

## WATER QUALITY ASSESSMENT OF DONG NAI RIVER BASIN

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**Abstract.** Recently, surface water of the Dong Nai river basin has been influenced by socio-economic development activities, so river water quality is reduced. The author used a number of methods such as collecting data, processing data, analyzing systems, and chart - map to assess water quality in the Dong Nai river basin based on the analysis of the measured values of 4 parameters as pH, BOD<sub>5</sub>, COD, DO, compared with QCVN 2015 for river water quality for 5 consecutive years from 2011 to 2015 with 12 monitoring points representing upper, middle and lower river. The research results show that the water quality of the Dong Nai river basin has a clear differentiation between the monitoring points along the upper, middle and lower of the river. The further lower of the river basin, the pollution level increases. The paper also analyzes the causes of socio-economic development and the fluctuation of water quality in the Dong Nai river basin in the context of promoting growth.

**Keywords:** Water quality, Dong Nai river basin, environmental monitoring.

### 1. Introduction

Water plays a very important role in the life and development of human society, the use of water resources in recent years has been fluctuated due to the increasing demand for water. In recent years [1] issues related to river basin management have been brought to the attention of the world as is one of the indispensable parts in the sustainable development strategy.

In the water research, Gordon J. Young, James C. Dooge and John C. Rodda [2] also highlighted water quality factors related to human life quality, especially for women and girls. Rogelio Galván Plaza & Manuel Omedas Margelí [3] mentioned that water quality in river basins can lead to conflicts, so assessment of river water quality and the availability of water quality management solutions for sustainable development goals are very important.

There are many researches on Dong Nai river basin, especially related to water resources such as Do Duc Dung and others [4] who have assessed the changing of water

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resources base on drought scenario development. drought, but not yet analyzed river water quality.

Although there are many researches on water resources in Dong Nai river basin, most of them are inclined to assess the fluctuation of water quantity or assess the status of water quality. Therefore, the author's research has assessed the change of some water quality parameters in 5 consecutive years to see specific fluctuations.

Recently, water quality in the river basins in Vietnam has been seriously reduced by the impact of economic sectors, leading to increasingly limited clean water. The socio-economic development activities in the Dong Nai River basin are taking place very actively in city centers, industrial parks, modern agricultural development models and concentrated population has caused pressures on the increasing demand for clean water while creating consequences for water quality from water users.

The Dong Nai river basin is one of the three major river basins in Vietnam (after the Mekong and the Red river basins) as the "inland" river basin, it related to the provinces of Dak Nong, Lam Dong and Binh Phuoc, Dong Nai, Tay Ninh, Ho Chi Minh City and a part of provinces of Binh Thuan and Long An with 44,100 km<sup>2</sup>, of which 37,400 km<sup>2</sup> (accounting for 84.4%) are in the territory of Vietnam and with 6,700 km<sup>2</sup> (accounting for 15, 2%) is located in the territory of Cambodia with the main stream of Dong Nai river and 4 major tributaries: La Nga river on the left bank, Be river, Saigon river and Vam Co river on the right bank [5].

Dong Nai river system is one of the few river systems to be regularly monitored for water quality, which has helped to adjust water using and management. Basing on good control of monitoring data of water quality parameters will help us to assess the impact of socio-economic development on the water in the basin. Therefore, assess to water quality changed for 5 years consecutive from 2011 - 2015 will help to use water more sustainably in the context of promoting economic growth.

## **2. Content**

### **2.1. Methods**

#### ***\* Data collection and processing method***

This is one of the indoor research methods needed to carry out accurate and scientific research. Based on actual monitoring data measured at selected points in the river basin, we process and systematize the data to provide input data for the calculation steps to bring the high quantitative results.

#### ***\* System analysis method***

Analysis system method is need more considered carefully in physical geography and environmental research, especially in the context of promoting growth socio-economic goals. Analysis system method often focuses on a certain problem due to the interaction between social factors, production facilities, and the environment, considering many different reaction possibilities of the problem.

Thus, the core goal of the analysis system is to help policymakers make decisions that have the least impact on the environment and people [6]. Thus, the core goal of the analysis system is to help policymakers make decisions that have the least impact on the

environment and people. Using the analysis system method has deepened of physical, economy - society and environment factors in a relationship of mutual ties, governed by surface water resources of the river basin.

**\* Map - chart method**

The map - chart method is one of the most popular methods used in geography research in general and the physical geography in particular. This method is based on the recording, description, data analysis and synthesis of related phenomena to set up charts, graphs and maps to show the desired results. The calculation results of the data series in the study are shown in diagrams, which make it possible to compare the changes over time in different places, more clearly and visually - it is the best method to present the input data.

The results of the calculation of the data series in the study are shown in the chart that makes the comparison of changes over time at different water quality monitoring points more clear and intuitive, which is the best way to represent the input data. In this research, the map - chart method is the link between data series on water quality at 12 monitoring points in the Dong Nai river basin, the results are shown more visually.

**2.2. Data collection**

To assess the water quality of the Dong Nai river basin, we use monitoring data for 5 consecutive years from 2011 to 2015 (source of monitoring data provided by the Environmental Monitoring Center - Vietnam Environment Administration) [7].

There are many parameters to assess the quality of river water, but in this research we only use the most basic water quality monitoring parameters of Dong Nai river basin including pH, BOD5, COD, DO, these are parameters which have affected to quality water for using daily, agriculture and the living environment of aquatic organisms. Data collected at 12 monitoring points represent the upper, middle and lower of the Dong Nai river basin.

**Table 1. Locations, water quality monitoring points in Dong Nai river basin**

No	Sign	Location	WQM point
1	DN1	Upper Dong Nai river	Nam Cat Tien ferry station
2	DN2	Middle Dong Nai river	Thien Tan water plant pumping station
3	DN3	Lower Dong Nai river	Den Do cape
4	SG1	Upper Sai gon river	Tha La bridge
5	SG2	Middle Sài gon river	Ben Suc bridge
6	SG3	Lower Sai gon river	Tan Thuan port
7	SB1	Upper Be river	Thac Mo lake
8	SB2	Middle Be river	Phuoc Hoa lake
9	SB3	Lower Be river	Mouth of Be river
10	VCD1	Upper Vam Co Dong river	Go Chai bridge
11	VCD2	Middle Vam Co Dong river	Confluence channels An Ha - VCD
12	VCD3	Lower Vam Co Dong river	Long Dinh Long Can industrial clusters

### 2.3. Results

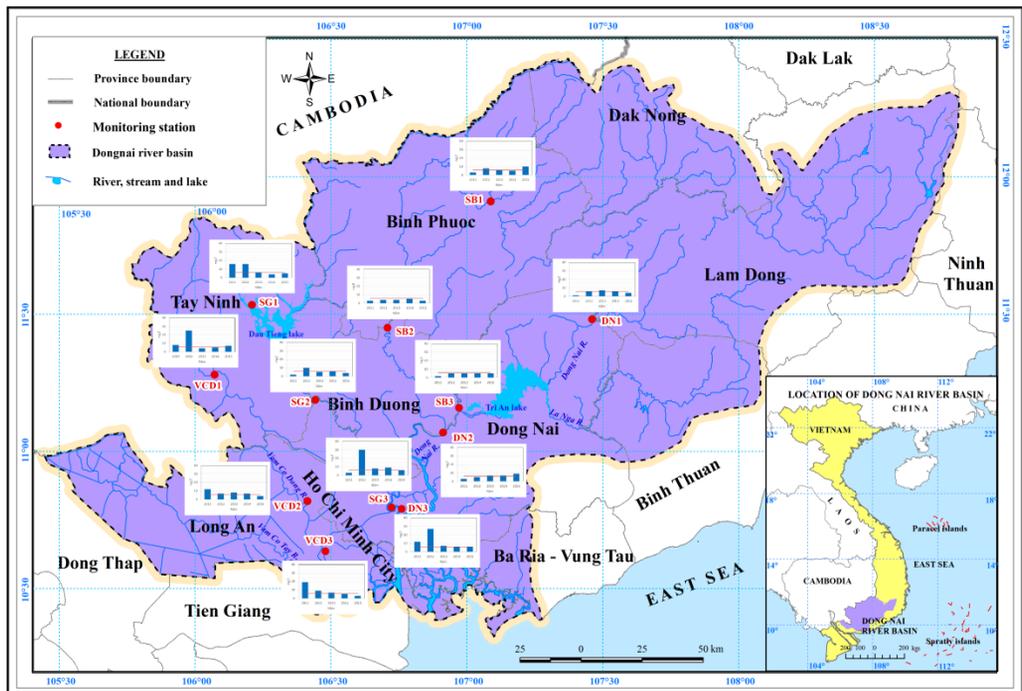
#### 2.3.1. Water quality assessment of Dong Nai river basin

To assess the quality of the river water in the Dong Nai river basin based on annual monitoring data at fixed points, which are representative of the tributaries, we compared real measurements with the Vietnam's surface water quality standard (QCVN 08: 2015 / BTNMT on national technical regulation on surface water quality with A2 type, water used for domestic water supply but must apply appropriate treatment technology or use purposes as B1 type and B2 type) (Table 2) for 5 consecutive years to see changes in water parameters by the impacted of socio-economic development process

**Table 2. Standard of surface water quality [8]**

No	Parameter	Unit	Limited value	Pollution value
1	pH		6 - 8,5	$\leq 6, \geq 8,5$
2	BOD <sub>5</sub>	mg/L	6	> 6
3	COD	mg/L	15	>15
4	DO	mg/L	$\geq 5$	< 5

There are many parameters to assess the quality of river water, in which pH is considered as one of the important parameters to assess water hardness, corrosion ability in assessing the level of pollution. Due to the pH express acidic and alkaline in water, so the actual values measured in water that are lower or higher than the allowed limits are also not good for the aquatic organisms.



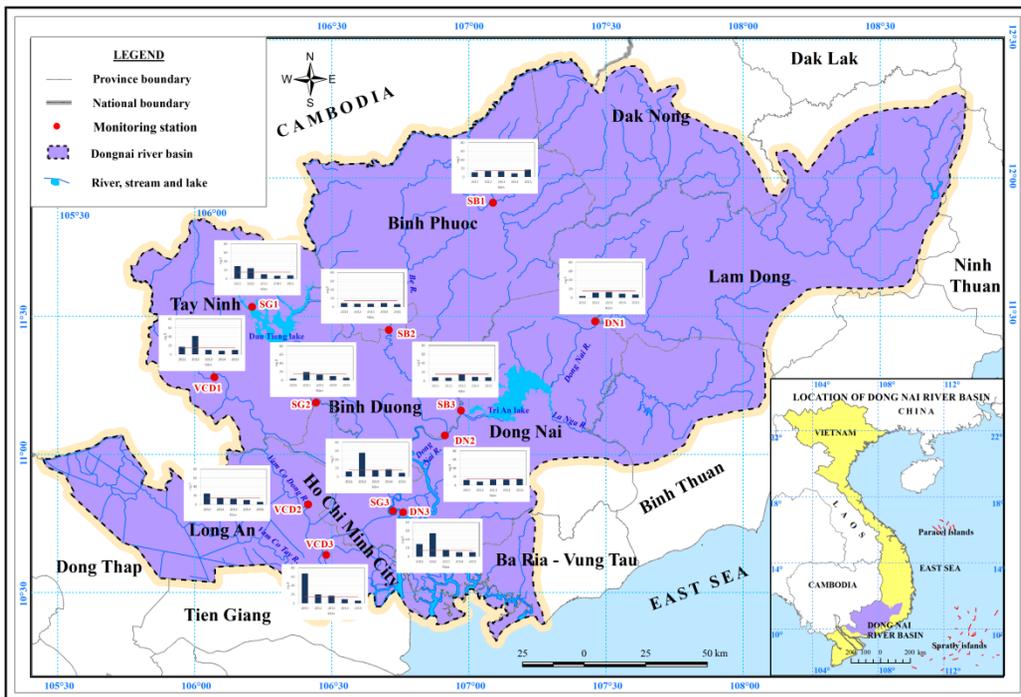
**Figure 1. BOD5 Monitoring of Dong Nai river basin period 2011 - 2015**

According to the analysis of pH concentration at 12 monitoring points in 5 years, basically that the pH of the river basin is within the allowable range of 6 - 8.5. Particularly, at the monitoring points, VCD3 in 2011, SG2 in 2011 and VCD2 had 4/5 years the pH less than 6 (2011, 2012, 2013, 2015).

Biochemical oxygen demand (BOD) is the amount of dissolved oxygen needed by aerobic biological organisms to break down organic material present in a given water sample at a certain temperature over a specific period time. The BOD value is most commonly expressed in milligrams of oxygen consumed per litre of the sample during 5 days of incubation at 20 °C and is often used as a surrogate of the degree of organic pollution of water.

The monitoring results show that at DN1 and SG2 only one year of BOD5 value exceeds the permitted value, and at DN2, DN3, SG1, SG3, SB1, VCD1, VCD2, VCD3 were exceeded the allowed values from 2 to 4 years. Especially, in 2012 at SG3, Tan Thuan port area, BOD5 increased 5 times higher than the permitted standard

Chemical oxygen demand (COD) is the amount of oxygen needed for complete oxidation of organic substances in water. COD is an important parameter to assess the level of pollution of surface water, it reflects the content of organic matter in water, the higher measurement index, the more organic pollutants.



**Figure 2. COD Monitoring of Dong Nai river basin in the period of 2011 - 2015**

Based on the results at 12 monitoring points of the Dong Nai river basin, there are four monitoring points within the permitted limits according to QCVN, which are points DN1, DN2, SB1, SB2, and SB3. In 2012, COD value increased suddenly by 3 - 4 times at DN3 (54mg/L) SG3 (56mg/L) and VCD1 (42mg/L), this period the number of organic pollutants increased sharply. However, base on measures to improve the water

environment following years, the COD content in the water decreased significantly, water was slightly polluted.

Dissolved oxygen (DO) is the amount of dissolved oxygen in water necessary for respiration of aquatic organisms such as shrimp, fish DO in water is usually generated due to the solubility in air and a small part is due to photosynthesis of algae, when water is polluted by organic substances easily decomposed by microorganisms, the DO in water will be consumed less, therefore DO value is often low, this is considered as an indicator of surface water to assess the pollution degree with organic origin. The monitoring results show that 5/12 monitoring points of DO value in 5 consecutive years are lower than 5mg/L as DN3, SG3, VCD1, VCD2, VCD3. SG1 and SG2 also have DO values within pollution limits from 2 to 4 years.

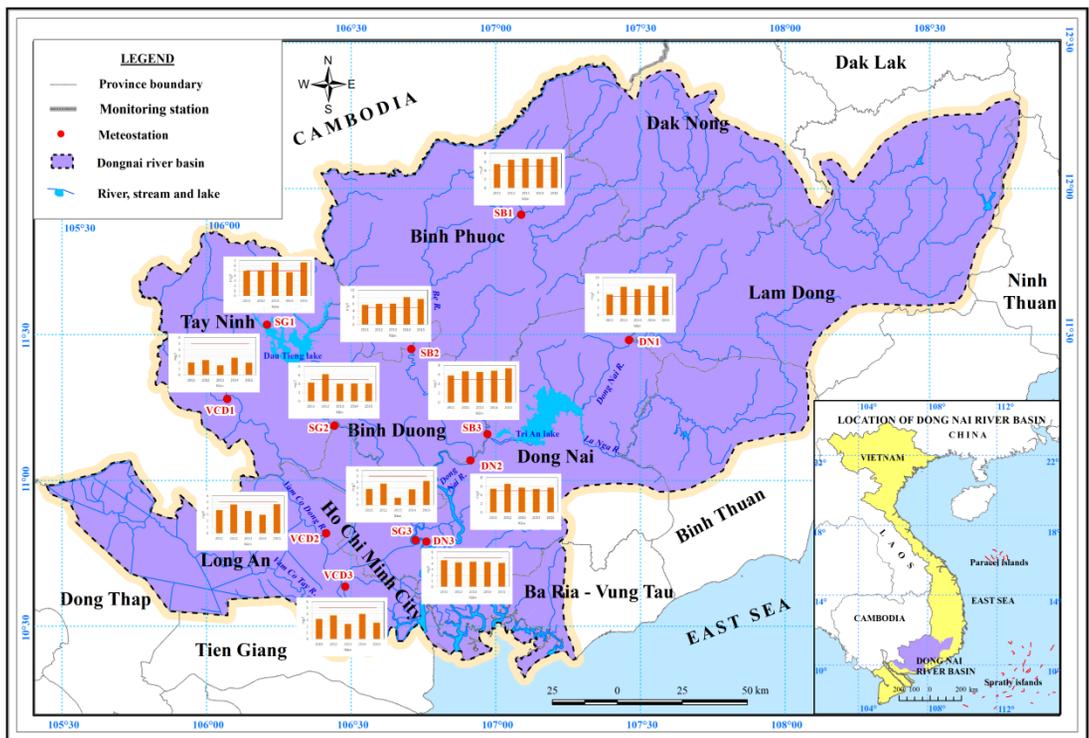


Figure 3. DO Monitoring of Dong Nai river basin period 2011 - 2015

### 2.3.2. Reasons for water pollution in the Dong Nai river basin

In recent years, the socio-economic development activities in the Dong Nai river basin have been very activated to promote growth processes. Activities of entering and leaving Saigon and Tan Thuan port by ships have affected the river water quality. Besides, dense industrial zones from the middle to the lower from large rivers in the basin have contributed to the increase of discharge into the river. The expansion of unsustainable agricultural models in provinces in the study area also increases the amount of organic matter flowing into the river.

### 3. Conclusions

Water quality in the Dong Nai river basin has a clear separation between the monitoring points along the upper, middle and lower of the river. The further lower of the river basin, the pollution level increases due to the densely populated area, industrial parks, and seaports. The monitoring points in industrial parks and centers of big cities have higher levels of pollution compared to areas with low population density and economic development activities are still not strong. In the first two years of the monitoring data series (2011 and 2012), the level of pollution is relatively high, especially there are measurement points that are 3-5 times higher than the permitted level. However, due to the requirements of green growth, industrial zones also take active measures to improve the quality of the water environment through the treatment of waste and wastewater before being discharged into the environment and under control. The pollution level tends to decrease gradually from 2013 to 2015.

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