THE POTENTIAL IMPACT OF AGRICULTURAL ACTIVITIES ON WATER QUALITY OF BERA LAKE

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor Degree of Civil Engineering

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Tesis ini adalah mengenai kajian tentang kualiti air yang disebabkan oleh aktiviti aktiviti pertanian. Salah satu aktiviti pertanian yang aktif di Tasik Bera ialah tanaman kelapa sawit. Aktiviti aktiviti pertanian akan menyebabkan pencemaran air di Tasik Bera. Semasa menjalankan kajian, sampel air telah diambil selama dua kali untuk mengetahui tentang pencemaran air di Tasik Bera. Kajian ini telah dijalankan sebanyak tiga stesen sampel iaitu tapak pertanian, resort, dan kawasan jeti. Kesemua stesen sampel berada di sekeliling Tasik Bera. Sebanyak tiga belas parameter kualiti air telah dianalisis termasuklah ujian in situ dan ujian makmal. Untuk ujian in situ, data terus terus diambil menggunakan peralatan manakala untuk ujian makmal, kaedah dan prosedur standard telah dijalankan untuk mengumpul data. Semua parameter telah diklasifikasikan berdasarkan Indeks Kualiti Air Malaysia, Jabatan Alam Sekitar, dan Standard Kualiti Air Negara Malaysia. Parameter fizikokimia adalah suhu, pH, kekonduksian elektrik (EC), oksigen terlarut (DO), kekeruhan, permintaan oksigen biokimia (BOD), permintaan oksigen kimia (COD), jumlah pepejal terampai (TSS), jumlah pepejal terlarut (TDS), nitrogen ammonia (NH3-N), nitrat (NO_3^-), dan fosfat (PO_4^{3-}). Berdasarkan keputusan, permintan oksigen biokimia (BOD) adalah paling tinggi di tapak pertanian (6.73mg/L) dan paling rendah di resort (2.35mg/L) manakala permintaan oksigen kimia paling tinggi di kawasan jeti (14.59mg/L) dan paling rendah di tapak pertanian (10.40mg/L). Untuk oksigen terlarut, oksigen terlarut adalah paling tinggi di tapak pertanian (4.50mg/L) dan paling rendah di resort (4.09mg/L). Berdasarkan keputusan, ia menunjukkan bahawa kualiti air di Tasik Bera adalah dalam Kelas II berdasarkan Indeks Kualiti Air Malaysia dan dikategorikan dalam keadaan air bersih.

ABSTRACT

The thesis is about the research on the water quality due to agricultural activities. One of the agricultural activities that active in Bera Lake is palm oil plantation. Agricultural activities cause the pollution to water. During the research, water samples were taken two times to know about the pollution of water at Bera Lake. The study was conducted at three sampling stations which were at agricultural site, resort, and jetty area. All of the sampling stations were around Bera Lake. A total of thirteen water quality parameters were analyzed including in situ test and laboratory analysis. For in-situ test, the data were collected directly using equipment while for the laboratory test, standard methods and procedures were carried out to collect the data. All the parameters were classified according to Department of Environment Water Quality Index (WQI) Malaysia and National Water Quality Standards (NWQS) Malaysia. The physicochemical parameters were temperature, pH, electrical conductivity (EC), dissolved oxygen (DO), turbidity, biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), total dissolved solids (TDS), ammoniacal nitrogen (NH3-N), nitrate (NO_3^-), and phosphate (PO_4^{3-}). Based on the results, the highest BOD was at agricultural site (6.73mg/L) and the lowest BOD was at resort (2.35mg/L) while the highest COD was at jetty area (14.59mg/L) and the lowest COD was at agricultural site (10.40mg/L). For dissolved oxygen, the highest dissolved oxygen was at agricultural site (4.50mg/L) and the lowest dissolved oxygen was at resort (4.09mg/L). Based on the results, it showed that the water quality of Bera Lake was in Class II based on the Water Quality Index (WQI) Malaysia and was categorized in clean water.

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LIST OF SYMBOLS

NH_3-N	Ammoniacal Nitrogen
NO_3^-	Nitrate
mg/L	Miligram per Litre
PO_4^{3-}	Phosphate
µs/cm	Microsiemens per Centimetre

LIST OF ABBREVIATIONS

AN	Ammoniacal Nitrogen
APHA	American Public Health Association
BOD	Biocchemical Oxygen Demand
COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
DOE	Department of Environment
TSS	Total Suspended Solids
EC	Electrical Conductivity
NWQS	National Water Quality Standards
MPN	Most Probable Number
NTU	Nephelometric Turbidity Units
USEPA	United States Environmental Protection Agency
WQI	Water Quality Index

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Water is very important to human daily life. People used water for cleansing, washing, bathing, especially as their sources of drinks. Rivers, lakes and other freshwaters resources also provide electrical power generation other than used for recreational activities, fisheries, and many more. However, the most important part that we want to discuss is about the quality of water which had been used for all of activities. For this research, we will discuss about the water quality of Bera Lake. Bera Lake is the largest in Peninsular Malaysia that is located in southwest Pahang, Malaysia. Lake is categorized as freshwater. The freshwater present on the surface of the earth is put to multifarious uses, it is used for drinking, domestic and municipal uses, agricultural irrigation, industries navigation, recreation etc. after being used in the above mentioned human activities the water flowing out becomes contaminated, (Arvind Kumar, 2008).

Water quality may refer to physical, chemical and biological characteristic of water. Water quality is degradation of natural process of eutrophication. In most high-income countries and many emerging economies, agricultural pollution has already overtaken contamination from settlements and industries as the major factor in the degradation of inland and coastal waters, for example eutrophication, ((Mateo-Sagasta, 2017). Eutrophication is defines as the increases of nutrients concentrations. According to Nixon's study as cited in National Estuarine Research Reserve System (NERRS), he defined eutrophication as an increase in the rate of supply organic matter in ecosystem. Human development has great impact on water quality, and new contaminants are emerging every day, (Ahuja, 2013). Human activities will increase the rate of nutrients input through point and non-point sources pollution. Of the non-point pollution, about

67% is from agriculture, 18% urban, and 15% from other sources, (Spellman, 2008). Agricultural activity may use and applied pesticides, herbicides, and fertilizers. The application of fertilizers and pesticide may produce dissolved nutrient in surface run off which is nitrogen and phosphorus. These nutrients may change and reduced the water quality in lake. Water quality appears to be largely influenced by suburban stormwater runoff, septic tank effluent, and relic row crop agricultural practices, though more work is required to identify point and non-point sources of nutrient loading. The World Bank estimates that 60% of the tropical forest area cleared each year makes room for new agricultural settlement. Based on the previous research, agricultural run-off consists of fertilizers, pesticides, and domestic discards. Excessive of nitrogen and phosphorus in the lake accelerated the eutrophication of lake. Heavy metals also increased in lake due to agricultural activities. Based on this statement, we may conclude that, low quality of water will give negatives impact to human life also to the environment as well.

1.2 Problem Statement

Bera Lake is the largest natural lake in Peninsular Malaysia and was designated as its first RAMSAR site in 1994. According to previous research, the total catchment area of the Bera Lake is 593.10 km^2. However, approximately 340.00 km^2 of the tropical rain forest cover has been converted to oil palm and rubber plantations since 1972.

Agriculture, which accounts for 70 percent of water abstractions worldwide, plays a major role in water pollution, (Mateo-Sagasta, 2017). The agricultural activities near Bera Lake caused agricultural run-off into Bera Lake that lead to the pollution of lake. Agricultural run-off consists of fertilizers, pesticides and domestic discards which affect the quality of water and aquatic life. Excessive of nitrogen and phosphorus in the lake accelerated the eutrophication of lake. Human activities have accelerated the rate and extent of eutrophication through both point-source discharges and non-point loadings of limiting nutrients, such as nitrogen and phosphorus, into aquatic ecosystems (i.e., cultural eutrophication), with dramatic consequences for drinking water sources, fisheries, and recreational water bodies, (Chislock, 2013). Eutrophication is caused by the leading of an impairment of many freshwater and coastal marine ecosystems in the world. Nitrate from agriculture is the most common chemical contaminant in the

world's groundwater aquifers, (WWAP, 2013). Heavy metals also increased in lake due to agricultural activities. Therefore, it is important that a study is conducted to assess the water quality in the Bera Lake due to agricultural activities.

1.3 Research Objective

The objectives of study are:

i) To evaluate the special variations of water quality in the Bera Lake catchment
ii) To identify the level of pollutants based on National Water Quality Standard (NWQS) and Water Quality Index (WQI) Malaysia

1.4 Scope of Study

The scope of study of this research is about the agricultural activities that have been developed in Bera Lake. From these activities, it will cause the lake to be polluted. Besides, it also will cause the agricultural run-off which may affect the water quality of Bera Lake. This research will be conducted for ten months starting from September 2017 until June 2018. There are two types of test that will be conducted in this research. The first one is in situ test and the second one is laboratory test. There are eight tests that will be conducted under laboratory test; turbidity, biological oxygen demand (BOD), chemical oxygen demand (COD), total suspended solid (TSS), ammoniacal nitrogen, nitrate, phosphate, and test for heavy metals. While for the in situ test, there are five tests that will be conducted; temperature, pH, dissolved oxygen, electrical conductivity, and total dissolved solid (TDS).

1.5 Significant of Study

From the research, we can know the conditions of water quality of the Bera Lake now either it is in good condition or not. The scale of water pollution that had been caused by agricultural activities can be determined. Furthermore, we can distinguish the pH of the water instead of temperature. During our research, we can have the information about the nutrients that present in the water of the lake. The nutrients that we want to research are ammoniacal nitrogen, nitrate, and phosphate. Other than that, we can recognize the heavy metals that produced in the Bera Lake.

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