Proceedings of the International Conference on

Disaster Risks and Climate Change: Technological and Managerial Opportunities and Challenges for the GMS

Organized by

Center for Natural Resources and Environmental Management
Mae Fah Luang University

in cooperation with

FULBRIGHT

Thailand - United States Educational Foundation (TUSEF/Fulbright)

The Institute for the Promotion of Teaching Science and Technology (IPST)

Office of the Higher Education Commission (OHEC)

Office of National Research Council of Thailand (NRTC)

on July 10-12, 2010

August 2010
Mae Fah Luang University
Chiang Rai, Thailand

Proceedings of the International Conference

on

"Disaster Risks and Climate Change: Technological and Managerial Opportunities and Challenges for the GMS"

July 10-12, 2010

Mae Fah Luang University, Chiang Rai, Thailand

Organized by

Center for Natural Resources and Environmental Management,
Mae Fah Luang University
Thailand - United States Educational Foundation (TUSEF/Fulbright)
The Institute for the Promotion of Teaching Science and Technology (IPST)
Office of the Higher Education Commission (OHEC)
Office of National Research Council of Thailand (NRTC)

Editorial Team

Dr. Hansa Sanguannoi, Dr. Nguyen Luong Bach,
Dr. Richard J. Frankel, and Ms. Nuttiga Hempattarasuwan

August, 2010

TABLE OF CONTENTS

Assessment of Scale and Pollution Level of Surface Water due to Industrial Discharge and the Purification of Thi Vai River using MIKE 21

Assoc. Prof. Dr. Bui Ta Long

Institute of Environment and Resources[2], Vietnam National University of Ho Chi Minh City

Ho Chi Minh City, Vietnam SR

Abstract

The problem of evaluating the impact of Vedan and groups of industrial park on the water environment on Thi Vai river basin, which often gather a dense network of economic activities is the subject of many programs, topic, research projects at all levels / [1] - [2] /.The complexity of this problem is because the system Thi Vai river basin is characterized by a complex hydrological regime. In addition, the presence of many sources of discharge changing overtime often impacts on the water environment makes the problem becomes very complex. To determine water quality of the basin should note to the the interaction of physical processes, chemical and biological. All this requires the application of the approach of environmental information systems and modeling tools.

The value of model was recognized in the world. But in Vietnam the application of this method still limited. In these topic and project, modeling is only considered as the reference and consistency with other areas, particularly information technology applications. One reason is the application of model requires more standardized data in the following steps: verification, calibration and through modeling.

During the period from 7/2009 to 3/2010, the authors have studied Mike21 software which are being widely used all over the world. In this report presents some initial results by using Mike21 software to evaluate the role of many enterprises (including Vedan) for polluting in the Thi Vai river. Modeling results help determine the scale of influence due to discharge without treatment. Based on the calculation results that help managers to propose solutions for solving problems in economic compensation to people. This is the most interested problem today.

[2] 142 To Hien Thanh Str., Dist. 10, Hochiminh city, longbuita@yahoo.com

1. Introduction

Thi Vai River basin is located on the left downstream of Dong Nai river. Upstream include Ca stream and Le stream. Ca streams is 41km long, basin area is 185 m^2, Le stream is 19 km long, basin area is 85 km^2. Thi Vai River is about 76 km long, flows through the region of Ba Ria - Vung Tau and Dong Nai province and extends to the fork (confluence) Go Gia River with total area of basin is 494 km^2, flowing into Cai Mep river (territory of Ho Chi Minh City and Ba Ria - Vung Tau) and flowing into the East Sea in Vanh Rai bay. Thi Vai river has salty water (due to salinity >0.25 g/l), short, rather broad and deep, can be regarded as a fjords on the mainland, influenced by the tide regime of the East Sea.

Thi Vai river flows directly into Vanh Rai bay. River has many tributaries in the downstream such as: Ca stream, Rạch Nước Lớn, Rach Chanh,... Thi Vai River has an average width from 300-800 m and depth from 30-50 m, so the ship tonnage of 60,000 tons can go through, river traffic is very convenient. However, Thi Vai River has salty water so could not be used for irrigation and water supply for living. Thi Vai River has strongly influenced by the tidal regime and here is the development of diverse ecosystems in brackish water, on the other hand it is also very favorable environment for professional development of aquaculture and fishing.

Thi Vai River is the source receiving wastewater from industrial parks and businesses which have a large volumn of waste discharge such as: Go Dau Industrial Zone, joint stock limited company Vedan Vietnam (Long Thanh district), Nhon Trach 1, Nhon Trach 2, Nhon Trach 3 - phase 1, Nhon Trach 3 - phase 2, Nhon Trach 5, Nhon Trach Textile and Garment (Nhon Trach district) of Dong Nai province. Besides, the Thi Vai River is also a source receiving wastewater from industrial zones such as: My Xuan A, My Xuan A2, B1 My Xuan, Phu My 1 and Cai Mep which are territory of Ba Ria - Vung Tau. According to the works [15] the total industrial wastewater according to the statistics and the actual inspection is 33.267m^3/day (Dong Nai: 21.877m^3/day and Ba Ria - Vung Tau: 11.390m^3/day). Total volume of waste water from aquaculture activities discharged into Thi Vai River is 58,698 to 93,917 m^3/day. Total volume of waste water from residential into Thi Vai River is 6078-8104 m^3/day. The Thi Vai River is also receive the waste water of manufacturing facilities, business services, and agricultural activities in the region, self-cleaning ability of Thi Vai River is poor. In addition, the Thi Vai river also affected by pollution sources imported from offshore flow regime in the tide. With the above characteristics, the Thi Vai River could not to be used for drinking water, which are mainly used for traffic purposes, aquaculture,

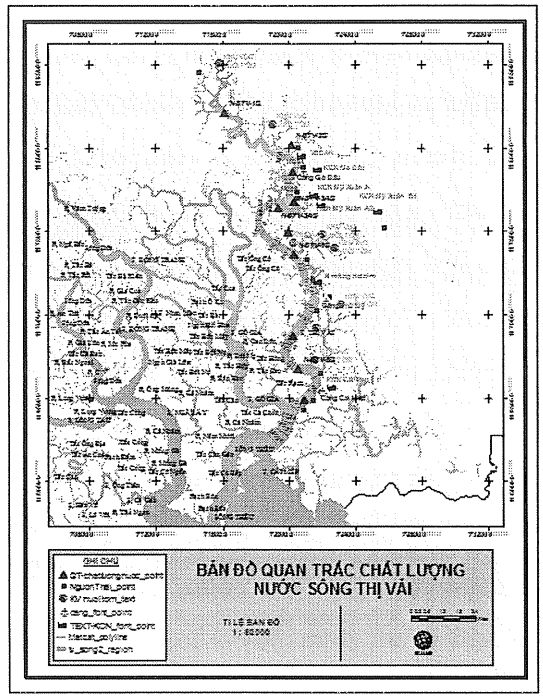


Figure 1: Map overview of research subject

2. Methodology

2.1 Modeling

Currently there are many mathematical models of water quality are widely used all over the world. These models are used for free or commercial models have to buy rights to use. Each model has its own strengths but in general licensed models are often reliable and stable than the model used for free.

The choice of model is very important stage in the process of calculation, this work is conducted based on the objectives of the problem and the database available. In this study, the software MIKE21 and MIKE11 mathematical model was chosen as it meets the following criteria:

- The software integrates multiple features;
- The software has been tested reality;
- Allows calculation of water quality with high accuracy;
- User interface friendly, easy to use;
- There are technical GIS applications, a new technique with high efficiency;

MIKE11 model and MIKE21 model is a specialized software engineering was building and development by DHI (Danish Hydraulics Institute) in about 20 years. It is used to simulate

flow, water quality and transportation move sediment in estuaries, rivers, irrigation systems, channels and other water systems. MIKE software includes a lot of software with difference function and task such as MIKE 11, MIKE 21, MIKE 31, MIKE GIS, MIKE Basin, MIKE SHE, MIKE MOUSE.... MIKE 11 is comprised of various modules with different capabilities and tasks such as:

Hydraulic module (HD)

Module rain runoff (RR)

Module load - Diffusion (AD)

Modular water quality (WQ) and some other modules.

In the model MIKE21 and MIKE11 the hydraulic module (HD) is a central part of the model, however, depending on the purpose for which we use in combination with other modules that are reasonable and scientific. In this study, the application module includes / [3] - [4] /:

Hydraulic module (Hydrodynamic - HD);

Diffusion load module (Advection Dispersion - AD);

Eco Module (Ecolab).

2.2 Describe Selected Area

In this topic the scope is shown on Figure 2. Selected parts of the river is 34 km in length and area is 19.75 km^2. The location and the parameters of two discharging of Vedan is shown in Figure 2.

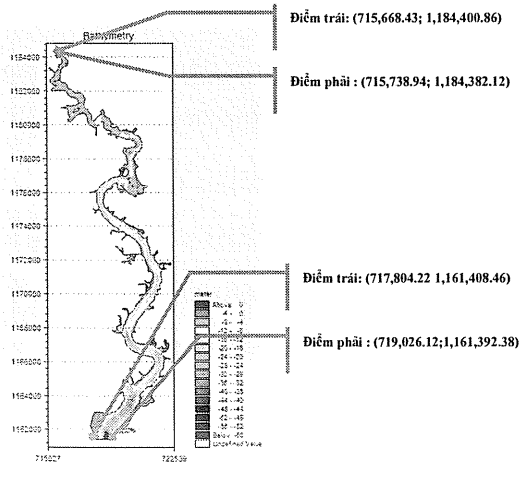


Figure 2: Limited, scope of research

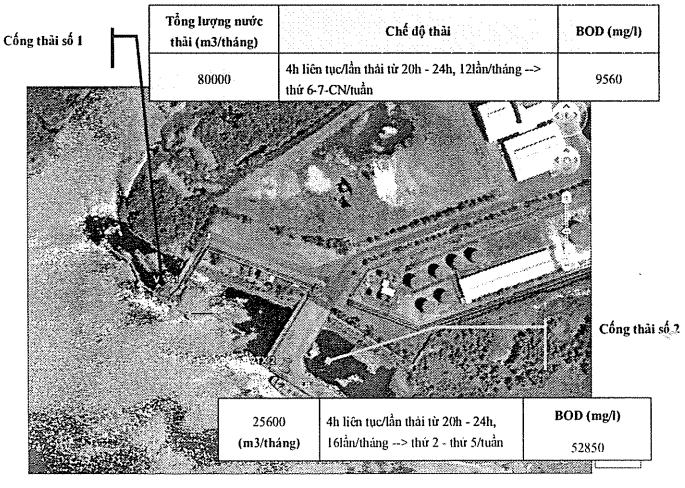


Figure 3: The location and parameters of Vedan discharging

2.3 Standard Applied

Standard: TCVN 6774:2000 - Water quality - The quality of freshwater aquatic life protection. Criteria: water quality regulations for BOD5 was less than 10 mg/l. Contaminated areas with BOD5 larger than 10mg/l, not polluted areas with BOD5 under 10mg/l. According to the standard of water quality for DO is less than 5 mg/l. Contaminated areas with DO less than 5 mg/L, not polluted areas with DO greater than 5 mg/L. According to the standard of water quality for NH3 is less than 1.49 mg/l (in conditions: pH = 6.5 and t^o = 20oC). Contaminated area with NH3 larger than 1.49 mg/l, not polluted areas with NH3 under 1.49 mg / l.

Calculation area: is limited in computational model - not the entire area of the Thi Vai River. The percentage of contaminated area base on calculation area.

Computing scenarios: Scenario in this topic include waste parameters are shown in table 1 and figures related to the hydraulic model in the selected date range.

Water surface area is 19.6805 (km^2). Length is 33.600 m. The percentage of contaminated area are calculated base on 19.6805 (km^2).

Upper border - border flow (m^3/s), the lower border - border water level (m), rain intensity (mm/day) is taken from the Institutes of VietNam. These data are legal.

The results focus on four periods: the dry season (01/2008 - 04/2008); rainy season (July 05/2008 - 08/2008), waste operations in 01/2008 - 08/2008; inactivities in July 09/2008 - 12/2008.

The reason for distinguishing four periods are:

- Clarifying the impact of seasonal factors on the scope and extent of pollution
- Clarifying the ability to accumulate pollution in a long time (1 year). Specifically, how far the pollution are pushed away from sources.
- Clarifying the self-cleaning ability of the Thi Vai River after Vedan stop

3. Results and Discussion

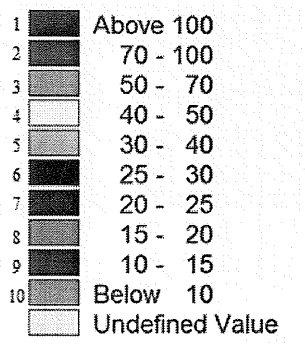


Figure 2: Color scales are used for BOD5

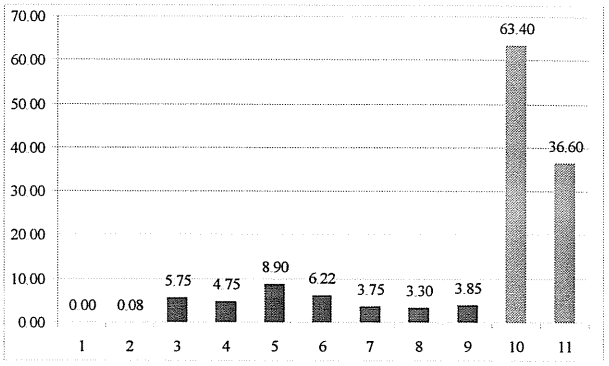


Figure 3: BOD5 pollution scope for dry season (1-4/2008)

Simulation results using MIKE21 with initial conditions of the river is assumed to be clean in accordance with TCVN 6774-2000 - Water quality - The quality of freshwater aquatic life protection with DO = 6mg/l, BOD = 4mg/l. Therefore, the concentration of pollutants (accumulation level) is not enhanced by the following month.

In dry season, water flow in rivers is low, the river flow regime depends primarily on the East Sea tides, which flow very slow.

Calculation results for dry season is shown in Figure 6. Using GIS technology to see the scope of the pollution length 16.220 m (compared with the length of the river 33,600 m) and the polluted area occupied 36.6% (Figure 5, Figure 4).

Results of rainy season (05/2008 - 08/2008) (Figure 7). The waste activities (since July 09/2008 shut down the waste) with river water quality conditions are taken from simulation results from 01/2008 - 04/2008 - the river was polluted.

Results calculated for four months after Vedan stop discharging (9-12/2008) is shown on Figure 8. Using GIS technology to see the scope of the pollution length 24.000 m (compared with the length of the river 33,600 m) and the polluted area occupied 58.07% (Figure 8).

Average results in 2008 are shown on Figure 9.

Results showed that although Vedan's discharging sources has stopped four months, but modeling results in 2008 showed that Thi Vai River is still polluted, with the distribution of pollutant concentration is expressed in Figure 9.

The scope of pollution extended to 21.410 m compared with the length of the river 33,600 m. Polluted area is 9.9627 km^2 compared with total area calculation: 19.6776km^2 (50.63%)

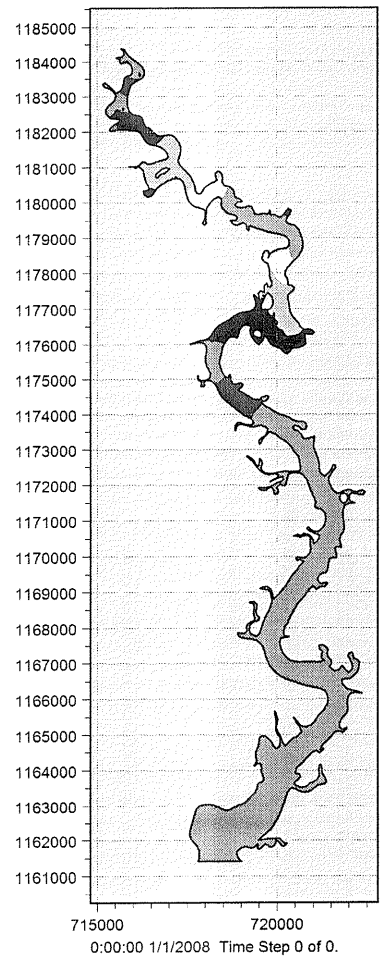


Figure 4: Range and BOD_5 pollution levels for dry season (01-04/2008)

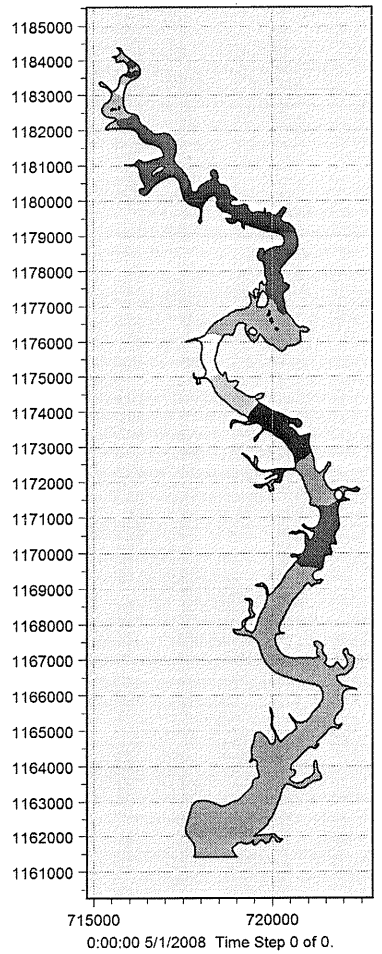


Figure 5: Range and BOD_5 pollution levels for rain season (05 - 08/2008)

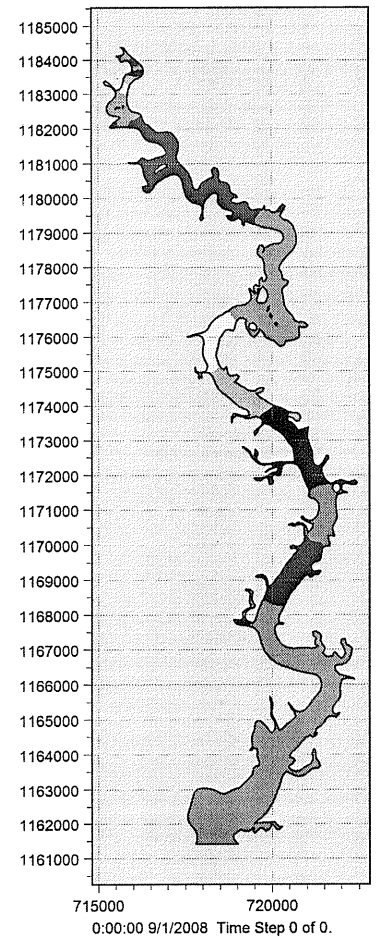


Figure 6: Range and BOD_5 pollution levels for after Vedan stopped discharging (09 – 12/2008)

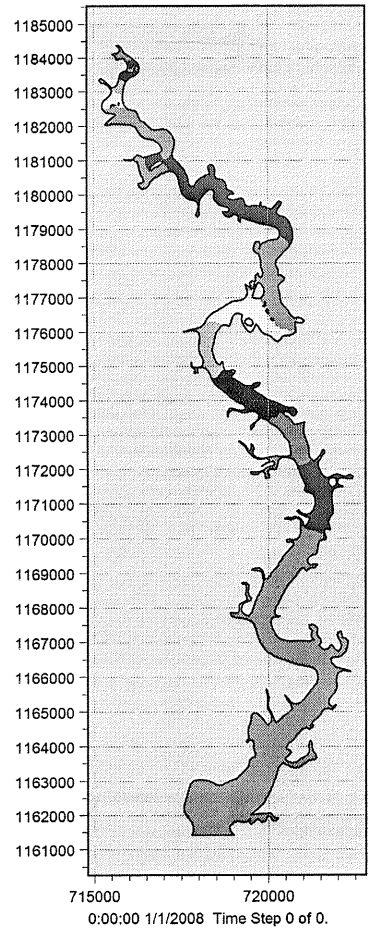


Figure 7: Average range and BOD_5 pollution levels in 2008

4. Conclusion

The role of Vedan in making pollution is clearly. In rainy season concentration of pollution caused by Vedan higher than dry months and the areas extend wider than dry months. Hydrological regime of the Thi Vai River significantly affects the pollution. The accumulation of pollutants over time is significant.

5. References

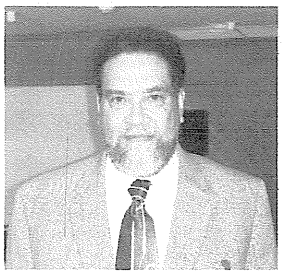
[1]. General report task "Environment monitoring program on Thi Vai River. Institute of Environment and Resources - HCM City National University (chair unit: Department of Environmental Protection, Ministry of Natural Resources and Environment. June 2006.

[2]. General report on the results of tasks: "Check and inspect the work of environmental protection for manufacturing facilities, business services, industrial parks on the Thi Vai River basin in 2008" , Department of Pollution Control, Ministry of Natural Resources and Environment, 2008.

[3]. DHI-Danish Hydraulic Institute, 1994. User Guide and Reference Manual Water Quality Module, release 2.4 MIKE 21.

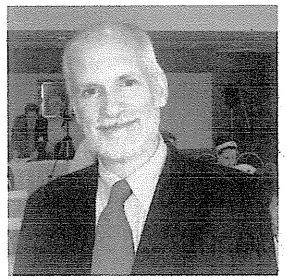
[4]. MIKE 21, user guide and reference manual. Horsholm, Denmark: DHI, Danish Hydraulic Institute; 2001.

Speakers' Photographs



Dr. Gilbert L. Rochon

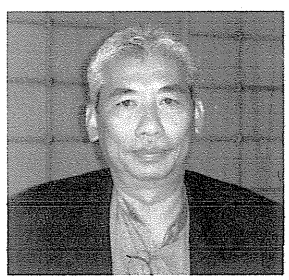
Dr. Bichit Rattakul



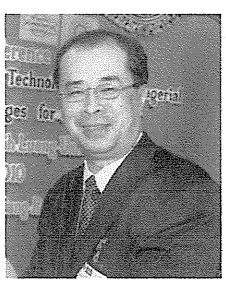
Mr. David Platter

Dr. Somchai Bovonkitti

Mr. Aslam Perwaiz



Dr. Jiragorn Gajaseni



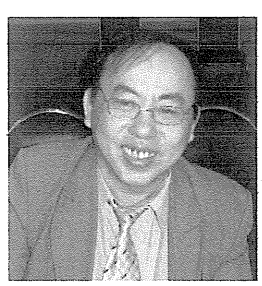
Mr. Adthaporn Singhawichai

Dr. Bui Ta Long

Dr. Chaowalit Silapathong

Dr. Pongsak Wittawatchutikul

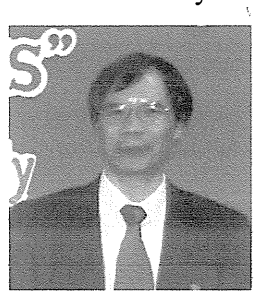
Dr. Krisanadej Jaroensutasinee



Dr. Che Dinh Ly

Dr. Vivarad Phonekeo

Dr. Chaiwat Munchareon



Dr. Nguyen Duy Binh

Dr. Nguyen Luong Bach

Dr. Lertsiri Bovornkitti

Dr. Richard J. Frankel

Group Photo