WATER QUALITY AT SETIU WETLAND, TERENGGANU, MALAYSIA

By

MOHAMAD FAIZ BIN WAHID

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

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DEDICATION

For my beloved Parents:
WAHID BIN NGAH
MAZNAH BINTI JUSOH

My siblings:
MOHD FAUZI BIN WAHID
ZULKIFLI BIN WAHID
MUHAMMAD FAIZOL BIN WAHID
MUHAMAD FAKRUL BIN WAHID

NORASMANI BINTI WAHID
NORHASLIZA SUSILAWATI BINTI WAHID
SUZIE UMIRA BINTI WAHID
MARLINA BINTI WAHID
NOR AKMAR BINTI WAHID

My supervisors:
ASSOC. PROF. DR. SECA GANDA
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NAJIHAH ZAKARIA

Thank you for your encouragements supports
And the helpful

Thank you for everything. May Allah Bless All of us.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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Setiu Wetlands in Terengganu is one of the most beautiful wetlands in Malaysia with pristine white beaches, rich in mangroves biodiversity, tranquil rivers, andbeautiful nature parks. The estuarine lagoon system is rich in natural capital and if systematically managed, it will sustainably provide resources for agriculture, aquaculture, eco-tourism, and recreational activities and benefited the local communities. Urbanization and industrialization pose ecological risks to the fauna and flora of the wetlands. Once the ecosystem is disturbed; the wetlands and its invaluable treasures will be destroyed and may come to extinction. A study on characteristics and status of water quality at two different rivers was conducted: UlarRiver and Setiu River. Ular River was an oil palm plantation area while Setiu River was an aquaculture and ecotourism development area. This study was conductedto determine and compare the quality level of water of the two rivers, especially during low and high tides. A total of 108 water samples were collected at three (3) different sampling station (S1, S,2 and S3) in four (4) different months from September 2018 to November 2019 during low and high tides condition. *In-situ* dataincluded Temperature; Conductivity; Dissolved Oxygen (DO), pH and Turbidity were recorded. Ammoniacal Nitrogen (NH3-N), Biochemical Oxygen Demand (BOD),Chemical Oxygen Demand (COD) and Total Suspended Solid (TSS) were conducted in laboratory. The Water Quality Index (WQI) was calculated based onsix (6) water quality parameters namely Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), pH, Ammoniacal Nitrogen (AN) and Total Suspended Solid (TSS) was representative of the state of water quality at study area. The parameters measured showed lower mean valuesof surface salinity, temperature, DO, pH and TSS during the wet season relative to dry season. Besides, the concentration of BOD was high during the wet season andlower in the dry season. At last, water quality for the Setiu Wetland was highly influenced by anthropogenic activities and seasonal variation. Therefore, both factors must be focused to move towards proper management of this wetland.

Keywords: Setiu Wetland; Water Quality Index (WQI); Tidal Activity; AnthropogenicActivities.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

KUALITI AIR DI SETIU WETLAND, TERENGGANU, MALAYSIA

Oleh

MOHAMAD FAIZ BIN WAHID

Ogos 2021

Pengerusi : Profesor Madya Seca Gandaseca, PhD
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Tanah Bencah Setiu di Terengganu adalah salah satu tanah lembap yang paling indah di Malaysia dengan pantai yang putih dan bersih, kaya dengan kepelbagaian biologi bakau, sungai yang tenang dan taman alam yang indah. Sistem lagunmuara kaya dengan hasil semulajadi dan jika dikendalikan secara sistematik, ia akan menyediakan sumber daya untuk pertanian, akuakultur, eko-pelancongan dan aktiviti rekreasi secara berterusan dan memberi manfaat kepada masyarakat setempat. Urbanisasi dan perindustrian menimbulkan risiko ekologi terhadap fauna dan flora di tanah lembap tersebut. Setelah ekosistem terganggu; tanah lembap dan khazanahnya yang tidak ternilai akan musnah dan mungkin akan pupus. Kajianmengenai ciri dan status kualiti air di dua sungai yang berbeza telah dilakukan; Sungai Ular dan Sungai Setiu. Sungai Ular adalah kawasan perladangan kelapa sawit sementara Sungai Setiu adalah kawasan akuakultur dan pembangunan ekopelancongan. Kajian ini dilakukan untuk menentukan dan membandingkan tahap kualiti air kedua sungai, terutama ketika air pasang surut dan pasang tinggi. Sebanyak 108 sampel air direkodkan di tiga (3) stesen persampelan berbeza (S1,S, 2 dan S3) dalam empat (4) bulan yang berbeza dari September 2018 hingga November 2019 dalam keadaan air surut dan pasang tinggi. Data *in-situ* termasuk Suhu; Kekonduksian; keterlarutan oksigen (DO), pH dan kekeruhan telah direkodkan. Ammoniacal Nitrogen (NH3-N), permintaan oksigen biologi (BOD), permintaan oksigen kimia (COD) dan jumlah pepejal terampai (TSS) dijalankan di makmal. Indeks Kualiti Air (WQI) dikira berdasarkan enam (6) parameter kualiti air iaitu Oksigen Terlarut (DO), Permintaan Oksigen Biokimia (BOD), Permintaan Oksigen Kimia (COD), pH, Nitrogen Amonia (AN) dan jumlah pepejal terampai (TSS) mewakili keadaan kualiti air di kawasan kajian. Parameter yang diukur menunjukkan nilai rata-rata saliniti, suhu, DO, pH dan TSS yang lebih rendah pada musim hujan berbanding musim kemarau. Selain itu, kepekatan BOD tinggi semasamusim hujan dan lebih rendah pada musim kemarau. Akhirnya, kualiti air bagi Tanah Bencah Setiu sangat dipengaruhi oleh aktiviti antropogenik dan perubahan musim. Oleh itu, kedua-dua faktor mesti diberi perhatian untuk pengurusan tanah lembap

yang baik.

Kata Kunci: Tanah Bencah Setiu; Index Kualiti Air (WQI); Aktiviti Pasang Surut;Aktiviti Antropogenik.

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This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
AN	Ammoniacal Nitrogen
APHA	American Public Health Association
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
CWT	Clean Water Team
DO	Dissolved Oxygen
DOE	Department of Environment
EC	Electrical Conductivity
EPA	Environmental Protection Agency
NQWS	National Quality Water Standard
TSS	Total Suspended Solids
WQI	Water Quality Index
SAS	Statistical Analysis System
NTU	Nephelometric Turbidity Unit
PSU	Practical Salinity Unit
USEPA	United States Environmental Protection Agency
WWF	Worldwide Fund

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Mangrove forests are a unique ecosystem. They provide valuable ecosystem services which interacting with associated aquatic fauna, social and physical factorsof the coastal environment. Adeel (2001) stated that the ecosystems contain 21 habitats such as spawning grounds, nursery for juveniles, and secure feeding grounds – for a wide number of fishes, crab, shrimp, and mollusk species. At the same time, these ecosystems serve as a sanctuary for indigenous and migratory bird species. Like other coastal ecosystems, mangroves are not safe from human intervention and destruction. They were traditionally managed by small coastalcommunities at a sustainable level, but their intense exploitation has led to an ever- worsening picture.

These ecosystems have become an easy target for the extraction of wood for fuel and construction, production of food and waste disposal (Adeel, 2001). One damaging factor that stands above all the rest is unfettered aquaculture and shrimp farming. The areas that suitable for mangroves also have ideal conditions for shrimpfarming.

This, coupled with an incredibly high economic return on shrimp farming, has been the undoing of mangroves. Large tracts of former mangrove ecosystems have now been laid waste because of mismanaged shrimp farming, which has made them toorich in nutrients and antibiotics to sustain a thriving ecosystem of any kind.

Mangrove forests literally live in two worlds, acting as the interface between landand sea. They are vital for a healthy coastal ecosystem. Forest detritus, consisting mainly of fallen leaves and branches from the mangroves, provides nutrients for the marine environment and supports immense varieties of sea life in intricate food webs associated directly through detritus or indirectly through the planktonic and epiphytic algal food chains.

Fries (2016) mentioned mangrove are the waterfront intertidal wetland forest which consists of halophytic trees and shrub species. Knight et al, 2008 concluded that intertidal wetland forest is characterized by the aggregate and complex interaction of hydrology, landscape position, sediment elements, storm-driven processes, sea level change, subsidence, colonization, and unsetting influence by creatures. FOA (2007) states that Asia holds one third of the world's

mangrove with 39%, 21% by Africa where 15% by North and Central America. Amir (2018) founded that Malaysiais the third largest nation that holds mangrove. Majority, the mangrove forests of peninsular Malaysia are located on its west coast facing the Malacca Straits, while mangrove forests on its east coast facing the South China Sea are small and mainlyrestricted to river mouths (Chong, 2006). Mangrove also help protect the coastlines from erosion, storm damage and wave action. The stability of mangrove forest is of immense importance. They prevent shoreline erosion by acting as buffers and accumulate alluvial materials, thus stabilizing land elevation by sediment accretion that balances sediment loss. Vital coral reefs and seagrass beds are also protected from damaging siltation.

Mangrove forest are of utmost importance to estuarine systems as a major primary producer of unique organism. Tropical and subtropical coastal and river mouths areas are usually occupied with these mangrove forests. Apart from being established as one of wetland's element, mangrove areas also known to be the most conducive ecosystem for various exotic living organism (Gandaseca *et al*., 2011).

1.2 Mangrove Forests

In tropical and sub-tropical regions, mangrove is the only type of forest based between land and sea. In a matter of fact, mangrove areas are like a breeding site for many important species of flora and fauna. Each component of mangroves has their own significant character which make this forest very distinct. Based on the findings of Alongi (2002), mangrove plants have a specially to influence the wave energy. It was found out that the plants reduce the smashing momentum of waves. Furthermore, according to Seager and Conchie (2004), mangrove sediment plays a crucial function as buffer between potential source of pollutants and the marine ecosystem.

1.3 Setiu Wetlands

The natural beauty of Setiu Wetlands prompted the WWF Malaysia and Departmentof Fisheries Malaysia in 1996, to propose to the State Government of Terengganu aconcept proposal to develop and conserve the area into a Terengganu State Park. The proposed park lies within the Setiu-Chalok-Bari basin. The two rivers Setiu and Chalok, their tributaries and catchments area cover approximately 230 square kilometers (Choi KS, 2003). The proposed park boundaries cover an area of approximate 150 square kilometers of land area and extend an approximate length and width of 35km and six kilometers, respectively.

1.4 Hydrological Cycle

Earth's water is always in movement, and the natural water cycle, also known as the hydrologic cycle, as United State Geological Survey (USGS, 2014) describes it as the continuous movement of water on, above, and below the surface of theEarth. Water always changing states between liquid, vapor, and ice, with these processes happening in the blink of an eye and over millions of years.

1.5 Problem Statement

Mangrove forests have been facing tremendous challenges in the face of development and exploitation lately. The increasing rate in population due to exploitation of forest area by human activities through deforestation, logging, agriculture, aquaculture, ecotourism, and plantation.

Therefore, these activities causing the destruction to the mangrove forest ecosystem and various problem such as a serious threat to water resource in the mangrove area. These anthropogenic impacts bring poor health and ecosystem resilience to the mangrove. Amir (2008) mentioned riverbanks erosion causingheavy scouring sediments lead to widen channels and shallow water which will change the hydrology and the morphology of the rivers and estuaries.

The wealth of natural attraction at Setiu Wetlands will gradually vanish if no systemic ecological study for sustaining the ecosystem is done. Since the lagoon's ecosystem is semi-enclosed, it is very fragile and sensitive to any activities, including the construction of ponds for aquaculture and agriculture. As a result, the water will be polluted and the natural habitat of some fauna and flora species will be disturbed. etiu Wetlands has only recently seen major development of its surrounding areas mainly in the opening of new aquaculture ponds, oil palmsplantation area and tourism attractive area. Thus, it remains to be to how much longer the present water quality can be sustained. This might contribute to their rapid extinction. In the intermediate term, these activities may adversely affect waterquality.

Yet a growing global population, excessive water use, inadequate water management, poor salination and global climate change are threatening freshwater supplies. The unpolluted water is a powerful attraction to the people. Therefore, a study to monitoring and characterize the water quality at Setiu Wetland are needed to evaluate the of river water based on Water Quality Index (WQI) for local community purposes especially in aquaculture activities, tourism attractive and dailyuse.

1.6 Objective

The objectives of this study were to determine Tidal Effect on Water Quality Characteristics. Hence, this research has been undertaken with the following specific objectives as follows:

i. to determine the water quality status of Setiu Wetland rivers based on Water Quality Index (WQI) classification and water quality results during lowand high tide; and

ii. to compare the tidal effect between Ular River and Setiu River.

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