses differ considerably, influencing pollutant input and water quality dynamics. For instance, Kemajuan Lake, located upstream, is bordered by administrative buildings and open green areas and has been classified as eutrophic (CTSI = 60–80), reflecting nutrient enrichment (Azman et al., 2023). Meanwhile, Teknologi Lake (FKAAB), situated downstream of Kemajuan Lake, exhibits moderately enriched conditions, whereas Teknologi Lake (FPTV), the terminal lake in the system, shows stronger eutrophic symptoms such as dense aquatic macrophyte growth, low transparency, and unpleasant odour (Azman et al., 2024). These conditions suggest that cumulative loading and site-specific land use play major roles in the deterioration of downstream lake quality.

Teknologi Lake (FPTV) is a man-made retention pond covering approximately 16,530 m², originally designed for flood control. Field observations and previous reports (Azman et al., 2024) show signs of eutrophication, such as dense macrophyte growth, low water transparency, and unpleasant odour. The deterioration of water quality has been linked to inputs from the mosque's ablution area, runoff from the food court, drainage from palm plantations, and surface runoff from paved areas.(Azman et al., 2024). According to information from the Sustainable Campus Office, UTHM operates a centralized Sewage Treatment Plant (STP) located near the Tun Fatimah Residential College. The facility has been in operation since around 2010 and treats domestic wastewater from campus buildings before discharge. The university has also announced plans to upgrade the system by incorporating anaerobic digestion to enhance sludge management and reduce environmental impact.

A previous study by Miswan et al. (2019) analyzed several physicochemical parameters in Teknologi Lake, including pH, DO, TSS, BOD, and ammoniacal nitrogen (NH_3–N). The results showed BOD values of 105–106 mg/L and ammoniacal nitrogen of 3.6–4.3 mg/L, corresponding to Class IV under DOE (2007) standards, poor quality suitable only for irrigation. However, no Water Quality Index (WQI) or trophic-state (CTSI) evaluation was conducted. Therefore, this study aims to perform an integrated assessment of Teknologi Lake (FPTV) using WQI and CTSI, supported by statistical and correlation analyses to explore relationships among eutrophication-related parameters (TP, Chl-a, and Secchi

depth). Findings from this study are expected to support sustainable lake management at UTHM.

1.2. Research Purpose and Objectives

This study aims to assess the water quality and trophic status of Teknologi Lake (FPTV) at UTHM using the Water Quality Index (WQI) and Carlson's Trophic State Index (CTSI) based on field sampling and laboratory analysis.

The objectives of this study are as follows:

1. To assess lake water quality using the Water Quality Index (WQI).
2. To determine the trophic state of Teknologi Lake (FPTV) using Carlson's Trophic State Index (CTSI).
3. To examine the relationships between WQI parameters (DO, BOD, COD, TSS, NH_3–N, and pH) and the WQI value, and between CTSI parameters (TP, Chl-a, and Secchi depth) and the CTSI value.

1.3. Research Benefits

The benefits of this research are:

1. To provide updated and integrated data on water quality and trophic status of Teknologi Lake (FPTV), which can serve as a reference for future research and monitoring programs related to artificial lakes.
2. To support campus-based environmental management at UTHM by supplying evidence-based input for formulating lake rehabilitation and pollution control strategies.
3. To assist relevant stakeholders, including university planners and environmental authorities, in identifying priority actions for water quality improvement and eutrophication prevention.
4. To serve as an academic case study that contributes to environmental science education, particularly in the areas of lake management, eutrophication, and urban water systems in tropical regions.

1.4. Research Scopes

The limitations of this research are:

1. This research was conducted at Teknologi Lake (FPTV), located at Universiti Tun Hussein Onn Malaysia (UTHM), Parit Raja, Johor.
2. The water quality parameters analyzed include temperature, pH, turbidity, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), ammoniacal nitrogen (NH_3–N), total phosphorus (TP), chlorophyll-a, and water transparency (Secchi disk).
3. Sampling was conducted weekly over 12 weeks from November 2024 to January 2025 at 6 monitoring points, including inlets, outlets, and visibly impacted areas. Sampling followed ISO 5667-4:2016 and EPA Guidelines (2007), employing both grab and composite techniques.
4. Laboratory analyses were conducted using APHA Method 5210B (2023), USEPA Methods 8000, 8006, 8038, and 8190, as well as procedures from the University of Leeds.
5. Potential pollution sources were identified through field observations and classified as point or non-point sources based on discharge characteristics and surrounding land use.
6. The Water Quality Index (WQI) was used to assess overall water quality status, while Carlson's Trophic State Index (CTSI) was applied to evaluate nutrient enrichment and trophic level based on TP, chlorophyll-a, and Secchi depth. The results were then compared with Malaysia's National Water Quality Standards (NWQS).
7. Descriptive and correlation analyses were performed to examine relationships among individual water quality parameters, as well as between WQI and CTSI,

1.5. Systematics of Writing

The systematics of writing are as follows:

CHAPTER I INTRODUCTION

The chapter contains the background, aims, objectives, benefits, limitations of the research problems and significance of the study.

CHAPTER II LITERATURE REVIEW

This chapter discusses eutrophication, water pollution sources, water quality parameters, and supporting theories related to CTSI, WQI, and MLR methodologies.

CHAPTER III RESEARCH METHODOLOGY

This chapter describes the stages of research carried out, literature study, location, and research time.

CHAPTER IV RESULT AND DISCUSSION

This chapter contains the results of the research along with its discussion.

CHAPTER V CONCLUSION AND SUGGESTIONS

This chapter contains conclusions and suggestions based on the research and discussion that has been described.