# WATER QUALITY STUDY AND ITS RELATIONSHIP WITH HIGH TIDE AND LOW TIDE AT KUANTAN RIVER

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# ABSTRACT

Water is an essential resources that sustains life on earth, changes in the natural quality and distribution of water have ecological impacts that can sometimes be devastating. Recently, Malaysian is facing a lot of environmental issues regarding water pollution. The purpose of the study was to access the hydrological properties and water quality of the Kuantan River, Pahang and how it related to low tide and high tide. The main objectives of the research of Kuantan River and its tributaries were to determine the value of Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Suspended Solids (SS), Ammoniacal Nitrogen (AN), pH and Dissolved Oxygen (DO) through field and laboratory experiments during high tide and low tide. DO and pH were analyzed as in-situ measurement while the rest of the parameters were analyzed in the laboratory. Recent activities such as residential, industrial, commercial and agricultural activities have taken place in the areas surrounding the river. The impact of these activities may have caused environmental degradation to Kuantan River and its adjacent areas by changing the water system's hydrological characteristics, with prospects of possible long term deterioration.

# ABSTRAK

Air adalah sumber penting yang menampung kehidupan di bumi. Perubahan kualiti alam dan pengaliran air memberi kesan ekologi yang sangat membimbangkan. Ketika ini, Malaysia sedang menghadapi banyak isu-isu alam sekitar terutama tentang pencemaran air. Tujuan penyelidikan ini adalah untuk mengenal pasti sifat–sifat hidrologi dan kualiti air Sungai Kuantan, Pahang dan pengaruhnya terhadap air pasang surut. Nilai keperluan oksigen biologi (BOD), oksigen kimia (COD), pepejal tersuspensi (SS), "nitrogen ammonical" (AN), "pH" dan oksigen terlarut (DO) diperolehi dari Sungai Kuantan dan anak-anak sungainya dikaji di makmal dengan membandingkan kadar pasang-surut sungai sebagai pengukuran "in-situ" sedangkan parameter yang lain dianalisis di makmal. Kegiatan yang terbaru seperti kegiatan perumahan, industri, komersial dan pertanian telah dikesan di sekitar sungai. Kesan dari kegiatan-kegiatan ini mungkin telah menyebabkan penurunan kualiti alam sekitar di Sungai Kuantan dan sekitarnya. Perubahan ciri-ciri hidrologi sistem air dijangka menyumbang kerosakan dalam jangka masa panjang.

# TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

## LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| INWQS | - | Interim National Water Quality Standard |
| DOE | - | Department of Environment |
| WQI | - | Water Quality Index |
| DO | - | Dissolved Oxygen |
| BOD | - | Biochemical Oxygen Demand |
| COD | - | Chemical Oxygen Demand |
| SS | - | Suspended Solids |
| AN | - | Ammonia Nitrate |
| GPS | - | Geographical Positioning System |
| JPS | - | Jabatan Pengairan Dan Saliran |
| Fe | - | Iron |
| Pb | - | Lead |
| Cu | - | Copper |
| Zn | - | Zinc |
| Mn | - | Manganese |
| km | - | Kilometer |
| mg/L | - | Milligram per Litre |
| $CO_2$ | - | Carbon Dioxide |
| $NO_3$ | - | Nitrate |
| $SO_4^{2-}$ | - | Sulfate |
| $O_2$ | - | Oxygen |
| $NO_2^-$ | - | Nitrite |

## LIST OF SYMBOLS

| | | |
|---|---|---|
| mg/L | - | Milligram per Litre |
| $CO_2$ | - | Carbon Dioxide |
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# LIST OF APPENDIX

# CHAPTER 1

# INTRODUCTION

## 1.1 Introduction

Water is an essential element in the maintenance of all forms of life, and most living organisms can survive only for short periods without water. In other words, water is an essential resources that sustains life on earth, changes in the natural quality and distribution of water have ecological impacts that can sometimes be devastating. Hydrology is the science dealing with the occurrence and movement of water, ecology is the science dealing with interactions between living things and their nonliving (abiotic) environment or habitat, and the relationship between hydrology and ecology is sometimes called hydrologic connectivity (Pringle, 2003). The presence of abundance liquid water is what makes the earth unique amongst known planets.

Surfaces water resources have played an important function throughout the history in the development of human civilization. About one third of the drinking water requirement of the world is obtained from surface sources like rivers, canals and lakes

(Das and Acharya, 2003). Unfortunately, these sources seem to be used as convenient places for the discharge of domestic as well as agricultural and domestic wastes. Dams, according to United Nations Environment Programme (2003), there are a visible tool for managing freshwater resources, contributing to socio-economic development and protecting drinking water supply. However, dams may negatively affect changes in downstream water flows, degradation of water quality, increased in-lake sedimentation, lake and river bank scouring, blocked movement of migratory species and loss of aquatic biodiversity.

Water pollution is caused by point and non-point sources. Point sources include sewage treatment plants, manufacturing and agro-based industries and animal farms. Non-point sources are defined as diffused sources such as agricultural activities and surface runoffs. The situation of water pollution in Malaysia is becoming more serious. As Malaysia is fast becoming an industrial country, many of her rivers have become polluted due to the many wastes that have been poured out into her rivers. The rivers are used as an outlet for the chemicals to drain away, in turn harming the waters and the lives that revolve around them. Many rivers in Malaysia have been polluted including Kuantan River, Pahang which in turn affects plants and organisms living in these bodies of water, people's health, the country's economy, and also to the natural environment. The main causes of river pollution are usually due to lack of awareness, unconsciousness and the attitude of people.

## 1.2 Problem Statement

Water qualities of rivers and lakes are one of the most common issues in Malaysia. The publics and government are conscious about the future of rivers. It is advised by our government that we should protect the richest water resources as water is

a vital resource, necessary for all aspects of human and ecosystem survival and health. Kuantan River has been chosen for the study of water quality because of its importance and function to the communities. Kuantan River serves as a very important natural resource for the people living around the area. Basically. Kuantan River is also known as one of recreation destination that listed in tourism place in Pahang. Along side of Kuantan River, there are many people live around that area. They used this river as water sources. Due to the rapid development and urbanization process around the area, the water quality of Kuantan River is significantly degrading.

Therefore, it is important to study the level of pollution in the river currently and determine the causes of pollution in order to recommend suitable solutions to the problem. This research will serve as a baseline study that is needed prior to the development of the Kuantan riverbank to assess the feasibility of the proposed project. The baseline data can also be used against which the results of future monitoring can be compared. The need to collect data is to document existing water quality conditions in Kuantan River which could be useful for future planning of the river efficiently. This data help to save ecology and environment of the ecosystem of the river.

## 1.3 Objectives

The objectives of this study are listed below:

i. To determine the water quality of Kuantan River based on six parameters which are Biochemical Oxygen Demand (BOD), Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), pH, Ammonia Nitrate (AN) and Suspended Solids (SS) in order to classify the river through field and laboratory experiments.

ii. Classify the Kuantan River in accordance to the Water Quality Index (WQI) during high and low tide of water quality profile.

iii. The relationship between WQI and flow rate during high tide and low tide.

## 1.4 Scope of Study

The scope of study area is at Kuantan River and it is located in the Pahang. The purpose of this study is to analysis the water river quality of Kuantan River based on two conditions which are during low tide and high tide. Besides that, this study investigated whether the water quality at Kuantan River had bad impact for demands of different users. The water quality parameters are based on the Water Quality Index (WQI) and Interim National Water Quality Standard for Malaysia (INWQS). The parameters are Biochemical Oxygen Demand, Chemical Oxygen Demand, Dissolved Oxygen, pH, Suspended Solids and Ammonia Nitrate. River classification were based on DOE-WQI. Sampling points were predetermined for field and laboratory testing. The parameters involve in in-situ measurement were Dissolved Oxygen and pH while the other parameters such as Biochemical Oxygen Demand, Chemical Oxygen Demand, Suspended Solids and Ammonia Nitrate were tested in the laboratory. Based on the water quality profile of Kuantan River, classification of the level of pollution of the river and identifying types of pollution exists in the river could be established. This scope of study describes an analysis which was carried out to determine the factors contributing to the pollution at Kuantan River in order to save our mother nature from further deterioration.

## 1.5 Significant of Study

The significant of this study are:

i. To know the level of pollution at Kuantan River and identifying the sources of river pollution.

ii. The current condition of water quality at Kuantan River can be analyzed and effective precaution steps should be taken to save Kuantan River.

iii. To study the land use of Kuantan River and relates it to the water quality.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Introduction

Unlike distilled or deionized water all drinking water supplies will contain a range of dissolved chemical compounds. Even rainwater, which is the purest water found naturally, contains a wide range of ions and cations. In the early days of chemistry, water was known as the universal solvent as a result of its ability to slowly dissolve into solution anything it comes into contact with, from gases to rocks. So as rain falls through the atmosphere, flows over and through the Earth's surface, it is constantly dissolving material, forming a chemical record of its passage from the clouds. Therefore, water supplies have a natural variety in quality, which depends largely on the source of the supply. All our water comes from the water cycle and it is this process that controls our water resources.

## 2.2 River Pollutions Issues In Malaysia

Water pollution is a serious problem in Malaysia and impacts negatively on the sustainability of water resources. Not only for that, but it is also affects plants and organism living, people's health and the country's economy. It reduces total water availability considerably as the cost of treating polluted waters is too high and in some instances, polluted waters are not treatable for consumption. The large quantity of water resources available in the catchment, unfortunately does not guarantee adequate supply to all users because of the rivers pollution. Urbanization within our river catchments gives rise to increase in population and urban life activities. The effect of urbanization normally changed the quality of runoff within a catchment, which in turn affect the water quality of receiving waters. Rainfall in urbanized areas washes down contaminants accumulated on land surfaces into stormwater facilities.

Wastewater from residential, commercial, and industrial areas causes foul smell, especially in the presence of garbage, and deteriorates the quality of stormwater and polluted the existing rivers system. Most of the sources of pollution have been caused by human activity, although some of them come from natural sources of pollution. The problem of water pollution is now becoming more serious with reports indicating a downward trend year by year. Water pollution however, is not a recent environmental issue as it had been synonymous with urbanization and modernization.

## 2.3 River Classification In Malaysia

In Malaysia, the Department of Environment (DOE) developed a Water Quality Index system (WQI) to analyze trends in water quality of rivers in our country based on six parameters which are Dissolved Oxygen, Biochemical Oxygen Demand, Chemical Oxygen Demand, Suspended Solids, Ammonia Nitrate and pH. Water quality data were used to determine the water quality status weather in clean, slightly polluted or polluted category and to classified the rivers in Class I, II, III, IV or V based on Water Quality Index (WQI) and Interim National Water Quality Standards for Malaysia (INWQS) every year. The river classification based on the DOE-WQI is given in the Table 2.1, Table 2.2 and Table 2.3 respectively. Rivers are usually classified according to their uses as shown in Table 2.4. Table 2.5 shows the calculation of sub index properties for each parameter in order to obtain the WQI value while Table 2.6 shows the general rating scale for WQI. Table 2.7 shows the classification based on INWQS and the parameters involved.

**Table 2.1: Classification WQI-DOE (DOE, 1986)**

| WQI-DOE Value | Condition |
|---|---|
| 90-100 | Very Good |
| 75-90 | Good |
| 45-75 | Average |
| 20-45 | Polluted |
| 0-20 | Very Polluted |

**Table 2.2: DOE Water Quality Classification Based On WQI (DOE, 1986)**

| PARAMETER | INDEX RANGE | | |
|---|---|---|---|
| | CLEAN | SLIGHTLY POLLUTED | POLLUTED |
| Water Quality Index (WQI) | 81 - 100 | 60 - 80 | 0 - 59 |
| Biochemical Oxygen Demand (BOD) | 91 - 100 | 80 - 90 | 0 - 79 |
| Ammoniacal Nitrogen (NH3-N) | 92 - 100 | 71 - 91 | 0 - 70 |
| Suspended Solids (SS) | 76 - 100 | 70 - 75 | 0 - 69 |

**Table 2.3: DOE Water Quality Index Classification (DOE, 1986)**

| PARAMETERS | UNIT | CLASS | | | | |
|---|---|---|---|---|---|---|
| | | I | II | III | IV | V |
| Ammoniacal Nitrogen | mg/l | < 0.1 | 0.1 - 0.3 | 0.3 - 0.9 | 0.9 - 2.7 | > 2.7 |
| Biochemical Oxygen Demand | mg/l | < 1 | 1 - 3 | 3 - 6 | 6 - 12 | > 12 |
| Chemical Oxygen Demand | mg/l | < 10 | 10 - 25 | 25 - 50 | 50 - 100 | > 100 |
| Dissolved Oksigen | mg/l | > 7 | 5 - 7 | 3 - 5 | 1 - 3 | < 1 |
| pH | mg/l | > 7.0 | 6.0 - 7.0 | 5.0 - 6.0 | < 5.0 | > 5.0 |
| Total Suspended Solids | mg/l | < 25 | 25 - 50 | 50 - 150 | 150 - 300 | > 300 |
| Water Quality Index | | > 92. 7 | 76.5 - 92.7 | 51.9 - 76.5 | 31.0 - 51.9 | < 31.0 |

**Table 2.4: Interim National River Water Quality Standards River Classification (DOE, 1986)**

| Class | Uses |
|---|---|
| CLASS I | Conservation of natural environment<br>Water Supply 1 - practically no treatment necessary<br>Fishery 1 - very sensitive aquatic species |
| CLASS IIA | Water Supply II - conventional treatment required<br>Fishery ll - sensitive aquatic species |
| CLASS IIB | Recreational use with body contact |
| CLASS III | Water Supply lll - extensive treatment required<br>Fishery lll - common, of economic value, and tolerant species; livestock drinking |
| CLASS IV | Irrigation |
| CLASS V | None of the above |