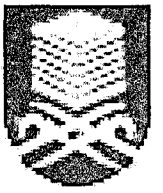
MODELLING AND MONITORING WATER QUALITY OF INLAND WATERBODIES USING REMOTE SENSING AND GIS METHODS



INSTITUT PENYELIDIKAN, PEMBANGUNAN DAN PENGKOMERSILAN
UNIVERSITI TEKNOLOGI MARA
40450 SHAH ALAM, SELANGOR
MALAYSIA

BY
ASSOC. PROF. DR. WAN MOHD NAIM B WAN MOHD
(PROJECT LEADER)

ASSOC. PROF. ABDUL MALEK B MOHD NOOR
AINON NISA BT OTHMAN

JANUARY 2006

Tarikh : 2 Mei 2006
No. Fail Projek :

Penolong Naib Canselor (penyelidikan)
Institut Penyelidikan, Pembangunan Dan Pengkomersilan
Universiti Teknologi Mara
40450 Shah Alam, Selangor
Malaysia

Y Bhg. Prof.

LAPORAN AKHIR PENYELIDIKAN

Perkara di atas adalan dengan hormatnya dirujuk.

Bersama-sama surat ini disertakan 2 naskah laporan akhir penyelidikan bertajuk "MODELLING AND MONITORING WATER QUALITY OF INLAND WATERBODIES USING REMOTE SENSING AND GIS METHODS".

Sekian, terima kasih.

Yang benar

Prof. Madya Dr. Wan Mohd Naim b. Wan Mohd
Ketua
Projek Penyelidikan

TABLE OF CONTENTS

ABSTRACT

Malaysia can be considered as one of most developed nation among Developing Countries and has undergone rapid development in many sectors. One of the consequences of rapid development is water pollution. Almost half of the coastal waters and beaches monitored by the Department of Environment are polluted with oil and grease mainly from ships plying Malaysian waters. As the country is now having a fast economic growth, there will definitely be an increase in water demand for other sectors such as industries and household consumers and coupled with the country's limited water resources, there is a need for a more efficient and responsive water quality monitoring and distribution management system to be implemented especially in the supply sources (i.e. reservoir). Catchment can be categorized as sensitive area. The developments within the catchment areas affect the water quality of the nearby reservoir. The program to monitor water quality of water bodies such as reservoirs in Malaysia is limited. A limited number of water quality monitoring stations, limits the initial strategy in water quality monitoring and prevention programs in Malaysia. Manual technique of monitoring water quality is costly and time consuming. One possible alternative is to use remote sensing technology. The objectives of this study are to i) review existing models which relates of satellite images spectral reflectance and water quality parameter, ii) to map and compare water quality of six (6) reservoirs in the state of Selangor and Negeri Sembilan based on existing models and iii) to identify the relationship between water quality and land use development within the catchment areas. Three (3) different Landsat 7 Enhance Thematic Mapper Plus (ETM+) datasets dated 15th July 2000, 31st May 2001 and 20th September 2001 were used. Manual water quality sampling of the Klang Gates Reservoir were also carried out on the 17th March 2004 and 23rd March 2004. This study only concentrate one water quality parameter i.e. total suspended solids (TSS). The study areas for this research include six (6) reservoirs located within the Klang Valley Region and part of Negeri Sembilan. Two (2) different models as used by earlier researchers, Baban (1993) and Keiner and Yan (1998) were used in this study. The kriging interpolation in the ArcView GIS 3.1 software is used to generate the water quality maps based on manual water quality sampling. ERDAS Imagine software is used to generate water quality maps from satellite images. Initial results from this study have indicated that Klang Gates Reservoir have poorer water quality at the upstream as compared with the downstream. Different results are obtained when different models are applied to the Landsat 7 ETM+ images of the study areas. The Langat and Klang Gates reservoirs can be considered to have good water quality (low TSS concentration) as compared to other reservoirs such as Semenyih, Sungai Batu, Sungai Terip and Sungai Buloh. Sungai Terip reservoir has the worst water quality. Land use development with the catchment and the amount of rainfall contribute the degradation of reservoir water quality.

CHAPTER 1

INTRODUCTION

1.1 Background

Malaysia can be considered as one of most developed nation among the Developing Countries and has undergone rapid development in many sectors. One of the consequences of rapid development is water pollution. According to the Department of Environment of Malaysia - DOE (2002), almost half of the coastal waters and beaches being monitored are polluted with oil and grease mainly from ships plying Malaysian waters. Besides oil and grease, 29.2 per cent of beaches and coastal waters are polluted with suspended solids, 13.3 per cent with E. Coli, and 19.5 per cent with heavy metals such as copper and mercury. Suspended solids are mostly from land-based activities. On river water quality, DOE's checks revealed that most of the rivers in the Klang Valley Region are highly polluted.

As the country is now having a fast economic growth, there will definitely be an increase in water demand for other sectors such as industries and household consumers and coupled with the country's limited water resources, there is a need for a more efficient and responsive water quality monitoring and distribution management system to be implemented especially in the supply sources (i.e. reservoirs). In Malaysia, especially in Selangor Darul Ehsan, there are many reservoirs located within the Klang-Langat watershed. This watershed is located in the mid western part of Peninsular Malaysia and encompasses several administrative districts of Selangor. There are currently five (5) reservoirs i.e. Batu Reservoir, Klang Gate Reservoir, Pangsun Reservoir, Langat Reservoir and also Semenyih Reservoir within this watershed. These water catchment areas functions as water supply for the population in the Klang Valley Region. In Negeri Sembilan Darul Khusus, there are also five (5) main reservoirs i.e. the Ulu Muar Reservoir, Sg. Kelinci Reservoir, Sg. Terip Reservoir, Pedas Reservoir and Gemencheh Reservoir.

In Malaysia itself, reservoir can be used for a number of functions such as flood control, hydroelectric, irrigation or drinking water supply (Marie, 1998). As reported by