EFFECTIVENESS OF SEDIMENT BASIN AND SILT TRAPS AT OIL PALM PLANTATIONS

NUR SYAHIZA BINTI ZAINUDDIN

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Universiti Teknologi Malaysia

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To

Beloved parents;

Mr. Zainuddin Said & Mrs. Jamilah Yusoff

&

Beloved sisters & brothers;

Halawati, Aini, Nazmi & Syafiq

For all of their patience and understanding

In the past, present, and future

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"In the name of God, the most Gracious, the most Compassionate"

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May all the good deeds that were done will be blessed by Allah. *Wassalam…*

ABSTRACT

In recent year, there has been an increasing comment over deterioration of water quality in many river systems in Malaysia. Therefore, this study analyse the effectiveness of implementing various types of sediment basin and silt trap in oil palm plantation located at Gua Musang. The district of Gua Musang is a major producer of oil palm plantation in Kelantan with the total area of 55 191 hectares. The aim of this study is to identify whether the water from this oil palm plantation be a part of contributor of the problem happened in Sg. Kelantan which is nowadays become shallow and polluted because of sedimentation problem. In this study there were three sediment basins has been analysed. A field measurement on suspended solid, turbidity and sediment loading was carried out before and after sediment basin. The range of Suspended Solid is between 5 mg/L to 50 mg/L before the sediment basins and 1 mg/L to 14 mg/L after sediment basins. Turbidity gives a result between 4.7 NTU to 79.0 NTU before the sediment basins and 5.8 NTU to 42.0 NTU after the sediment basins. From these data, total sediment loading per hectares was calculated and compared to the amount calculate by using USLE and MSLE formula. Beside that, the examination upon efficiency of sediment elimination was done and each sediment basin gave a result of 80%, 37.5% and 72%. However from questionnaire analysis on environmental awareness, the result shows that most developers and their workers awareness are still in moderate and low level.

ABSTRAK

Dewasa ini isu berkenaan kemerosotan kualiti air sungai-sungai yang terdapat di Malaysia semakin meningkat. Oleh yang demikian, kajian ini bertujuan untuk mengenalpasti keberkesanan kepelbagaian perangkap keladak yang dilaksanakan di ladang kelapa sawit di Gua Musang sebagai salah satu usaha pengawalan kemerosotan kualiti air. Daerah Gua Musang merupakan kawasan perladangan kelapa sawit utama di negeri Kelantan dengan keluasan 55 191 hektar. Matlamat kajian ini adalah untuk mengenalpasti samada aliran yang mengalir dari ladang kelapa sawit ini turut menyumbang kepada masalah yang berlaku di Sungai Kelantan di mana pada hari ini didapati semakin cetek & dan tercemar akibat daripada masalah pemendapan. Tiga perangkap keladak dianalisis. Pengukuran terhadap beberapa parameter kualiti air seperti pepejal terampai, kekeruhan dan beban sediment dibuat sebelum dan selepas perangkap keladak. Pepejal terampai memberi keputusan antara 5 mg/L hingga 50 mg/L sebelum perangkap keladak manakala 1 mg/L hingga 14 mg/L untuk selepas perangkap keladak. Kekeruhan memberi nilai antara 4.7 NTU hingga 7.90 NTU dan 5.8 NTU hingga 42 NTU masing-masing untuk sebelum dan selepas perangkap keladak. Daripada data tersebut, beban sedimen dikira dan perbandingan dibuat dengan menggunakan kaedah USLE dan MSLE. Selain itu, pemeriksaan terhadap keberkesanan penyingkiran keladak juga dianalisis dan ketiga-tiga perangkap yang dikaji masing-masing memberi peratus 80%, 37.5% dan 72%. Walaubagaimanapun, daripada keputusan analisa soal selidik, didapati tahap kesedaran terhadap kepentingan alam sekitar dikalangan pengusaha dan pekerjanya masih di peringkat sederhana dan perlu dipertingkatkan.

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LIST OF SYMBOL

A	-	Catchment area
a	-	An empirical coefficient
C	-	Erosion control practice factor
$\hat{C}$	-	EMC of pollutant
E	-	Mean annual soil loss
e	-	An empirical exponent
ha	-	hectare
K	-	Factor of the soil erodibility
km	-	Kilometer
L	-	Annual load of Pollutant
m	-	Meter
mg	-	Milligram
P	-	Factor expressing the effects of conservation
R	-	Rainfall erosivity factor
S	-	Slope steepness factor
s	-	second
V	-	Settling zone
VM	-	Vegetation management factor
V_R	-	Annual runoff depth
W	-	Average width
Y	-	Zone depth

LIST OF ABBREVIATION

AN	-	Ammoniacal Nitrogen
BOD	-	Biochemical Oxygen Demand
COD	-	Chemical Oxygen Demand
DO	-	Dissolved Oxygen
DOE	-	Department of Environment
EIA	-	Environmental Impact Assessment
EME	-	Environmental Monitoring Exercise
EMP	-	Environmental Monitoring Plan
INWQSM	-	Interim national Water Quality Standard for Malaysia
IZE		I. Z. Environmind
JUPEM	-	*Jabatan Ukur dan Pemetaan*
KHSB	-	Kapasiti Harapan Sdn. Bhd.
MPOB	-	Malaysian Palm Oil Board
MSLE	-	Modified Soil Loss Equation
POMs		Palm Oil Mills
PVSB	-	Peransang Venture Sdn. Bhd.
SS	-	Suspended Solid
TSS	-	Total suspended solids
USLE	-	Universal Soil Loss Equation
WQI	-	Water Quality Index

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CHAPTER I

INTRODUCTION

1.1 Preamble

When land is disturbed either for construction, agriculture, road building, mining, logging, or other activities, the soil erosion rate increase from 2 to 40 000 times (Goldman et. al., 1986). The effect of this phenomenon is millions of tons of the soil end up in our rivers, lakes, and reservoirs. Each year, billions of dollars have to spend by land developers or property owner in order to cleaning up sediment and repairing eroded stream banks, gullied hillsides, washed-out roads, mud chocked drains and other erosion damage.

Most erosion will cause sediment problem and this can be greatly reduced by proper planning and maintenance. Some of the methods are by using sediment basin and silt trap. We should bear in mind that these structures does not stop erosion. They only trap eroded soil before it can reach water body or adjacent property.

Generally, a sediment basin is designed to remove and retains portions of the sediment being carried by runoff. In essence, they work by slowing the velocity of runoff and letting suspended soil particles settle by gravity. During periods of heavy rainfall sediment basin or silt trap constructed in oil palm plantation site must be fully function to soakaways retain water and soil run-off. Therefore, leaf matter left

on slope from trimming the palm trees to harvest the fruit should be used to reinforce terraces or to otherwise create erosion barriers on contours. The other way is by construct silt pits along roads and in fields to trap eroded soil carried in runoff.

From management aspect, before any land is to be developed for oil palm cultivation, an Environment Impact Assessment (EIA) must be undertaken to ensure that there are no adverse effects on the environment arising from the cultivation of the crop. A detailed Environmental Monitoring Plan (EMP) with institutional reporting requirements, and parameters for monitoring of water quality, agrochemical usage, impact on aquatic life, changes in forest and wildlife and other impacts as based on public consultations must be included in the EIA study.

Environmental monitoring, auditing and surveillance must be conducted to ensure that all the works done are comply with the regulations and conditions lay down by the Department of Environment (DOE) prior to the commencement of a project.

1.2 Problem Statement

Kelantan River or namely as Sungai Kelantan in Malay language is the major river in Kelantan, Malaysia. It drains a catchment area of about 12 000 km² in north-east Malaysia and flows northwards into the South China Sea. The rainfall over the area varies between 0 mm in the dry season (March-May) to 1750 mm in the monsoon season (November-January). The average runoff from the area is about 500 m³/s. Figure 1.1 shows the satellite view of Kelantan River.

The Kelantan River regularly overspills its banks either during the months of November to February because of the northeast monsoon season or others reason. Some of the worst floods in recent years are listed in table 1.1 (Hazalizah, 2005).

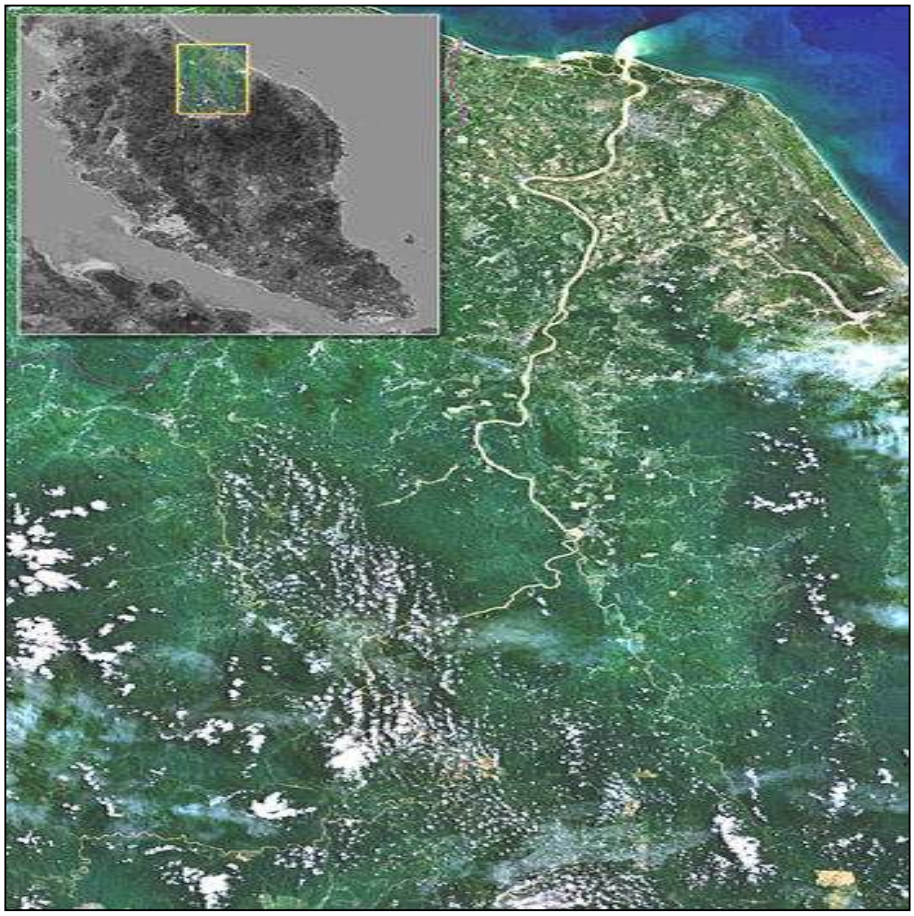

Figure 1.1: Satellite view of Kelantan River

(source: http://www.worldwindcentral.com)

Table 1.1: Flood impact in Kelantan

Year	Evacuees	Deaths	Damage (US$1000)
2004	10 476	12	3 767
2003	2 228	2	1 461
2001	5 800	0	2 227
1993	13 587	0	3 98
1988	41 059	0	*
1986	7 963	0	1 603
1983	33 815	0	*

** Data not available*

This flood phenomenon occurs because of many reasons. Latest issues contribute to this problem was report in The Star newspaper on 28 March 2007 where the last frontier in Lojing Highlands, Kota Bharu state with lush forest reserve is now in danger of being log bare and will give big impact on the state's ecology. The articles of this report are shown in Appendix 1.1 and 1.2. The existing impact has been studied and the result found that nowadays Kelantan River is become shallow and cannot provide irrigation resources to paddy farmers nearby. If this problem is not protected, it will affect the state's future natural resources which may be compromised by excessive logging. The purpose of logging activities carried out at this area is for development of oil palm plantation.

Oil palm (*Elaeis guineensis*) was first introduced into Malaysia as an ornamental plant in 1870 (Williams et. al., 1970). The cultivation of oil palm has grown every year since 1960 when the Malaysian government embarked on a massive agricultural diversification programme. It has now become the cornerstone of the country's agricultural sector, with a planted area of 4 165 215 hectares in 2006 (MPOB, 2006). Table 1.2 shows the statistics of oil palm land area at Malaysia for a few latest years. From that total area, Kelantan was covered about 80 152 hectares and Gua Musang is the main oil palm manufacturer for this state. Based on Country & Land Office of Gua Musang, the total area of oil palm cultivation in 2001 situated in Gua Musang is 51 170.5 hectares.

Table 1.2: Statistics of oil palm land area at Malaysia

Land Area (ha) under Oil Palm Cultivation (1975-2006)								
1980	1985	1990	1995	2000	2003	2004	2005	2006
1 023 306	1 482 399	2 029 464	2 540 087	3 376 644	3 802 040	3 880 000	4 051 374	4 165 215

(Source: MPOB Malaysia, 2006)

Oil palm cultivation can cause erosion and sedimentation during its operation. This sediment will wash away into the lakes, rivers and waterways. Although this sediment is only a fraction of the total sediment load, it is a major source of pollution

of many lakes, streams and river. Eroded soil contains nitrogen, phosphorus, and other nutrients (Goldman et. al., 1986). When carried into water bodies, these nutrients trigger algal bloom that reduce water clarity, deplete oxygen, lead to fish kills and create odors. Turbidity from sediment also reduces in-stream photosynthesis, which leads to reduce food supply and habitat.

To prevent eroded soil or sediment from polluted the nearest river or stream, one of the methods that can be implementing is by using sediment basin or silt trap. Nowadays, there is very little performance data on sediment or silt structures at one site. All too often these structures have been constructed with major flaws which prevent good performance. In other cases, these sediment basin and silt trap have been properly constructed but not monitored or maintained.

The fact is, those structures required maintenance and cleaning at regular intervals. If too much sediment is allowed to accumulate in them, they will cease to function. Little or no settling will occur, and trapped sediment will be resuspended and washed away. Finally, sediment basin can pose a safety hazard to human when water is impounded in them.

Awareness on above phenomenon was the main reason why this study was conducted. Two main areas were chosen around Gua Musang. First project site was initiated by Kapasiti Harapan Sdn. Bhd. (KHSB) which is located at PT 4957 & 4958, Mukim Ulu Nenggiri, Daerah Bertam, Gua Musang, Kelantan Darul Naim. This oil palm site is situated adjacent to the north, south and east of Hutan Rizab Sungai Betis and west of Hutan Rizab Sungai Papan. Total area for this project site is 3 000.00 acres (1, 214.06 hectares).

The second project site was initiated by Peransang Venture Sdn. Bhd. (PVSB). PVSB have been given responsibility to develop approximately 2,000.00 acres (809.39 hectares) land located at PT 5011, Mukim Ulu Nenggiri, Daerah Bertam, Gua Musang, Kelantan into an oil palm plantation project. This project site is located adjacent to the north, south, west and east of Hutan Rizab Sungai Betis. Both project sites are situated near the main river and small rivulets which found scattered within the project area. Therefore, it is important to study the effectiveness

of sediment basin and silt trap constructed at both side in order to check the efficiency.

1.3 Aim of Study

The aim of this study primarily at deriving the level of effectiveness and awareness on sediment basin and silt trap implemented in oil palm plantation at Gua Musang.

1.4 Objective

The objective of this study was three-fold, namely:

i. To determine the efficiency of sediment basin and silt trap implemented in oil palm plantation.
ii. To analyze the trend of water quality at the project sites.
iii. To identify the level of environmental awareness among developers or planters involve in oil palm plantation project.

1.5 Scope of Study

The scope of the study covers all types of sediment basin and silt trap located at two oil palm plantation given below:

i. Oil palm plantation at PT 4957 & 4958, Mukim Ulu Nenggiri, Daerah Bertam, Gua Musang, Kelantan Darul Naim which initiated by Kapasiti Harapan Sdn. Bhd. (KHSB), and

ii. Oil palm plantation at PT 5011, Mukim Ulu Nenggiri, Daerah Bertam, Gua Musang, Kelantan Darul Naim which initiated by Peransang Venture Sdn. Bhd. (PVSB).

This study will concentrate on deriving the effectiveness of sediment basin and silt trap implemented in oil palm plantation in Gua Musang. The effectiveness will be determined based on considering a few factors. Suspended solid and turbidity are the main parameter studied for both sediment basin and silt trap. Assessment on water quality of water bodies on selected parameters namely pH, Dissolved Oxygen (DO), temperature, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Suspended Solid (SS), Ammoniacal Nitrogen (AN), E-Coli and Oil & Grease are also conducted to analyze water quality at the site.

Beside that, erosion risk analysis was also done by comparing with Universal Soil Loss Equation (USLE) method and Modified Soil Loss Equation (MSLE) method. This study also conducted interview session with project proponent and workers in order to analyze their level of environmental awareness on implementing oil palm plantation project.