DETERMINATION OF WATER QUALITY STATUS AND HEAVY METALS FOR SELECTED RIVER AT TASIK CHINI DUE TO LAND USE ACTIVITIES

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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

Tujuan kajian ini dijalankan adalah untuk mengkaji tahap kualiti air pada masa sekarang di sungai sekitar Tasik Chini iaitu Sungai Jemberau dan Sungai Chini pada musim kemarau tahun 2018 dan musim hujan tahun 2019. Terdapat tiga belas jenis parameter kualiti air dan tujuh jenis logam berat yang telah dibuat uji kajian dan dikelaskan berdasarkan Indeks Kualiti Air iaitu daripada Jabatan Alam Sekitar (DOE-WQI) dan Piawai Interim Kualiti Air Kebangsaan, Malaysia (INWQS). Antara parameter kimia dan fizikal yang telah dianalisis ialah pH, suhu, kekeruhan, Kekonduksian Elektrik (EC), Pepejal Terampai (SS), Jumlah Pepejal Terampai (TSS), Oksigen Terlarut (DO), Permintaan Oksigen Biokimia (BOD), Permintaan Oksigen Kimia (COD), Nitrogen Ammonia (NH3-N), Kalium (K), Nitrat (N) dan Fosforus (P) yang telah dianalisis di lokasi sampel diambil dan uji kajian di makmal juga dilakukan. Selain daripada itu, terdapat tujuh jenis logam berat yang telah diuji kajian di makmal untuk mengenalpasti kepekatan logam berat yang terdapat di dalam sampel air daripada Sungai Chini dan Sungai Jemberau. Kuprum (Cu), Kromium (Cr), Kadmium (Cd), Ferrum (Fe), Zink (Zn), Mangan (Mn) dan Plumbum (Pb) telah diuji menggunakan alat yang terdapat di makmal iaitu Atomic Absorption Spectroscopy (AAS). Di samping itu, kepekatan logam berat untuk sampel tanah semasa musim hujan yang diambil berhampiran Sungai Jemberau telah diuji di Makmal Berpusat Universiti Malaysia Pahang dengan menggunakan alat Inductively Coupled Plasma Mass Spectrometry (ICP-MS), manakala sampel air dari Sungai Jemberau dan Sungai Chini semasa musim kering telah diuji dengan menggunakan kepekatan logam berat untuk sampel tanah yang diambil berhampiran Sungai Jemberau telah dibuat uji kajian di Makmal Berpusat Universiti Malaysia Pahang dengan menggunakan alat Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). Menurut hasil kajian yang telah dibuat mengikut Indeks Kualiti Air (WQI), kualiti air di lokasi terpilih iaitu Sungai Jemberau dan Sungai Chini yang terletak berhampiran Tasik Chini telah dikelaskan sebagai Kelas III yang bermaksud air di sungai tersebut memerlukan rawatan secara meluas untuk memastikan kualiti air kembali bersih dan selamat digunakan sebagai air minuman kepada penduduk tempatan di masa hadapan. Menurut hasil kajian yang telah dijalankan, terdapat aktiviti yang dilakukan di sekitar Tasik Chini yang telah menyebabkan berlakunya pencemaran air yang melibatkan pelepasan logam berat. Antara aktiviti yang telah dikenalpasti sebagai penyebab utama pencemaran air di Tasik Chini ialah perlombongan besi, pertanian, pembalakan haram dan pembuangan sisa buangan daripada kawasan penempatan seperti tapak Program Latihan Khidmat Negara (PLKN).
The purpose of this study is to investigate the current water quality levels in the rivers around Lake Chini namely Jemberau River and Chini River during the dry season of 2018 and the rainy season of 2019. There are thirteen types of water quality parameters and seven types of heavy metals have been made experimental and classified based on the Water Quality Index which is from the Department of Environment (DOE-WQI) and the National Water Quality Interim Standard, Malaysia (INWQS). There are chemical and physical parameters that have been analyzed such as pH, temperature, turbidity, Electrical Conductivity (EC), Suspended Solids (SS), Total Suspended Solids (TSS), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Ammonia Nitrogen (NH3-N), Potassium (K), Nitrate (N) and Phosphorus (P) were analyzed at the sample site and laboratory experiments were also performed. In addition, there are seven types of heavy metals that have been tested in the laboratory to determine the concentration of heavy metals contained in the water samples from the Chini River and the Jemberau River. Copper (Cu), Chromium (Cr) Cadmium (Cd), Iron (Fe), Zinc (Zn), Manganese (Mn) and Lead (Pb) were tested using laboratory tools named as Atomic Absorption Spectroscopy (AAS). In addition, heavy metal concentrations for soil samples during rainy season taken near the Jemberau River were tested at the University Malaysia Pahang Central Laboratory using Inductively Coupled Plasma Mass Spectrometry (ICP-MS), while water sample from Jemberau River and Chini River during dry season were tested by using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). Based on the results of the study conducted according to the Water Quality Index (WQI), the water quality at selected locations which are Jemberau River and Chini River located near Lake Chini was classified as Class III which means water in the river requires extensive treatment to ensure water quality return clean and safe to use as drinking water to the locals in the future. According to the results of the study, there are activities conducted around Lake Chini which have caused water pollution which involves the release of heavy metals. Among the activities identified as the main cause of water pollution in Lake Chini are iron mining, agriculture, illegal logging and waste disposal from residential areas such as the National Service Training Program (PLKN).
# TABLE OF CONTENT

DECLARATION
TITLE PAGE
ACKNOWLEDGEMENTS ii
ABSTRAK iii
ABSTRACT iv
TABLE OF CONTENT v
LIST OF TABLES ix
LIST OF FIGURES x
LIST OF CHART xii
LIST OF ABBREVIATIONS xiii

## CHAPTER 1 INTRODUCTION

1.1 Background of Study 1
1.2 Problem Statement 2
1.3 Research Objectives 2
1.4 Scope of Study 3
1.5 Significance of Study 3

## CHAPTER 2 LITERATURE REVIEW

2.1 Introduction 4
2.2 Surface Water 5
2.3 Lake 5
2.4 Tasik Chini 6
2.5 Pollution of Lake 6
2.5.1 Point Source Pollution 7
2.5.2 Non-point Source Pollution 8
2.5.3 Run-Off 8
2.6 Water Quality 8
2.6.1 Physical Parameter 11
2.6.1.1 Temperature 12
2.6.1.2 Turbidity 12
2.6.1.3 Total Suspended Solid (TSS) 13
2.6.2  Chemical Parameter
  2.6.2.1 Electrical Conductivity (EC)
  2.6.2.2 pH
  2.6.2.3 Biochemical Oxygen Demand (BOD)
  2.6.2.4 Dissolved Oxygen (DO)
  2.6.2.5 Chemical Oxygen Demand (COD)
  2.6.2.6 Heavy Metals
  2.6.2.7 Nitrogen as Ammoniacal Nitrogen

CHAPTER 3 STUDY AREA AND METHODOLOGY

3.1  Introduction 17
3.2  Map Location 18
3.3  Sampling Area 19
  3.3.1 Jemberau River 19
  3.3.2 Chini River 20
3.4  Methodology Flow Chart 21
3.5  Research Method 22
  3.5.1 Sampling Station 22
  3.5.2 Preparation for Collecting Sample 23
  3.5.3 Sample Preservation 23
3.6  In-situ Test 24
3.7  Laboratory Test 25
3.8  Procedure for Laboratory Test 25
  3.8.1 Physical Parameter 25
    3.8.1.1 Turbidity 25
    3.8.1.2 Temperature 26
    3.8.1.3 Total Suspended Solid (TSS) 26
    3.8.1.4 Suspended Solid (SS) 27
  3.8.2 Chemical Parameter 28
    3.8.2.1 Biochemical Oxygen Demand (BOD) 28
    3.8.2.2 Chemical Oxygen Demand (COD) 31
    3.8.2.3 Nitrate 32
    3.8.2.4 Ammoniacal Nitrogen 33
    3.8.2.5 pH 34
3.8.2.6 Potassium 34
3.8.2.7 Heavy Metals 35

CHAPTER 4 RESULT AND DISCUSSION

4.1 Introduction 37
4.2 Water Quality Parameters in 2018 and 2019 38
  4.2.1 In-Situ Test Result 38
    4.2.1.1 pH 38
    4.2.1.2 Electrical Conductivity (EC) 39
    4.2.1.3 Turbidity 40
    4.2.1.4 Dissolved Oxygen (DO) 41
    4.2.1.5 Temperature 42
  4.2.2 Laboratory Test Result 43
    4.2.2.1 Biochemical Oxygen Demand (BOD) 43
    4.2.2.2 Chemical Oxygen Demand (COD) 44
    4.2.2.3 Ammoniacal Nitrogen 45
    4.2.2.4 Nitrate 46
    4.2.2.5 Total Suspended Solid (TSS) 47
    4.2.2.6 Phosphorus 48
    4.2.2.7 Potassium 49
    4.2.2.8 Heavy Metals (AAS Method) 50
4.3 Comparison of Water Quality during years 2016, 2017, 2018 and 2019 54
  4.3.1 In-Situ Test Result 54
    4.3.1.1 pH 54
    4.3.1.2 Electrical Conductivity (EC) 55
    4.3.1.3 Turbidity 56
    4.3.1.4 Dissolved Oxygen (DO) 57
    4.3.1.5 Temperature 58
  4.3.2 Laboratory Test Result 59
    4.3.2.1 Biochemical Oxygen Demand (BOD) 59
    4.3.2.2 Chemical Oxygen Demand (COD) 60
    4.3.2.3 Ammoniacal Nitrogen 61
    4.3.2.4 Nitrate 62
4.3.2.5 Total Suspended Solid (TSS) ................................. 63
4.3.2.6 Phosphorus ................................................. 64
4.3.2.7 Potassium ..................................................... 65
4.3.2.8 Heavy Metals .................................................. 66
4.4 Water Quality Index (WQI) ........................................... 70

CHAPTER 5 CONCLUSION AND RECOMMENDATIONS

5.1 Introduction .......................................................... 73
5.2 Recommendations .................................................... 74

REFERENCES .............................................................. 75
APPENDIX A ............................................................... 78
APPENDIX B ............................................................... 88
LIST OF TABLES

Table 2.1 Excerpt of the National Water Quality Standards 9
Table 2.2 DOE Water Quality Index Classification 10
Table 2.3 NWQS Class Definitions 10
Table 2.4 Water Quality Formula 11
Table 3.1 Preservation Techniques 24
Table 4.1 Results for Heavy Metals using AAS Method 50
Table 4.2 Weather forecast for October 2018 (rainy season) at Pekan, Pahang 52
Table 4.3 Weather forecast for February 2019 (dry season) at Pekan, Pahang 53
Table 4.4 Heavy Metal Results for soil sample at Jemberau River (outside river) 66
Table 4.5 Heavy Metal Results for soil sample at Jemberau River (inside river) 67
Table 4.6 Heavy Metal Results for water sample at Jemberau River 68
Table 4.7 Heavy Metal Results for water sample at Chini River 69
LIST OF FIGURES

Figure 3.1  Maps of Tasik Chini, Pekan Pahang 18
Figure 3.2  Jemberau River, Tasik Chini 19
Figure 3.3  Coordinate for Jemberau River 19
Figure 3.4  Chini River, Tasik Chini 20
Figure 3.5  Coordinate for Chini River 20
Figure 3.6  Determining position of sampling station 22
Figure 3.7  All apparatus are examined and prepared 23
Figure 3.8  In-situ Parameters Measurement 24
Figure 3.9  Recording of Turbidity Value 25
Figure 3.10  Measurement of Total Suspended Solids 27
Figure 3.11  Measurement of Suspended Solids using DR5000 28
Figure 3.12  Biochemical Oxygen Demand (BOD) Experiment 30
Figure 3.13  Chemical Oxygen Demand (COD) Experiment 31
Figure 3.14  Nitrate Reading by Using DR5000 32
Figure 3.15  Ammoniacal Nitrogen Reading by Using DR5000 33
Figure 3.16  Potassium Experiment by Using DR5000 35
Figure 3.17  Heavy Metals Test by Using AAS Method 36
Figure 4.1  Graph for pH in 2018 and 2019 38
Figure 4.2  Graph for Electrical Conductivity in 2018 and 2019 39
Figure 4.3  Graph for Turbidity in 2018 and 2019 40
Figure 4.4  Graph for Dissolved Oxygen in 2018 and 2019 41
Figure 4.5  Graph for Temperature in 2018 and 2019 42
Figure 4.6  Graph for Biochemical Oxygen Demand (BOD) in 2018 and 2019 43
Figure 4.7  Graph for Chemical Oxygen Demand (COD) in 2018 and 2019 44
Figure 4.8  Graph for Ammoniacal Nitrogen (NH3-N) in 2018 and 2019 45
Figure 4.9  Graph for Nitrate in 2018 and 2019 46
Figure 4.10  Graph for Total Suspended Solid (TSS) in 2018 and 2019 47
Figure 4.11  Graph for Phosphorus in 2018 and 2019 48
Figure 4.12  Graph for Potassium in 2018 and 2019 49
Figure 4.13  Graph for pH in 2016, 2017, 2018 and 2019 54
Figure 4.14  Graph for Electrical Conductivity in 2016, 2017, 2018 and 2019 55
Figure 4.15  Graph for Turbidity in 2016, 2017, 2018 and 2019 56
Figure 4.16  Graph for Dissolved Oxygen in 2016, 2017, 2018 and 2019 57
<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 4.17</td>
<td>Graph for Temperature in 2016, 2017, 2018 and 2019</td>
<td>58</td>
</tr>
<tr>
<td>Figure 4.18</td>
<td>Graph for Biochemical Oxygen Demand (BOD) in 2016, 2017, 2018 and 2019</td>
<td>59</td>
</tr>
<tr>
<td>Figure 4.19</td>
<td>Graph for Chemical Oxygen Demand (COD) in 2016, 2017, 2018 and 2019</td>
<td>60</td>
</tr>
<tr>
<td>Figure 4.20</td>
<td>Graph for Ammoniacal Nitrogen (NH3-N) in 2016, 2017, 2018 and 2019</td>
<td>61</td>
</tr>
<tr>
<td>Figure 4.21</td>
<td>Graph for Nitrate in 2016, 2017, 2018 and 2019</td>
<td>62</td>
</tr>
<tr>
<td>Figure 4.22</td>
<td>Graph for Total Suspended Solid (TSS) in 2016, 2017, 2018 and 2019</td>
<td>63</td>
</tr>
<tr>
<td>Figure 4.23</td>
<td>Graph for Phosphorus in 2016, 2017, 2018 and 2019</td>
<td>64</td>
</tr>
<tr>
<td>Figure 4.24</td>
<td>Graph for Potassium in 2016, 2017, 2018 and 2019</td>
<td>65</td>
</tr>
<tr>
<td>Figure 4.25</td>
<td>Graph for Water Quality Index at Jemberau River and Chini River during rainy season in 2018 and dry season in 2019</td>
<td>71</td>
</tr>
<tr>
<td>Figure 4.26</td>
<td>Graph for Water Quality Standard based on WQI at Jemberau River and Chini River during rainy season in 2018 and dry season in 2019</td>
<td>72</td>
</tr>
</tbody>
</table>
LIST OF CHART

Chart 3.1       Flow of Methodology       21
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAS</td>
<td>Atomic Absorption Spectroscopy</td>
</tr>
<tr>
<td>AN</td>
<td>Ammoniacal Nitrogen</td>
</tr>
<tr>
<td>APHA</td>
<td>American Public Health Association</td>
</tr>
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<td>BOD</td>
<td>Biochemical Oxygen Demand</td>
</tr>
<tr>
<td>COD</td>
<td>Chemical Oxygen Demand</td>
</tr>
<tr>
<td>DO</td>
<td>Dissolved Oxygen</td>
</tr>
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<td>DOE</td>
<td>Department of Environment</td>
</tr>
<tr>
<td>EC</td>
<td>Electrical Conductivity</td>
</tr>
<tr>
<td>FE</td>
<td>Iron</td>
</tr>
<tr>
<td>HACH DR 5000</td>
<td>Spectrophotometer Procedures Manual</td>
</tr>
<tr>
<td>H$_2$SO$_4$</td>
<td>Sulphuric Acid</td>
</tr>
<tr>
<td>K</td>
<td>Potassium</td>
</tr>
<tr>
<td>ICP-MS</td>
<td>Inductively Coupled Plasma-Mass Spectrometry</td>
</tr>
<tr>
<td>ICP-OES</td>
<td>Inductively Coupled Plasma-Optical Emission Spectrometry</td>
</tr>
<tr>
<td>Mg</td>
<td>Magnesium</td>
</tr>
<tr>
<td>Mg/L</td>
<td>Milligram per litre</td>
</tr>
<tr>
<td>Na</td>
<td>Sodium</td>
</tr>
<tr>
<td>NH$_3$-N</td>
<td>Ammoniacal Nitrogen</td>
</tr>
<tr>
<td>NO$_3^{-}$</td>
<td>Nitrate</td>
</tr>
<tr>
<td>NTU</td>
<td>Nephelometric Turbidity Units</td>
</tr>
<tr>
<td>NWQS</td>
<td>National Water Quality Standard</td>
</tr>
<tr>
<td>pH</td>
<td>Potential Hydrogen</td>
</tr>
<tr>
<td>PO$_{3-4}^{3-}$</td>
<td>Phosphate</td>
</tr>
<tr>
<td>SI</td>
<td>Sub-indices</td>
</tr>
<tr>
<td>TSS</td>
<td>Total Suspended Solid</td>
</tr>
<tr>
<td>$\mu$s/cm</td>
<td>Microsiemens per centimetre</td>
</tr>
<tr>
<td>WQI</td>
<td>Water Quality Index</td>
</tr>
</tbody>
</table>
CHAPTER 1

INTRODUCTION

1.1 Background of Study

Water is very important to human daily life. The quality of water that free from heavy metals from rivers, lakes, streams and ocean is very important for human in order to do their daily routine especially for drinking. Lakes are important source of freshwater which account only the very small part of around 0.01 percent of the global amount of water. Lakes are one of major water source in Malaysia as freshwater because they are often fed by rivers, rain and springs. The lake is very sensitive area because of the potential exposure pollutants from many sources. For example, pollution can flow through the water body of the lake by connecting to the river, water from runoff and from the deposition of atmospheric. The limited water movement within the lake affects the level pollution in the lake environment. Moreover, high concentrations pollutants can reduce the biodiversity of the lake ecosystem and change the physical environment around the lake.

In Malaysia, Tasik Chini which is located within the state of Pahang on the east coast of Peninsular Malaysia is the second largest natural lake in Malaysia after Tasik Bera. Surface area of the Tasik Chini covers 12,565 acres and it was surrounded by natural forest and aboriginal settlements. Tasik Chini has a unique shape that consists of 12 small lakes that local people called as “Laut” which is interconnected by natural channels. Tasik Chini has recreational value and ecological importance in terms of its biodiversity as this area richly endowed with biological resources and some 288 species of plants, 21 species of aquatic plants, 92 species of birds, and 144 species of freshwater fish.
1.2 Problem Statement

Tasik Chini is an ecological area which is importance due to large biodiversity and it is also very important for local parties’ economy. The mainstay economy is mainly forest-based and agriculture-based activities (Habibah et al., 2013). These activities could be the source for pollution to the lake. There is logging, iron ore mining, rubber plantation, palm oil plantation and residential area. There is presence of heavy metals that come from iron ore mining activities which gives bad effect to water quality of Tasik Chini. Accumulation of metals and organic pollutants in the sediments may have long-term adverse effects on aquatic organisms (Sun et al., 2018).

Heavy metals concentration such as Lead (Pb), Iron (Fe), Manganese (Mn), Cadmium (Cd), Zinc (Zn) and Chromium (Cr) become increasing due mining activities. Heavy metals are a metallic element that has a relatively high density, specific gravity, or atomic weight and has toxic effects (Jamshaid et al., 2018). Meaning that, if there are unwell-operated for mining activity, it will causes increasing of heavy metal concentrations in water body because lake is a stagnant water area surrounding by land which is term water pollution refers to any types of aquatic pollution between two extremes of a highly productive body of water poisoned by toxic chemicals that eliminates living organisms. Water quality is among the most important environmental issues related to sustainable development, especially to ensure national drinking water safety (Gao et al., 2019). So that, it is important to maintain a good quality of water in our life.

1.3 Research Objectives

i. To evaluate the characteristics of each water quality parameters and to analyze the current status of water quality at Jemberau River and Chini River during rainy season in 2018 and dry season in 2019.

ii. To identify current heavy metals level in Jemberau River and Chini River.
1.4 **Scope of Study**

This research is conducted on October 2018 until February 2019. The location of study area is at Tasik Chini, Pahang. The scope of study in this research is about effect from land use activities to the water quality at Jemberau River and Chini River that are currently facing problem due to mining activity, logging activity and agricultural activity. All of this activity can contribute to the increasing of heavy metal concentration and will give worse effect to the water quality at rivers. The increase in water demands causes more conflict between the human system and the river ecological system (Yan et al., 2018). There are two types of test that were conducted which are in-situ test and laboratory test in order to identify the water quality of selected river near the Tasik Chini. There are 5 in situ tests have been conducted which are temperature, pH, electrical conductivity, dissolved oxygen (DO) and turbidity. For laboratory test, 10 tests are conducted which are Biological Oxygen Demand (BOD₅) test, Chemical Oxygen Demand (COD) test, Total Suspended Solid (TSS) test, Suspended Solid (SS) test, Ammoniacal Nitrogen test, Phosphorus test, Nitrate test, Potassium test, Hardness test and Heavy Metal test.

1.5 **Significance of Study**

From this study, water quality of selected rivers at Tasik Chini will be determined based on the classification from Interim National Water Quality Standards for Malaysia (NWQS) and Water Quality Index (WQI). The data and result that has been collect and carried out from this research will be useful for water quality record in future studies. This is a good result to safeguard the safety of drinking water in future. Furthermore, by examining the quality of water, it raises awareness among the people surrounding Tasik Chini on the hygiene of their domestic water use. This research will give people surrounding Tasik Chini an understanding on how to protect their daily health and maintain good environment with great ecosystems.
REFERENCES


