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WATER QUALITY STUDY AT LEBIR RIVER CAUSE BY FLOOD EVENT AND
SEDIMENTATION PROCESS

SITI SYUHaida BINTI ADNAN

Report submitted in fulfilment of the
requirements for the award of the degree of
B.Eng(Hons) Civil Engineering

Faculty of Civil Engineering and Earth Resources
UNIVERSITI MALAYSIA PAHANG

JUNE 2016

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LIST OF SYMBOLS

%	Percentage
Φ	Phi
α	coefficient in the rough turbulent equation
SE	energy gradient
u^*	shear velocity
ν	kinematic viscosity
d_{50}	median particle diameter
ω	particle fall velocity
M	sediment concentration parameter
g_{sb}	bed load sediment transport
g_{ssU}	suspended sediment transport in upper zone
g_{ssM}	suspended sediment transport in middle zone
g_{ssL}	suspended sediment transport in lower zone
g_s	total sediment transport
F()	function of the ration of shear velocity to fall velocity
τ_c	critical bed shear stress
τ_0	bed shear stress
Ds	mean particle diameter
G	unit weight of water
Cm	sediment discharge concentration
H	depth of flow
Sf	energy slope
D ₅₀	particle size at which 50% of bed material by weight is finer

g	acceleration of gravity
S_g	specific gravity of the sediment
D	mean depth
n	transition exponent depending on sediment size
C	concentration of bed-material discharge
V	the mean velocity
V_c	the critical velocity
A	coefficient
B	Exponent
D	diameter of bed particles
γ	density of water
γ_s	density of sediment particles

LIST OF ABBREVIATIONS

AN	Ammoniacal Nitrogen
BOD	Biochemical Oxygen Demand
DID	Department of Irrigation and Drainage
DO	Dissolved Oxygen
DOE	Department of Environment
H	Hydrographic
NWQS	National Water Quality Standard
NEM	Northeast Monsoon
pH	Potential Hydrogen
SI	Sub-indices
SWM	Southwest Monsoon
TSS	Total Suspended Solid
WQI	Water Quality Index
DDM	Degrees Decimal Minutes
RF	Rainfall
US	United State
NaOH	Sodium Hydroxide
APHA	American Public Health Association
HACH DR 5000	Spectrophotometer Procedures Manual
H ₂ SO ₄	Sulphuric Acid
NTU	Nephelometric Turbidity Unit

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ABSTRACT

Lebir River is one of the main tributary of Kelantan River and has been spotted that which has high potential rate affected by flood. A research was conducted as to calculate the total sediment load at Lebir River, analyze the water quality of Lebir river due to flood event and sedimentation process and to identify the relationship between amounts of sediment load with water quality in the river. Five stations were setting up for the collection of sample of sediments and water samples which are situated at downstream, Kg Lebir, Paloh (Station 1), Kg Manek Urai Lama (Station 2), middle stream, Kg Laloh (Station 3), Kg Bukit Tebuk (Station 4) and upstream, Kg Ladang Lapan Kabu (Station 5) along the Lebir River on October 2015. The particle size for sediments was distributed in the range of 0.063mm to 5mm by using sieve analysis method. Engelund/Hansen function method was used for the prediction of the total sediment load at Lebir River. Besides that, analysis of water quality at Lebir River was conducted based on six parameters (Biochemical Oxygen Demand, Chemical Oxygen Demand, Dissolved Oxygen Total Suspended Solid, Ammoniacal Nitrogen, pH and Turbidity). From overall findings, the sediment size at Station 1, 2, 3 and 4 retained 1.18mm and found as coarse sand type (0.5-2.0mm) and for Stations 5 retained on the size 5mm which indicates the fine gravel types. For the prediction of total sediment loads, Station 1 has 13737.6tonnes/m-day, Station 2 has 16243.2 tonnes/m-day, Station 3 has 7516.8 tonnes/m-day, Station 4 has 3801.6 tonnes/m-day and Station 5 has 518.4 tonnes/m-day. Based on analysis of water quality at Lebir River, the river is in Class IV which is in range (34.35 to 51.59) after flood compare to Class II before flood event. Biochemical Oxygen Demand, Chemical Oxygen Demand, Dissolved Oxygen Total Suspended Solid, Ammoniacal Nitrogen, pH and Turbidity shows the higher value than the value before flood event.

ABSTRAK

Sungai Lebir merupakan salah satu anak sungai utama Sungai Kelantan dan telah dikesan yang mempunyai kadar potensi yang tinggi dilanda banjir. Penyelidikan telah dijalankan untuk mengira jumlah mendapan di Sungai Lebir, menganalisis kualiti air Sungai Lebir kesan daripada peristiwa banjir dan proses pemendapan dan untuk mengenal pasti hubungan antara jumlah mendapan dengan kualiti air sungai. Lima stesen telah ditetapkan untuk pengumpulan sampel mendapan dan sampel air yang terletak di hilir, Kg Lebir, Paloh (Stesen 1), Kg Manek Urai Lama (Stesen 2), aliran pertengahan, Kg Laloh (Stesen 3), Kg Bukit Tebuk (Stesen 4) dan hulu, Kg Ladang Lapan Kabu (Stesen 5) sepanjang Sungai Lebir pada Oktober 2015. Saiz mendapan telah dibahagikan dalam lingkungan 0.063mm ke 5mm dengan menggunakan kaedah analisis ayak. Kaedah fungsi Engelund/Hansen telah digunakan untuk meramalkan jumlah mendapan di Sungai Lebir. Selain itu, analisis kualiti air di Sungai Lebir telah dijalankan berdasarkan kepada enam parameter (Permintaan Oksigen Biokimia, Permintaan Oksigen Kimia, Jumlah Oksigen, Jumlah Pepejal Terampai, Ammoniakal Nitrogen, pH dan kekeruhan). Daripada kajian keseluruhan, saiz mendapan di Stesen 1, 2, 3 dan 4 kebanyakannya berada pada 1.18mm dan dikategorikan sebagai jenis pasir kasar (0.5-2.0mm) dan untuk Stesen 5 berada pada saiz 5mm yang menunjukkan jenis batu halus. Untuk ramalan jumlah mendapan, Stesen 1 mempunyai 13737.6 tan/m-hari, Stesen 2 mempunyai 16243.2 tan/m-hari, Stesen 3 mempunyai 7516.8 tan/m-hari, Stesen 4 mempunyai 3801.6 tan/m-hari dan Stesen 5 mempunyai 518.4 tan/m-hari. Berdasarkan analisis kualiti air di Sungai Lebir, selepas banjir sungai berada dalam Kelas IV yang berada dalam julat (34.35-51.59) berbanding Kelas II sebelum berlakunya banjir. Permintaan Oksigen Biokimia, Permintaan Oksigen Kimia, Jumlah Oksigen Terlarut, Jumlah Pepejal Terampai, Ammoniakal Nitrogen, pH dan Kekeruhan menunjukkan nilai yang lebih tinggi daripada nilai sebelum banjir.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF RESEARCH

Rivers in Malaysia under natural conditions were known to have stable regimes and carried low sediment loads. However, as a result of sedimentation process due to flood event, river sediment loads have gravely increased. Consequently, problems of the massive clearing of forest for oil palm plantations and vegetable farming. It has been estimated that more than 80% of the suspended sediment load is caused by human activities in the catchments. Besides that, there are also the sedimentation that cause by flood.

High level of sedimentation in rivers leads to physical disruption of the hydraulic characteristics of the channel. This can have serious impacts on navigation through reduction in depth of channel and can increased flooding because of reduction in capacity of the river channel to efficiently route water through the drainage basin. These problems also affect the water quality of the river.

1.2 PROBLEM STATEMENT

Lebir River is one of the river that are involved in the flood event at the end of 2014 which situated in the district of Kuala Krai , Kelantan. Previous floods, including those 1927 and 1967 , were considered significant in Kelantan's history. The 2014 flood was the most significant and largest recorded flood in the history of Kelantan. It was considered to be a 'Tsunami-like disaster'. This flood was called 'Bah Kuning'(yellow-coloured flood) because of its high mud content. Nonpoint source pollutants come from

a number of sources and are washed into our waterways by surface runoff. When land disturbing activities occur, soil particles are transported by surface water movement. Soil particles transported by water are often deposited in streams, lakes, and wetlands. This soil material is called sediment. Sediment is the largest single nonpoint source pollutant and the primary factor in the deterioration of surface water quality. Land disturbing activities such as road construction and maintenance, timber harvesting, mining, agriculture, residential and commercial development, all contribute to this problem.

Flooding is a natural occurrence which can be an important source of sediment and nutrients to a variety of downstream riverine, estuarine and marine environments. However, when catchments are modified or floodwaters become increasingly large and more frequent, the benefits of flooding can be overridden by the excessive transport of freshwater, nutrients, sediment and pollution. Temporal variations in water quality also may occur, due to seasonal flow variations as a result of precipitation. Water quality during the dry season may remain fairly constant with some variations (provided there are no serious external disturbances or draught). During the wet season, where precipitation is at maximum, the water quality has the potential to get better or become worse, depending on input from runoff or non-point sources.

1.3 OBJECTIVES

To conduct a study, the aim of the ultimate objective of the study should be specified so that the study can be done thoroughly according to its aim. Several objectives have been set which are:

- i. To analyze the water quality of Lebir river due to flood event and sedimentation process.
- ii. To calculate the total sediment load at Lebir River.
- iii. To identify the relationship between amounts of sediment load with water quality in the river.

1.4 SCOPE OF STUDY

Five stations will set up for sample collection of sediments and water which are situated at the upstream, middle stream and downstream at Lebir River. The analysis of the size and types of sediment sample is using sieve analysis method and several data from in-situ. The Total sediment load at Lebir River will calculate using Engelund-Hansen method. Water quality at Lebir River will analyse based on 6 parameters, which is taken in situ and by lab experimental. Six parameters were chosen for the Water Quality Index (WQI) which is Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD₅), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), Ammoniacal Nitrogen (NH₃-N) and potential hydrogen (pH). The previous rainfall, sediment and water quality data taken from Department of Irrigation and Drainage (DID) will analyse in order to see the pattern of the changes and its effect.

1.5 SIGNIFICANCE OF STUDY

Identification of various size and types of sediments are vital to determine the total sediment loads due to transportability of sediment along the river. With the increase of sediment loads, the water level of river also increases which will cause flooding. Thus, this data analysis is important for authorities to take precautions. In addition, the sediments contain many toxic substances due to urban area which causes pollution to river. Therefore, it is vital for researcher to test and improve the water quality of the river.

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