

A STUDY OF SEDIMENT YIELD IN KERTEH RIVER
CATCHMENT AREA USING GIS TECHNOLOGY

CHEAH MUN WEI

FACULTY OF MARITIME STUDIES AND MARINE SCIENCE
UNIVERSITI MALAYSIA TERENGGANU

2011

**A STUDY OF SEDIMENT YIELD IN KERTEH RIVER CATCHMENT AREA BY
USING GIS TECHNOLOGY**

By

CHEAH MUN WEI

**Research Report submitted in partial fulfillment of
The requirement for the degree of
Bachelor of Science (Marine Science)**

**Department of Marine Science
Faculty of Maritime Studies and Marine Science
UNIVERSITI MALAYSIA TERENGGANU
2011**

This project report should be cited as:

Cheah, M.W. 2011. A Study of Sediment Yield in Kerteh River Catchment Area using GIS Technology. Undergraduate thesis, Bachelor of Science in Marine Science, Faculty of Maritime Studies and Marine Science, Universiti Malaysia Terengganu, Terengganu. 63p.

No part of this project report may be reproduced by any mechanical, photographic, or electronic process, or in the form of phonographic recording, nor may it be stored in a retrieval system, transmitted, or otherwise copied for public or private use, without written permission from the author and the supervisor(s) of the project.

11
5
4/12/2011
2
2011



**DEPARTMENT OF MARINE SCIENCE
FACULTY OF MARITIME STUDIES AND MARINE SCIENCE
UNIVERSITI MALAYSIA TERENGGANU**

**DECLARATION AND VERIFICATION REPORT
FINAL YEAR RESEARCH PROJECT**

It is hereby declared and verified that this research report entitled:
**A STUDY OF SEDIMENT YIELD IN KERTEH RIVER CATCHMENT AREA
BY USING GIS TECHNOLOGY** by **CHEAH MUN WEI**, Matric No. **UK17102**
have been examined and all errors identified have been corrected. This report is
submitted to the Department of Marine Science as partial fulfillment towards obtaining
the Degree of (Science) Marine Science, Faculty of Maritime Studies and Marine
Science, Universiti Malaysia Terengganu.

Verified by:

Principal Supervisor

Name: **DR. RAZAK ZAKARIYA**
Ketua Jabatan Sains Marin
Official stamp: **Fakulti Pengajian Maritim dan Sains Marin
Universiti Malaysia Terengganu
(UMT)**

Date: **26/4/11**

Head of Department of Marine Science

Name: **DR. RAZAK ZAKARIYA**
Ketua Jabatan Sains Marin
Official stamp: **Fakulti Pengajian Maritim dan Sains Marin
Universiti Malaysia Terengganu
(UMT)**

Date: **26/4/11**

Acknowledgement

First and foremost, I would like to express my sincere gratitude and deepest appreciation to my project supervisor Dr Razak Zakariya for all the advices and guidance given in order to assist me in the completion of this study.

Secondly, I would like to thank to all of the remote sensing and GIS laboratory staffs for their corporation. My gratitude also gone to master student Mr. Muhammad Taufiq Bin. Abu Bakar, for his patient in teaching and sharing his knowledge during my conduction of the project.

Thirdly, my gratitude also to Malaysia Center for Remote Sensing (MARCES), Department of Drainage and Irrigation of Malaysia (DID), Malaysia Department of Agriculture (DOA), Malaysia Metrological Department (MMD), Malaysia Department of Survey and Mapping and Institute of Oceanography for their support on Materials.

Furthermore, I also want to gratefully acknowledge my team work members Wong Fen Fen and Tan Beng Lee for their corporation, help and advice during sampling and in the laboratory.

Last but not least, my sincere gratitude to my beloved family, for their interest and support. Especially, for my parents because their always encouragement and effort to help me to achieve my goals.

TABLE OF CONTENTS

CONTENT	PAGE
1.0 INTRODUCTION	1
1.1 Introduction	1
1.1 Justification	3
1.2 Objectives	5
2.0 LITERATURE REVIEW	6
2.1 Sediment	6
2.1.1 Suspended sediment	7
2.1.2 Sediment load	8
2.1.3 Sediment yield	9
2.2 River Catchment / Drainage Basin	9
2.3 Geographic Information System (GIS)	10
2.4 Watershed Modelling	11
2.5 AVSWAT	13
2.5.1 Comparison of watershed model (AVSWAT and CONCEPTS)	14
2.6 Review of Method and Study Area	18
2.7 Review on the Previous Study of Sediment Yield in Malaysia	19
3.0 METHODOLOGY	21
3.1 Study area	21
3.2 Material	23

3.3	General Methodology	24
3.4	Ground Survey	25
3.4.1	Land cover activity	26
3.4.2	Suspended sediment concentration sampling	26
3.5	Suspended Sediment Concentration At The Laboratory	27
3.6	AVSWAT Simulation- Input Data	30
3.6.1	Edit SWAT database	30
3.6.1a	soil data	30
3.6.1b	weather and precipitation data	31
3.7	Watershed Delineation	32
3.8	Land Use and Soil Definition	33
3.9	Run Simulation	35
4.0	RESULT	37
4.1	Suspended Sediment Concentration	37
4.2	Watershed Delineation	41
4.3	Land Use Classification	42
4.4	Soil Type Classification	45
4.5	SWAT Simulation	47
4.6	Analysis (Correlation Coefficient)	49
4.7	AVSWAT Prediction	51
5.0	DISCUSSION	53
5.1	Suspended Sediment Concentration (SSC)	53
5.2	Watershed Delineation	55

5.3	Effect of Land Use Activity on Sediment Yield	56
5.4	SWAT Simulation	58
5.5	AVSWAT Prediction	59
6.0	CONCLUSION AND RECOMMENDATION	61
6.1	Conclusion	61
6.2	Recommendation	62
REFERENCES		
APPENDICES		
VIRAE CURICULUM		

TABLE OF TABLE

TABLE		PAGE
2.1	Summary of watershed model and procedures	17
4.1	Suspended sediment concentration (SSC) in station 1 and station 2	39
4.2	The averages of SSC values for first and second sampling in the study area	41
4.3	Land use classification for the Kerteh River catchment area	44
4.4	The percentages of watershed area for each soil classes in the study area	46
4.5	The sediment out from the sub-basins 41 and 42 for the Kerteh River catchment area	48
4.6	The in-situ data (suspended sediment concentration) and the simulation data (sediment out) from the Kerteh River catchment area	49
4.7	The prediction of the sediment yield from year 2015 until 2040	51

TABLE OF FIGURES

FIGURE		PAGE
3.1	The catchment area of Kerteh River where the study is conducted	22
3.2	The water samples are collected from the station 1 and station 2 along the Kerteh River catchment area	22
3.3	Flow diagram of the general methodology	25
3.4	Process of collected the water samples for SSC analysis	27
3.5	Process of remove all the particle and dust from the filter paper	28
3.6	Process of suspended sediment concentration analysis	29
3.7	The main interface screen once AVSWAT is loaded in Arc View	30
3.8	The soil data information of the study area was inserted into edit SWAT database-user soils dialog	31
3.9	User weather stations dialog is use to insert weather and precipitation data into SWAT database	32
3.10	The watershed delineator dialog in AVSWAT	33
3.11	The geomatic correction of SPOT-5 satellite images of the study area	34
3.12	The land use and soil types distribution in Kerteh River catchment area	35
3.13	The dialog for the set up and run the simulation	36
4.1	The relationship between the time series and suspended sediment concentration for station 1 and station2 for the first and second sampling.	40
4.2	Watershed sub-basins with the stream network for Kerteh River catchment area	42

4.3	Land use classification of the Kerteh River catchment area	44
4.4	The percentages areas for land use classification in the catchment area	45
4.5	Soil map that show seven types of soil classes that found in Kerteh River catchment area	46
4.6	Percentages of watershed area for each soil classes	47
4.7	AVSWAT prediction of sediment discharge out from the sub-basins 41 and 42 for the sampling dates	49
4.8	The relationship between the suspended sediment concentration and the amount of sediment discharge out from the sub-basin 41 (station2) and sub-basin 42 (station 1)	50
4.9	The prediction of the sediment yield in the Kerteh River catchment area from year 2015 until 2040	52

LIST OF ABBREATION

%	-	Percentages
°C	-	Degree Celsius
µm	-	Micrometer
am	-	morning
ARS	-	Agriculture Research Service
AVSWAT	-	Arc View Soil Water Assessment Tools
CONCEPTS	-	Conservation Channel Evolution and Pollutant Transport System
dbf-	-	dBase file
DEM	-	Digital Elevation Model
E	-	East
FRSR	-	Forest evergreen
g	-	Gram
GIS	-	Geographic Information System
GPS	-	Global positioning System
ha	-	Hectare
hr	-	Hour
HRU	-	Hydrology Respond Unit
km	-	Kilometer
mg/L	-	milligrams per liter
mm	-	Millimeter
m/s	-	meter per second

MJ/m ² /day	-	Megajoule per square meter per day
N	-	North
NSL	-	National Sedimentation Laboratory
ORCH	-	Orchard
pm	-	Afternoon
.shp.	-	Shape file
R ²	-	Correlation Coefficient
SSC	-	Suspended Sediment Concentration
SWAT	-	Soil Water Assessment Tools
TSS	-	Total Suspended Solid
USDA	-	United State Department of Agriculture
USGS	-	United State Geological Survey

LIST OF APPENDICES

Appendix		Page
I	Soil input data required by the SWAT edit database	70
II	Weather data and precipitation data required by the SWAT edit database	72
III	The percentages of the land use and soil types cover the watershed area	74
IV	Calculate the suspended sediment concentration for the station 1 and station 2	76

ABSTRACT

To date, Kerteh is under rapid development via expansion of the industrialization area as well as the increase in population. Thus, the study of sediment yield was conducted in Kerteh River catchment area. The methodology of this study is divided into two parts which is the ground sampling and using GIS technology (AVSWAT) to create a watershed model to predict the sediment yield in the study area. For the ground sampling, the water samples from the station 1 and station 2 were collected to determine the suspended sediment concentration (SSC) from the study area by using SSC method. Furthermore, the actual land use activity of the study area was recorded which the latter was used in the AVSWAT. The digital elevation model, land cover data, stream network data, soil data, weather data, and precipitation data were loaded into AVSWAT to simulate the suspended sediment yield in the study area. The simulation of the sediment yield must be compare with the SSC to make the AVSWAT to simulate an accurate data of sediment yield in the study area. The correlation coefficient is use in this study to determine the relationship between SSC and the simulation of suspended sediment load by the AVSWAT in the station 1 and station 2. The correlation coefficient has shows a very strong relation between the SSC and simulation data by the AVSWAT. This is due to the R value of the station 1 is 0.926 and station 2 is 0.864. The prediction of the sediment yield in the Kerteh River catchment area from year 2015 until year 2040 is in the ranges 731700 metric tonne until 1782000 metric tonne.

Thus, it can be concluded that, the study of the sediment yield in a catchment area can be using GIS technology (AVSWAT) to create a watershed model to predict the sediment yield. Since, it is easier and economic if compare to do the ground sampling at the study area for a long period to collect the useful data.

Kajian Terhadap Jumlah Hasil Sedimen Yang Berada Pada Kawasan Tadahan Kerteh Dengan Menggunakan GIS Teknologi

ABSTRAK

Pada masa kini, Kerteh sedang mengalami perkembangan yang pesat melalui perluasan kawasan perindustrian dan peningkatan penduduk. Dengan demikian, satu kajian yang berkaitan dengan jumlah hasil sedimen yang berada di kawasan tadahan Kerteh telah dilakukan. Metodologi bagi kajian ini telah dibahagikan kepada dua bahagian. Bahagian pertama ialah mengambil sample air daripada stesen 1 dan stesen 2 untuk mengkaji kepekatan sedimen terapung (SSC) dengan menggunakan kaedah SSC. Selain itu, penggunaan tanah yang berada di kawasan tadahan Kerteh telah dicatatkan untuk digunakan dalam AVSWAT. DEM, data penggunaan tanah, data rangkaian aliran sungai Kerteh, data tanah dan data cuaca telah dimasukkan ke dalam AVSWAT untuk mensimulasikan jumlah hasil sedimen yang ada pada kawasan kajian. Simulasi hasil sedimen perlu dibandingkan dengan SSC untuk membantu AVSWAT mensimulasikan data yang lebih tepat di kawasan kajian tersebut. Pekali korelasi telah digunakan dalam kajian ini untuk mengetahui hubungan antara SSC dengan hasil sedimen yang disimulasikan oleh AVSWAT pada stesen 1 dan stesen 2. Pekali korelasi pada stesen 1 dan stesen 2 telah menunjukkan hubungan yang sangat kuat antara SSC dengan data simulasi. Hal ini disebabkan, nilai R bagi stesen 1 adalah 0.926 dan stesen 2 adalah 0.864.

Ramalan jumlah hasil sedimen di kawasan tadahan Kerteh dari tahun 2015 hingga tahun 2040 adalah berada pada langkungan 731.700 metrik tan hingga 1.782.000 metrik tan. Dengan demikian, kajian ini menyimpulkan bahawa hasil sedimen di kawasan tadahan Kerteh boleh dilakukan dengan menggunakan teknologi GIS (AVSWAT) untuk mencipta satu model bagi meramalkan jumlah hasil sedimen. Hal ini disebabkan, AVSWAT adalah lebih mudah dan ekonomi jika dibandingkan dengan kaedah tradisional yang menggunakan jangka masa yang lama untuk mengumpul data yang bermanfaat.