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STUDY ON WATER QUALITY AT TASIK CHINI, PAHANG

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ABSTRACT

The purpose of the study were to determine the characteristic of water quality at Tasik Chini (Chini Lake) and to obtain the water quality classification based on WQI (Water Quality Index) of the selected sampling stations. A total of five sampling stations were selected for this study: Laut Gumum, Laut Jerangking, Laut Kenawar, Laut Melai and Laut Pulau Balai. Eleven water quality parameters were analyzed based on in- situ and ex-situ analysis during dry and rainy day. Laboratory analysis carried out according to the HACH method. In-situ water quality were including pH, dissolved oxygen, conductivity, turbidity and temperature. For ex-situ water quality parameters included TSS, ammoniacal nitrogen, COD, BOD, total coliform and E-coli. The result show that based on Malaysia WQI, the water in Tasik Chini is classified as Class II which suitable for recreational activities and body contact. However, recent activities such as illegal logging, iron mining, agricultural and industrial activities have taken place in surrounding of the lake consequently affected the water body of Tasik Chini thus undergone devastating changes.

ABSTRAK

Tujuan kajian ini adalah untuk menentukan ciri-ciri kualiti air di Tasik Chini serta untuk mengelaskan kualiti air berdasarkan Indeks Kualiti Air (WQI) pada stesen persampelan yang ditentukan. Jumlah sebanyak lima stesen yang ditentukan, antaranya ialah Laut Gumum, Laut Jerangking, Laut Kenawar, Laut Melai and Laut Pulau Balai.Sejumlah sebelas parameter kualiti air dianalisis berdasarkan in-stu dan analisis makmal pada masa hujan dan waktu kering. Analisis makmal yang dijalankan adalah mengikut kaedah HACH. In-situ kualiti air termasuk nilai pH, oksigen terlarut(DO), kekonduksian elektrik (EC), kekeruhan dan suhu manakala untul analisis makmal termasuk jumlah pepejal terampai (TSS), permintaan oksigen biologi (BOD), permintaan oksigen kimia (COD), ammonikal nitrogen (AN), koliform dan escheriachia coli (E.Coli). Berdasarkan Indeks Kualiti Air (WQI) Malaysia, air di Tasik Chini dikategorikan dalam Kelas II. Walau bagaimanapun, aktiviti-aktiviti baru-baru ini seperti pembalakan haram, perlombongan besi, pertanian dan perindustrian telah berlaku di sekitar tasik seterusnya terjejas badan air Tasik Chini.

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LIST OF ABBREVIATIONS

BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
EC	Electrical Conductivity
E.Coli	*Escherichia Coli*
DOE	Department of Environment
NH_3-N	Ammoniacal Nitrogen
LULC	Land use or land cover
NWQS	National Water Quality Standard
NTU	Nephelometric Turbidity Units
NWQS	National Water Quality Standard
µs/cm	Microsiemens per centimetre
mg/L	Milligram per litre
S/m	Siemen per meter
TSS	Total Suspended Solids
WQI	Water Quality Index

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Water is vital to our existence in life and its importance in our daily life makes it imperative which has been a part of planet Earth for billions of year as it availability has been a matter of concern all over the world. Water is especially remarkable because it can occur as liquid, solid or even gas. In spite of this apparent abundance, several factors serve to limit the amount of water available for human use. Containing more than 90% of all the liquid freshwater on the surface of our planet, water support a range of human activities which include agriculture , commerce, transportation, recreation, tourism and food and energy production. Besides, they also provide an important habitat for a diverse array of organisms. Generally, water quality is linked to land use or land cover in catchment with the relation on variables such as dissolved salts, suspended solid and nutrients (Ahearn et al., 2005). Many parameters have evolved that qualitatively reflect the impact that various impurities have on selected water uses. Analytical procedures have been developed that quantitatively measure these parameters (Peavy et al., 1985). Water Quality Index been used as a primary sources to classified the water quality.

Tasik Chini is situated in the State of Pahang where it lies in the southeast region of Pahang with latitude 3°26'07" N and longitude 102° 55'42" E in Kuantan. Tasik Chini is one of the two natural lakes in Peninsular Malaysia that located about 100km

from Kuantan , the capital of Pahang's state. The lake is shaped as 12 protrusions that drained by a single Chini River to the main Pahang river.

1.2 PROBLEM STATEMENT

Lakes are important sources of water in Malaysia which considered as multipurpose functions. However, some of the lakes constructed as flood control detention storage in order to buffer flow during dry and wet season although most of them currently seem to have multipurpose functions (Zati & Salmah , 2008). Besides, lake water is an essential renewable resource for mankind and the environment which important for civil (drinking water supply, irrigation, transportation), industrial and recreational purposes.

Over the past decades, the rapid pace of development surrounding the lake catchments had significant effects on the quality of the water body (Zati & Salmah , 2008). Most pollution situation has evolved gradually over time until they have become apparent and measurable. There are many countries do not have standards to control water pollution adequately while others cannot enforce water quality standards. Consequently, a reduction in water quality which will leads to health problems and bring to the endangerment of agriculture and aquatic ecosystems.

The climate around the Chini Lake area is typical of the equatorial climate of Peninsular Malaysia which is characteristic by moderate average annual rainfall, temperature and humidity. According to Ainon and Yanti (2008), there was a barrage been constructed across Chini river downstream where it meets Pahang river with the purpose of maintaining the depth of the lake depth especially during the dry season as for ease in boating activities for tourism purpose. However, the natural ecology of the lake had been disrupted due to the barrage. Hence, it caused to the death of trees on its shores due to the elevated water level.

Furthermore, the construction of National Service Centre for National Service Training programmed in Chini Lake since 2004 which consequently adds some physical impact towards the water quality of this lake. A native plant was reduced and species

becomes endangered because their habitats have been modified. Therefore, it is important that a study is conducted to assess the trend of water quality changes in the lake for sustainable management which based on physical, chemical parameter including the distribution of E.coli and total coliform that present in Tasik Chini and also to find out the factors that contribute to the pollution that occurred at Sungai Chini.

According to Ainon and Yanti, state government had developed some of the areas that surrounding Tasik Chini into large plantation forest which had changed the virginity of the forest into oil palm and rubber plantation. Hence, the environment of Task Chini has undergone the devastating changes (Gasim et. al., 2007). However, the condition of Tasik Chini worsened after a constructing of a dam in 1995 which having the purposed of retain water in Tasik Chini for tourism use.

1.3 SIGNIFICANCE OF PROPOSED STUDY

The significance of the proposed study is to know the status of water quality at Tasik Chini as it is a well-known as one of the eco-tourism and wetland place in West Malaysia in order to protect the downstream areas from flood and also avoid from riverbank erosion. The data regarding water quality at Tasik Chini is helpful for policy making.

1.4 RESEARCH OBJECTIVE

The objectives of this study are:

i. To determine the characteristic of water quality in the Tasik Chini.

ii. To obtain the water quality classification based on Water Quality Index (WQI).

1.5 SCOPE OF STUDY

The scope of this study can be listed as follow:

i. This study conducted at Tasik Chini where the samples will be taken from 5 different locations.

ii. This study conducted 2 types of test which are in-situ test and analysis at lab.

iii. The water samples are analyzed in laboratory to determine their physical, chemical and biological condition based on the parameters.

1.6 EXPECTED OUTCOME

The expected outcomes of this study are:

i. The characteristic of water quality and total concentration of coliform bacteria at Tasik Chini can be determined.

ii. Information and data gathering based on water sampling and through laboratory analysis (experiment) will be helpful to the policy maker to protect the Tasik Chini.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Water is one of the most precious resources on earth which also known to be very complex resource. Contrary to a static resources such as land, water occurs in a very dynamic cycle of rain, runoff and evaporation with enormous temporal and spatial variations and follow by the variations in quality that completely govern its value to people and ecosystems. According to Frank, there were 1.2 billion people lacked access to safe and affordable water for their domestic use which bring impacts on people's well-being as well as caused to massive health impacts. Hence, fresh water is so much critical to an array of global challenges from health, to malnutrition, poverty as well as a sustainable natural resources management. Besides that, one third of the drinking water requirement by the world indeed obtained from surface sources such as rivers, canals and lakes that act as place for domestic discharge, agricultural as well as for domestic wastes (Gasim et. al, 2006).

2.2 LAKE

Lakes are the most easily available water resources which extensively being used in many parts of the world. They cover millions of km^2 of continental area together with other surface water bodies such as wetlands, artificial surface reservoirs and constitute an essential component of the regional and global water cycles. Lakes also play an important role in supporting the balance of ecosystem and repository of biodiversity of rare, endemic and endangered species. Since, lakes act as catchment basins for close to 40% of the landscape so serve as recreational, sporting and fishing activities. (Ashraf et. al, 2010). Generally, there are few of natural lakes in Malaysia which form as part of swamp wetlands such as Lake Bera, Paya Bungor Lake, Ulu Lepar Lake (Zati & Salmah , 2008). There are less than 73 man-made lakes had been created for water supply irrigation hydropower generation, flood mitigation and others. The lake water is an essential renewable resource for mankind and the environment which important for civil, industrial and recreational purposes. Moreover, it also provides an avenue for breeding, spawning and nursery grounds for both resident and migratory fish species.

2.2.1 Components of a Lake

A lake is defined as "a body of slowly moving or standing water that occupies an inland basin". An operational definition for management purposes sets a lower limit to a lake volume of about 1000 m^3 (Meybeck, 1995). For lakes located in floodplains there is a continuum between lakes and other water bodies without continuous and permanent vegetation cover and wetlands. However, lakes are complex dynamic systems by interacting with the local environment and connected to the water cycle through both surface and underground inflows and outflows as well as via precipitation or evaporation fluxes.

2.3 WATER POLLUTION

Pollution of natural watercourses is a major environmental issue that faced by worldwide. Water pollution is relatively new problems which increase the stress arising until an unprecedented population growth, urbanization and industrialization. Thus, water pollution problems increase evidently as led to serious imbalance of ecological system and the rise of environmental problems (Ma et al., 2009). The main cause of water pollution is mainly due to human activities where human produces bodily wastes that enter lakes and reservoir. Basically ,the discharge from industrial that produced pollutant to the waste water which includes heavy metals, organic toxins, oil nutrients and solids as a result in increasing the concentration of suspended solids(turbidity), bacteria growth that lead to potential in health impacts. Nevertheless, there can be little doubt that water actually being extracted more rapidly than being replaced where the quality of the water may change as its volume declines. According to Ashraf, Jamil and Ismail, lakes and estuaries are impaired by some form of pollution which consist over one third of the nation streams.

According to the National Water Quality Inventory 2000 Report to Congress that reported by the U.S. Environmental Protection Agency, there are only 61 percent of the streams, lakes and estuaries that were assessed (19 percent of all rivers and streams, and 43 percent of all lakes, ponds, and reservoirs in the United States) met the water quality standards evaluated. Leading pollutants in these impaired waters included sediments, bacteria, nutrients, and metals.

2.3.1 Pollutant

Under normal conditions, pollutants are those activities that on Earth, both natural processes and human-made processes, produce some type of byproduct from that activity. In fact, natural environmental processes have the ability to assimilate some pollutants and correct most imbalances if given enough time. However, if a persistent overload of a pollutant is allowed to continue or the pollutant is not a substance that the

environment can handle, then the environment has little chance to "self-clean." In short, a pollutant is a substance that enters the environment and elevates the "natural" background level of that substance. In many cases, the natural system may not have any of the substance present until human activities add it to the environment. There are two sources of water pollution which known as point sources and non-point sources.

2.3.1.1 Point source pollution

Pollutions that originate from a single, identifiable source is known as point-source pollution. It discharges pollutant at specific locations such as landfills, industrial wastes through inlets into surface water. The various types of point-source pollutants found in waters are as varied as the types of business, industry, agricultural and urban sources that produce them. Point sources of pollution from agriculture may include animal feeding operations, animal waste treatment lagoons or storage, handling, mixing and cleaning areas for pesticides, fertilizers as well as petroleum (Ashraf et.al., 2010). Characteristically, point source pollutant easier to control and it is more measurable which generally more toxic.

2.3.1.2 Non-point source pollution

Non-point sources of pollution are the consequence of agricultural activities (irrigation and drainage, applications of pesticides and fertilizers, runoff and erosion), erosion associated with construction and hydrologic modification (dams, diversions, channelization, over pumping of groundwater, siltation). Besides, non-point source pollution is usually found spread out throughout a large area. It is often difficult to trace the exact origin of these pollutants because they result from a wide variety of human activities on the land as well as natural characteristics of the soil, climate and topography. Characteristically, non-point source pollutants are difficult or impossible to trace to a source. Moreover, non-point source related to certain

uncontrollable meteorological events. By comparing with the point source, non-point sources have the potential for maintaining a relatively long active presence on the global ecosystem as a result in long term, chronic that effect on human health and soil-aquatic degradation (Ashraf et al., 2010). However, these pollutants have harmful effects on drinking water supplies, recreation, fisheries and wildlife. Human being are indeed the main cause of nonpoint sources that contributing to the problem arise.

2.3.1.3 Lake Polluted effect of Dam

Dam is an artificial barrier usually constructed across a stream channel to impound water which generally serves the primary purpose of the retaining water while other structures such as floodgates or levees are used to manage or prevent water flow into specific land regions. According to the UNEP (2003), dams serve as a function of visible tool to manage freshwater resources thereby contributing to socio-economic development through supplying drinking water. Besides, dams might have show negative impact change in downstream water flows, degradation of water quality, increase in-lake sedimentation, lake and river bank and blocked the movement of the migratory species (Gasim et al., 2007).

Tasik Chini (Chini Lake) plays an important role in providing fisheries as a source of revenue to the local people as it also provides an avenue for breeding, spawning and the growth of the fish species. Unfortunately, the condition of Tasik Chini worsened after the construction of a dam that built in 1995. The purpose of the dam was built to retain the water in Tasik Chini for tourism purpose. Consequently, the water movement becomes sluggish and the water level of the lake has risen and become stagnant after the construction of the dam (Shuhaimi et al., 2007). During the raining season, the overflowing of Sungai Pahang together with the reverse flow of flood water into Sungai Chini and Tasik Chini will cause to flooding. Nevertheless, according to Collier, Webb and Schmidt, dams can actually distracting the structure and function of river ecosystems by flow regimes, altering the water quality and severing their biological continuity. Hence, these conditions have raise to the concern on deterioration in water quality of the lake.

2.4 WATER QUALITY

Water quality determines the 'goodness' of water for particular purposes. It expressed in term of measurable quantities and also narrative statements where it actually shows the composition of water that affected either by nature or human cultural activities. However, there may be different of parameters that best expressing water quality in every country. Generally, water quality linked to land use or land cover (LULC) in catchment (Li et. al., 2008). Water quality can be thought of as a measure of the suitability of water for a particular use based on selected physical, chemical and biological characteristics. For each intended use and water quality benefit, there may be different parameters best expressing water quality. Both single compound (BOD_5, ammonia, dissolved oxygen, etc) and multiple compound parameters (oil and grease, whole effluent toxicity, coliforms, etc) are been used (Sia, 2008). However, water quality tests will give information about the health of the waterway.

Water qualities refer to the physical, chemical and biological characteristic of water. It is most frequently used by reference to a set of standards against which compliance can be assessed. The physical characteristics include the temperature, clarity and similar qualities which variables are temperature, pH, dissolved oxygen, conductivity, total dissolved solid and turbidity. Chemical variables include Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Total Suspended Solid (TSS), ammonia-N, nitrate, phosphate and sulphate which show characteristic of the presence of inorganic and organic substances in one solution as well as the way act when dispersed in water. For biological characteristics, it include identify, impact and organisms that are present in water with the variables are total coliform and *E.coli* (Jayalakshmi et.al, 2011).

2.4.1 Physical Water Quality Parameter

The physical parameters of water quality can be broken down into many topics such as turbidity and taste or odour to name a few. However, one needs to take into

consideration on the nature of the physical parameters of the ecosystem surrounding a water source to understand the physical appearance of later finished water. So, suspended solids, turbidity, colour, taste and odour and temperature categorize into this category.

2.4.1.1 Turbidity

Turbidity is a principal physical characteristic of water and is an expression of the optical property that causes light to be scattered and absorbed by particles and molecules rather than transmitted in straight lines through a water sample. It can caused by silt, sand and mud, bacteria and other germs, and chemical precipitates that interfere with the clarity of the water. These impurities may include clay, silt, finely divided inorganic and organic matter, soluble coloured organic compounds and plankton and other microscopic organisms. In short, turbidity is the measure of relative clarity of a liquid. However, turbidity often increases sharply during a rainfall especially happened in developed watersheds which typically have relatively high proportions of impervious surfaces (Aron, 2010).

Turbidity is usually measured in Nephelometric Turbidity Units with the unit of NTUs in water. Although high turbidity is often a sign of poor water quality and land management but crystal clear water does not always guarantee healthy water while extremely clear water can signify very acidic conditions or high levels of salinity. In Tasik Chini, the turbidity of water samples varied from 4.67 to 28.67 NTU. The mean concentration was 16.41 NTU. The highest was 28.67 NTU at the Cenahan River during wet season and the lowest was 4.67 NTU at the Melai River during dry season (Gasim et. al, 2007).