

EFFECT OF CANALS ON WATER QUALITY OF SAIGON RIVER – SECTIONS FLOW THROUGH BINH DUONG PROVINCE

Nguyen Hien Than¹, Truong Quoc Minh¹

¹Thu Dau Mot University

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Contact: quocminh@tdmu.edu.vn

Abstract

Saigon River is a major river system and plays an important role in the economic and social development of the Southern key economic region. This paper studies the relationship between canals and the Saigon River. Water quality monitoring data was collected at the Department of Natural Resources and Environment, with 10 parameters (temperature, pH, DO, turbidity, TSS, COD, BOD5, N-NH₄, P-PO₄, coliform) calculated in the period 2007-2016. The results showed that the Saigon River's water quality has been good and stable water quality in recent years, fluctuating around the level of 80 - used for domestic water supply after appropriate measures have been taken. The water quality in canals flowing into the Saigon River was relatively stable and was at the medium level over years. It is used for irrigation purposes and other similar purposes. The results of the correlation analysis also showed that the RSG1 (at Ba Sang Bridge), RSG2 (Suoi Giua at Suoi Giua Bridge) and RSG6 (Rach Vinh Binh at Din Ky Restaurant) were fair correlated with Saigon river's water quality with the correlation coefficient of 0.3995, 0.4280 and 0.3351 respectively. These results indicated that the monitoring points at Ba Sang Bridge and Suoi Giua at Suoi Giua Bridge and Vinh Binh Canal at Din Ky restaurant affected the Sai Gon river's water quality in the area flowing Binh Duong province.

Keywords: Binh Duong, Saigon river, water quality

INTRODUCTION

Binh Duong is one of the dynamic localities in the economy. By November 30, 2017, domestic investment attracted VND 44,046 billion (up 51.4%); Up to now, the province has 30,571 enterprises registered business, total registered capital VND 234.722 billion. Foreign direct investment reached 2.557 billion US dollars, surpassing 82.6% of the year plan; Up to now, the province has 3,034 foreign-invested projects with a total registered capital of 28.33 billion US dollars (Binh Duong Provincial Statistics Office, 2017).

Along with the development of the industry, the environmental quality in the area is reduced significantly. Household effluent is discharged directly into canals, ponds, rivers, streams, pesticides of farmer households following rainwater flow to nearby water sources, waste disposed of canals. Water from these canals follows the flow to the Sai Gon River system in Binh Duong province, which pollutes river water and affects people's life and health.

Therefore, protecting the environment of the Saigon River is an urgent and important concern. In order to have a good source of information to serve the environmental protection of the Saigon River, the water monitoring network has become more and more widespread. Water monitoring data from monitoring programs are often used in environmental status reports of the Saigon River. Parameters in the water environment are analyzed and assessed for state and status of water quality. From there, the assessment of river water quality to give accurate results on the situation and the main causes affecting water quality is important. Currently, the research of water quality in Binh Duong province has many projects such as:

The research project of Nguyen Hien Than with the title "Assessment about the relationship between economic growth and environmental quality in Binh Duong province" (Nguyen Hien Than, 2013). In this study, the author has used the WQI index to assess the water quality of Binh Duong province.

Cao Thi Thuy Tien with the title "Research on sustainable solutions to manage surface water resources and serve the urban environment and industrial zones in Binh Duong province up to 2020" (Cao Thi Thuy Tien, 2011). In this study, the author has used the WQI weight to assess the water quality of Binh Duong province.

Nguyen Thi Kim Yen (2009) with the topic "Research and assessment of water quality in the Thi Tinh River basin under the impacts of the socio-economic development process in Binh Duong province".

In addition, Huynh Thi Nhu Quynh (2008) with the topic "Assessment of water quality by WQI index and proposed solutions for environmental protection of surface water in Binh Duong province".

In general, there have been many studies to evaluate the quality of river water environment in the province of Binh Duong by WQI method, but there have been no studies on the impact of the canal systems on the water quality of the Saigon river – sections flow through Binh Duong province. In order to contribute to the environmental protection of the Saigon River in Binh Duong Province, the author conducts research on the impact of canals on the water quality of Saigon River. The result of this study will provide quantitative information on pollution levels and impacts of canals to the Saigon River from which to devise pollution mitigation measures and water quality management plans.

MATERIALS AND METHODS

Materials

Data were collected from environmental monitoring data in Binh Duong province from 2007 to 2016. The monitoring points consisted of 03 monitoring points on the Saigon River: 2 km from Dau Tieng dam (point SG1), water intake Thu Dau Mot water plant (point SG2), 50m from the Vinh Binh canal - Saigon River junction downstream to the lower section (point SG3); Eleven monitoring points at canals: Ba Sang Bridge (point RSG1), Suoi Giua Bridge (point RSG2), Ong Danh Canal at Ong Danh Bridge (point RSG3), Suoi Cat (point RSG4), Chom Sao Stream (point RSG5), Vinh Binh canal (point RSG6), Ba Bo canal (point RSG7), the drainage canal of An Tay

(point RSG8), the drainage canal of the Ong Bo bridge (point RSG9), D canal (point RSG10), Don stream (point RSG11).

Methods

Water quality index method

The Water Quality Index is an index calculated from the Water Quality monitoring parameters used to quantify the water quality and its utilization; performed on a scale.

$$WQI = \frac{WQI_{pH}}{100} \left[\frac{1}{3} \sum_{a=1}^3 WQI_a \times \frac{1}{2} \sum_{b=1}^2 WQI_b \times WQI_c \right]^{1/3}$$

Where, WQI_a : The calculated WQI value for the parameters: DO, NH_3 , COD; WQI_b : The calculated WQI value for two parameters: TSS, Turbidity; WQI_c : The calculated WQI value for Total coliform; WQI_{pH} : The calculated WQI value for pH (General Department of Environment, 2011).

Statistical analysis method

Method of regression analysis – correlation: modeling (or Equation) regression and defining properties (reciprocal) as well as the form of relationship (type of model)

Canonical Correspondence Analysis (CCA) is a multivariate analysis method developed by Braak (1986). In this study, CCA is used to identify and measure the relationship between two variables. Variable X is the water quality of the canals that flow into the Saigon River (consist of RSG1, RSG2, RSG3, RSG4, RSG5, RSG6 và RSG7) and variable Y is the water quality of Sai Gon river (consist of SG1, SG2 and SG3). This method will develop a model showing which monitoring points are related to the points: SG1, SG2 and SG3 and these points are not related.

In this study, using SPSS software to model a regression – correlation of the parameters and studying the dependence of the Water Quality Index (WQI) on those parameters. By graphing method, express and explain the relationship of the parameters and water quality.

RESULTS AND DISCUSSION

State of water quality in Saigon River - the section flows through Binh Duong province from 2007 to 2016

Saigon River:

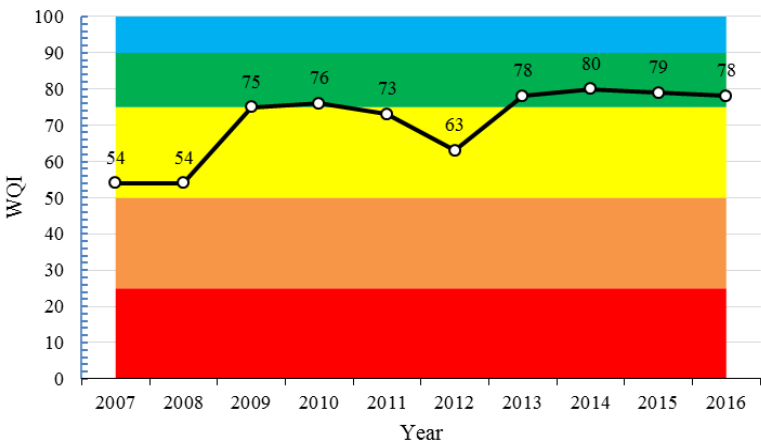


Figure 1: Water quality of Sai Gon River from 2007 to 2016

From the chart above, the water quality of Saigon River varies between the two types. In 2007, 2008, 2011 and 2012, water quality is medium, used for irrigation and other similar purposes. In 2009, 2010 and from 2013 to 2016, water quality is good and stable, used for domestic water supply but appropriate treatment measures were required.

Canals flow into Saigon river

Results of assessment of common water quality flowing into Saigon river showed that the water quality was fluctuating continuously. Generally, water quality in canals from 2015 to 2016 decreased when comparing to previous years.

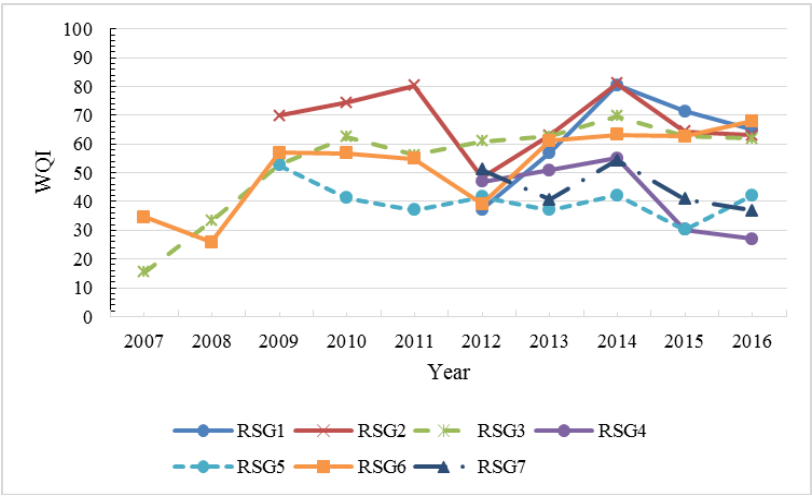
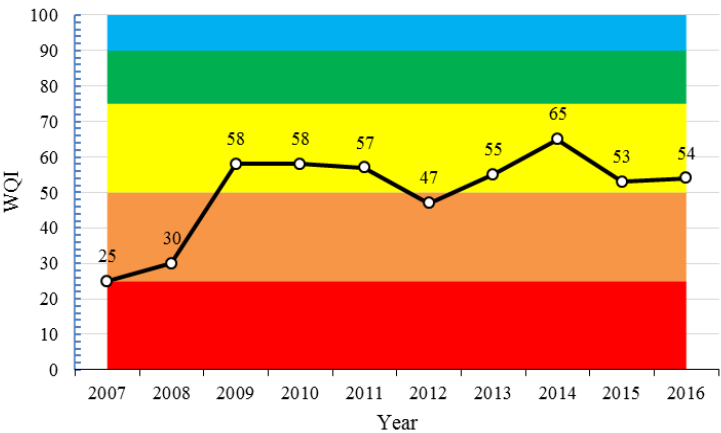


Figure 2: The overall water quality of canals flow into the Saigon River from 2007 to 2016

The water quality of the Saigon River fluctuates continuously over time. In 2007, poor water quality, heavy polluted water and need appropriate treatment measures. In 2008, improved water quality was improved and water was used for navigation and other similar purposes. From 2009 to 2011, water quality was increased and stabilized and used for domestic water supply but appropriate treatment measures were required. In 2012, water quality was reduced, used for navigation and other similar purposes. From 2013-2016, water quality was increased and stable, used for irrigation purposes and other similar purposes. In general, the water quality in canals that flow into the Saigon River is mainly used for irrigation and other similar or lower purposes.

Figure 3: Water quality of canals flow into Saigon river from 2007 to 2016



Assessment the impact of water quality from canals on Saigon river - the section flows through Binh Duong

Using the correlation analysis method to examine the relationship between water quality in canals and water quality in Sai Gon river, we have the following results:

Table 1: The result of correlation analysis between Saigon river and canals flow into Saigon River from 2012 to 2016

	SG	RSG1	RSG2	RSG3	RSG4	RSG5	RSG6	RSG7
SG	1							
RSG1	0.3995	1						
RSG2	0.4280	0.7950	1					
RSG3	0.1199	0.1823	0.0357	1				
RSG4	0.0073	-0.0070	0.1002	0.3443	1			
RSG5	-0.1748	-0.2118	-0.2864	0.4817	0.1210	1		
RSG6	0.3351	0.4276	0.3273	0.0906	0.0382	-0.0189	1	
RSG7	-0.1669	0.1082	0.0861	0.2468	0.2922	0.0970	-0.3666	1

The results showed that the water quality of Saigon River (average WQI at 3 points SG1, SG2 and SG3) is related to Saigon canals (RSG1, RSG2 and RSG6). This showed that the water quality of WQI of these canals affected the water quality of Saigon River. The remaining canals did not clearly show the degree of relation.

Using Canonical Correspondence Analysis (CCA) method to determine the relationship between the canals and the monitoring points on the Saigon River, we obtain the following results:

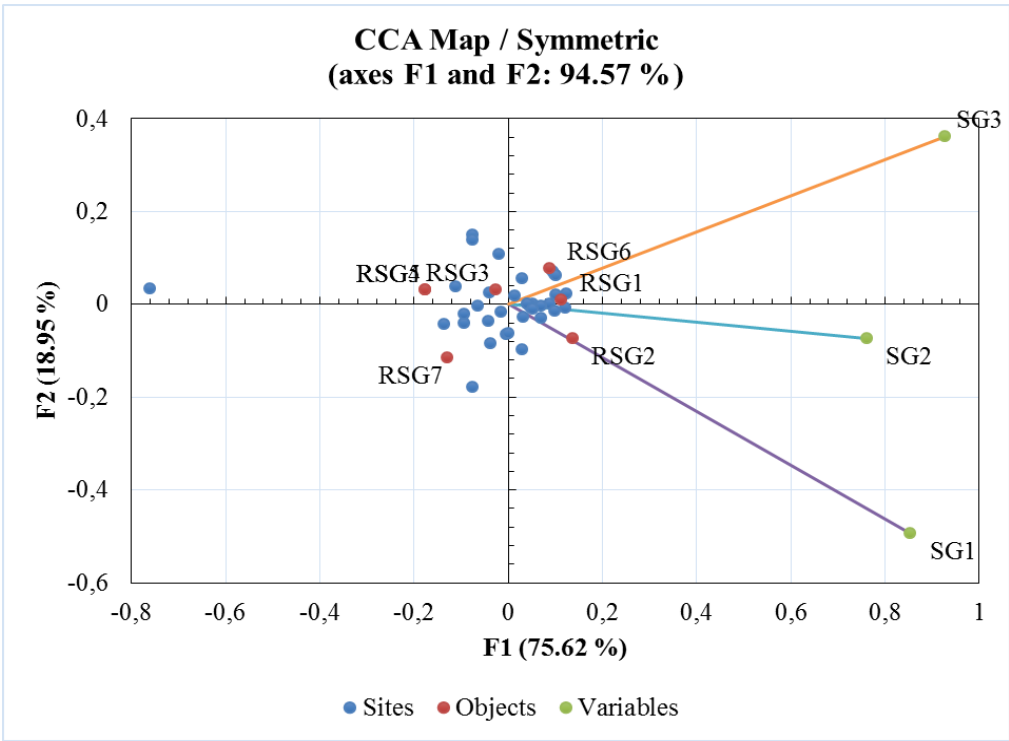


Figure 4: Correlation between Saigon River and Canals flow into Saigon River

From the chart above, the RSG1, RSG2 and RSG6 are highly correlated with monitoring points on Saigon River: SG1, SG2 and SG3. This result was absolutely consistent with the results of the regression analysis - correlation above. Thus, through the assessment and evaluation of RSG1 (at Ba Sang Bridge), RSG2 (Suoi Giua at Suoi Giua Bridge) and RSG6 (Vinh Binh canal at Din Ky Restaurant) showed the effect on water quality of Saigon River.

CONCLUSIONS

The study aimed at analyzing and evaluating the impact of canal water quality on the water quality of the Saigon River running through Binh Duong province. The results showed that:

- The Saigon River has good water quality that meets water quality requirements. About current of water quality, the Saigon River is moving in a positive direction. In particular, the SG1 section has a slight downward trend, the SG2 and SG3 section, water quality was improved. The water quality of the sections has almost no difference between rainy season and dry season.

- The results of analyzing the impacts of canals on the Saigon River showed that the RSG1 (Ba Sang Bridge), RSG2 (Suoi Giua at Suoi Giua Bridge) and RSG3 (Vinh Binh canal at Din Ky restaurant) affected the water quality of the Saigon River. The remaining points were not related.

Based on the results of this study, to overcome the problem of environmental pollution and develop socio-economic firmly in Binh Duong in the next time, the authors have the following suggestions: (1) Improve the environmental protection system in the province; (2) Consider and prioritize the allocation of state budget to focus investment on environmental protection projects; (3) Increase the network of monitoring; Addition of method to determine sample number, frequency of sample collection for wastewater; Installation of additional automated monitoring equipment to provide continuous data.

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