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Author(s)	Le, Van Thang; Tran, Dang Bao Thuyen
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# THE QUALITY WATER ENVIRONMENT HAPPENING OF THE HUONG RIVER IN THE HUE CITY, PERIOD OF 2003 – 2006

Le Van Thang, Tran Dang Bao Thuyen

*Center for Resources, Environment and Biotechnology – Hue University*

## Abstract

Huong river water quality in Hue city is gradually declining. Many specific figures to chemical compositions ( $BOD_5$ , COD), nutrition ingredients ( $NH_4^+$ ,  $NO_3^-$  and  $PO_4^{3-}$ ) and total coliform are increasing. Some positions into Hue city do not satisfy Surface Water Quality Standard – Level A (TCVN 5942 – 1995) permanently. The research result proves that Huong river must be put on a considered, monitored and improved state.

**Key words:** gradually declining, Huong river water quality, monitoring.

## 1. Introduction

The Huong river is the main branch of the Huong river system. The Huong river plays an important role of socio - economic development of Hue city and Thua Thien Hue province. The Huong river is a domestic water supply for local people and surroundings as well as a received source of domestic-productive wastewater in area. The Huong river is also the source of endless-inspiration of many musicians, poets. In addition, The Huong river makes the climate equable of Hue city; is the foundation of development of economic careers (services, travel, aquaculture...). Therefore, the Huong river is very important not only using values, environment but also aesthetic aspect, so UNESCO has suggested that People's Provincial Committee set up a file to ask UNESCO to recognize the Huong river to be the World Cultural Heritage.

As the aim of environmental quality monitoring from 2003 up to now, Ministry of Resources and Environment had entrusted Center for Resources, Environment and Biotechnology - Hue University with task of monitoring the Huong river water quality. After some years of monitoring, with set of monitored datas, the work has showed a general view of the Huong river water quality happening.

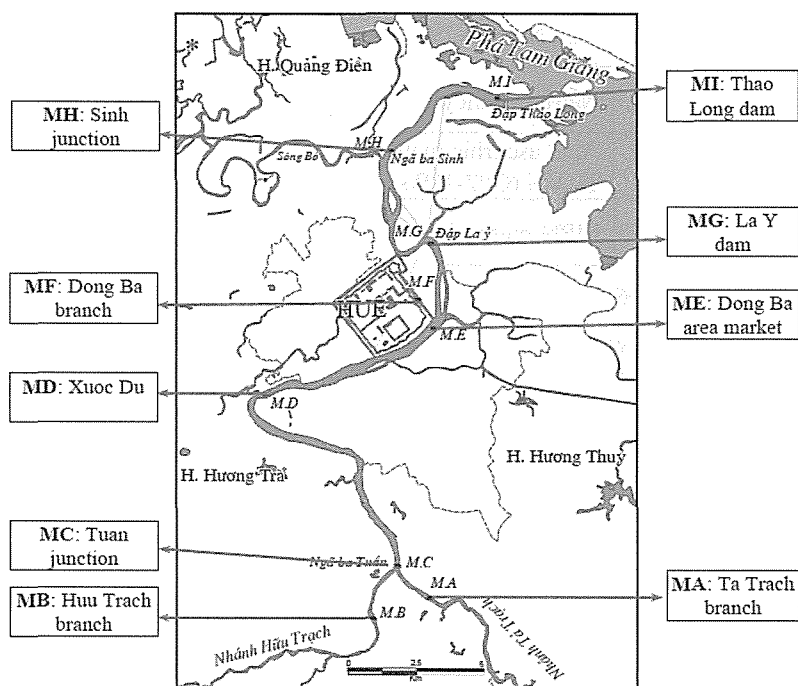
## 2. Methods

### 2.1. Scope and object of study

Monitoring areas: from Ta Trach branch, Huu Trach branch to Thao Long dam. All monitoring positions were chosen against some features: geology; topography; form of the Huong river watershed; flow's system; flow's ratet; sakes and needs of use the Huong river water of people in region. Besides, finding monitoring position still took capability of discharge of big sources of waste water to impact on the Huong river water quality such as factory, manufacturer, ... on two sides of the River. (figure 1).

Monitoring plan: 1 time/month (12 times/year), from 8<sup>th</sup> to 20<sup>th</sup> every month.

Total of monitoring time: 4 years (from 2003 to 2006).



**Fig. 1.** Monitoring point's position diagram on the Huong river

## 2.2. Methods of study

The work has used many methods as: documental research and collection method; map method; analyst and sampling method in Lab; statistics method; computer method; expert method; interview method; comparative method,... to have objective appraisements and considerations of the Huong river water quality turn from 2003 to 2006.

## 2.3. Estimative parameter and equipment

No	Parameter	Estimative method	Equipment
1	Turbidity (NTU)	Measured by turbidity meter	Water Quality Checker (TOA-WQC 22A - Japan)
2	EC (mS/cm)	Measure EC	
3	pH	Measure puse	
4	DO (mg/L)	Measured by DO meter	
5	SS (mg/L)	Gravimetry TCVN 4559-1988	Fiberglass filter paper, vacuum pump (Millipore - USA, Oven fan (ULM400 + Time, Memmert-German)
6	TDS (mg/L)	Gravimetry TCVN 6053-1995	
7	BOD <sub>5</sub> (mg/L)	TCVN 6001-1995	DO/ BOD <sub>5</sub> meter (U-05511-00, Cole Parmer - USA); BOD incubator
8	COD (mg/L)	ISO 6060-1989	UV-VIS Spectrophotometer (V530-PC – Jasco, Japan)
9	Cl <sup>-</sup> (mg/L)	TCVN 6194-1996	Titration
10	Total Fe (mg/L)	Anodic stripping voltammetry (ASV)	Autolab 636 (Holland)

11	NH <sub>4</sub> <sup>+</sup> - N (mg/L)	TCVN 6179-1995	UV-VIS Spectrophotometer (V530-PC - Jasco, Japan)
12	NO <sub>3</sub> <sup>-</sup> - N (mg/L)	Sodium salicylate method	UV-VIS Spectrophotometer (V530-PC - Jasco, Japan)
13	Total PO <sub>4</sub> <sup>3-</sup> (mg/L)	Acid ascorbic method TCVN 6202-1996	UV-VIS Spectrophotometer (V530-PC - Jasco, Japan)
14	Total Coliforms (MPN/1000mL)	MPN method	

Sampling following TCVN 5996-1995 and sample preservation following TCVN 5993-1995.

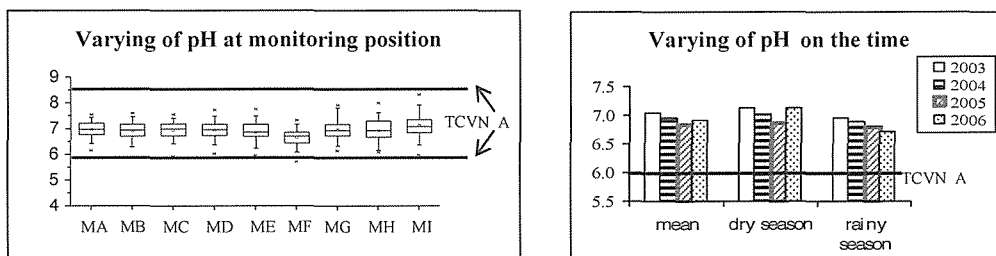
All the chemical were of analytical grade and purchased from Merck (Germany). De-ionized water was used to prepare all solution. The laboratory glassware was kept in a 5% (v/v) nitric acid solution overnight. Afterwards, it was rinsed thoroughly with de-ionized water and dry. All glasswares are specialized equipments and high fidelity.

### 3. Results and Discussion

#### 3.1. pH

In all of monitored courses on the Huong river, pH was often in the range of 6,0 – 8,5, it satisfied Surface Water Quality Standard - Level A (TCVN 5942 – 1995), in which MF position (Dong Ba branch) had the lowest pH value.

Generally, pH in rainy season is lower than in dry season but difference is not high. In dry season, transformation of substances process, chemical reactions, biological reactions, ... occur more quickly and transmute many properties of the Huong river water under temperature's impact and level of high solar radiation in which have pH.

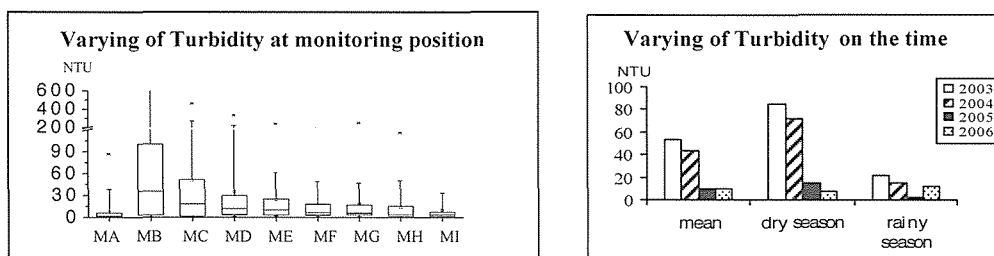


**Fig. 2.** Variability of pH according to monitoring position and time

After monitoring period, it is remarked that pH of the Huong river water tended to decline but it was still appropriate to aquatic life. However, if the tendency continues as previous years, pH of the Huong river will reduce in next time and maybe impact on aquatic life.

#### 3.2. Turbidity and Suspended Solid (SS)

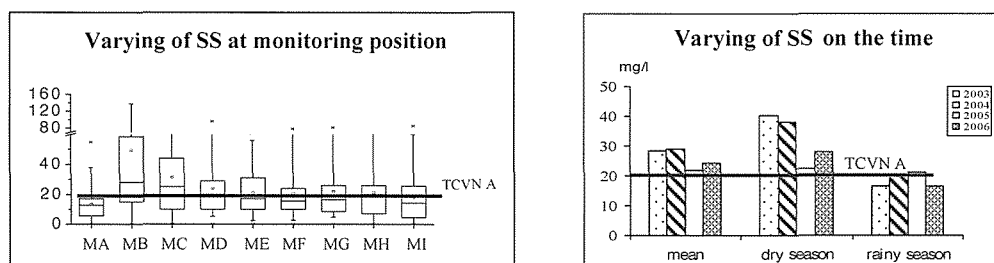
Turbidity and SS in MB are the highest in 9 monitoring position and oscillate in a large range (turbidity: 2 - 300 NTU; SS: 0 – 140 mg/l). Conversely, MA's turbidity and SS are the lowest. From MB to MI, turbidity and SS are decreasing according to deposit capacity of the River water.



**Fig. 3.** Variability of turbidity according to monitoring position and time

Turbidity and SS of the Huong river water in 2003 and 2004 were much higher than in 2005 and 2006. The phenomenon of high turbidity and SS values in 2003-2004 due to construction of Ho Chi Minh trail (section of the trail passing Thua Thien Hue province – source of Huu Trach branch); the uncontrolled exploitation of hugging and sand in two branches Ta Trach, Huu Trach has impacted on flow's rate, stirred and mixed water, reduced deposit capacity of water. Moreover, composition and quantity of domestic wastewater which people have wasted also impacted on the Huong river. In 2005-2006, turbidity and SS also depended on content and composition of domestic wastewater.

In comparison with rainy season's months, dry season's months had turbidity and SS higher for human being's stronger and more permanent impacts.



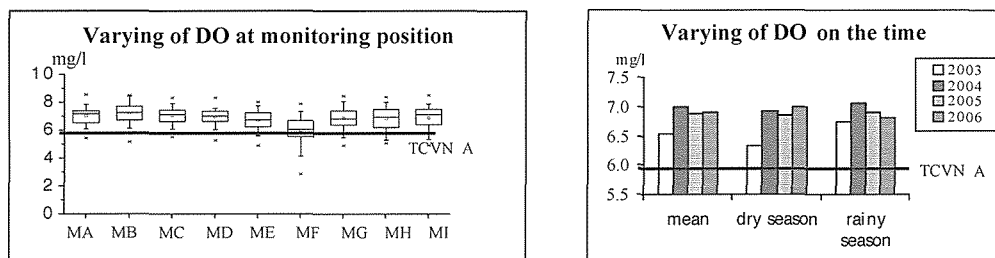
**Fig. 4.** Variability of SS according to monitoring position and time

### 3.3. Dissolved Oxygen

In 9 monitoring points, only DO of MF position (about 30% monitoring time that  $DO < 6\text{mg/l}$ ) satisfies Surface Water Quality Standard – Level B (TCVN 5942 – 1995), DO of the other points satisfy Surface Water Quality Standard – Level A (TCVN 5942 – 1995). As monitored DO values, aquatic life of animals are not impacted but the River water's self-purification capability is very bad.

MF point is one of points that level of pollution is the highest due to be influenced by a lot of diverse source of waste with high content of pollutants (wastewater of markets, domestic wastewater, wastewater of boat village on Dong Ba branch and many different sources). Besides, this position' output is very slow ( $\approx 0,0\text{ m/s}$ ) so exchange capability of water with outside and the River water's self-purification capability is very weak. This is one of main reasons to make the branch to be a hot point of water environment in Hue city.

In 2003, three months of the beginning of the year, the Center monitored only section of the Huong river passing Hue city (low DO), so the year-average DO value is low. From 2004 to 2006, DO was decreasing (not much). This was a sign of the Huong river water changing bad; water quality is gradually declining, obviously in dry season's months.

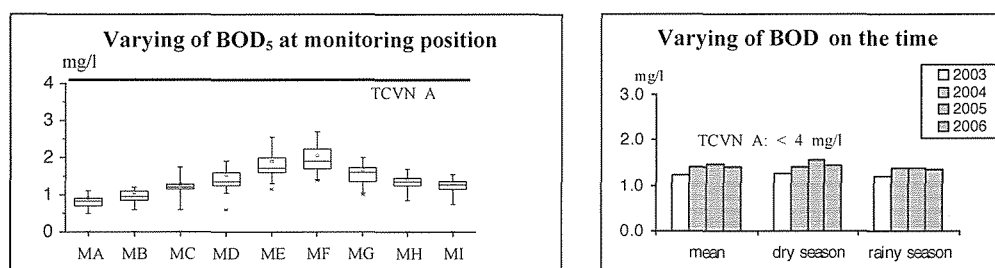


**Fig. 5.** Variability of DO according to monitoring position and time

### 3.4. Organic substances

Biochemical Oxygen Demand ( $BOD_5$ ) and Chemical Oxygen Demand (COD) are the specific quantity for organic matter in the water.

- *Biochemical Oxygen Demand ( $BOD_5$ )*

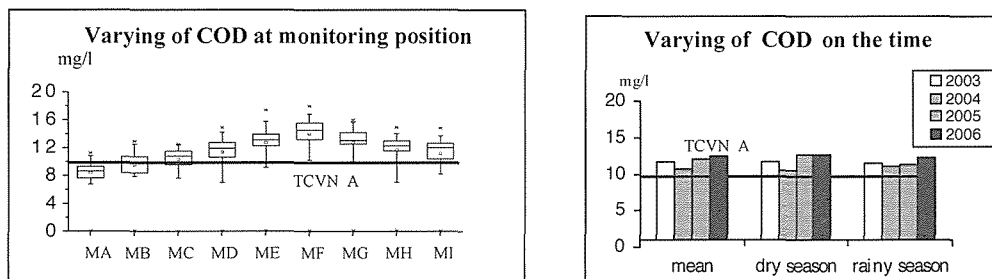


**Fig. 6.** Variability of  $BOD_5$  according to monitoring position and time

All of the monitoring positions are  $BOD_5$  value lower 4 mg/l, they satisfy Surface Water Quality Standard – Level A (TCVN 5942 – 1995). Among them, the river runs through Hue city ( from MD to MF), the  $BOD_5$  value is much higher than other positions, the highest is the MF point.

Like that, Biochemical Oxygen Demand of the Huong river are having increasing sign with chronological and the polluted water river phenomena are moving gradually to Tam Giang- Cau Hai lagoon side.

- *Chemical Oxygen Demand (COD)*



**Fig. 7.** Variability of COD according to monitoring position and time

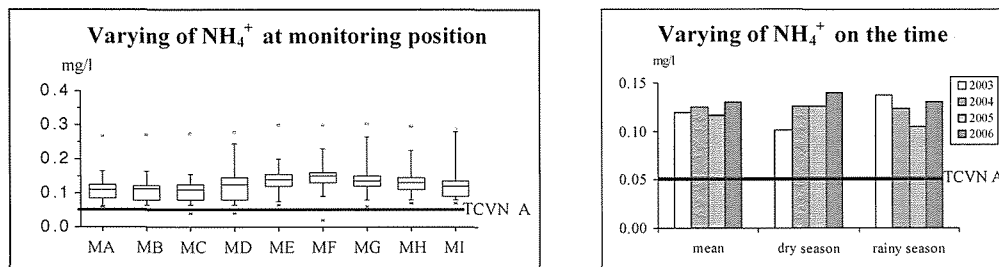
Only the Ta Trach river and some the course of monitoring at the Huu Trach river were COD value < 10 mg/l - satisfy Surface Water Quality Standard – Level A (TCVN 5942 – 1995). COD of the other monitoring points do not satisfy standard for Surface water quality of Grade A but satisfy Standard for Surface Water Quality of Grade B (TCVN 5942- 1995). As well as  $BOD_5$  values, COD values are higher at the position through Hue city where received much wastewater (the environmental sensitive positions).

If calculating average result, COD of whole the years are higher than 10 mg/l - Do not satisfy standard for Surface water quality of grade A (TCVN 5942- 1995)

### 3.5. Nutrition

Nutrition of water is evaluated by the concentration of ammonium ( $\text{NH}_4^+$ ), nitrate ( $\text{NO}_3^-$ ) and concentration of phosphate ( $\text{PO}_4^{3-}$ ).

- *Concentration of Ammonium*



**Fig. 8.** Variability of ammonium according to monitoring position and time

Ammonium content in the Huong river water increasing from the position such as MA, MB to MF, then it is lightening when arrive near MI. All of monitoring positions aquilateral that there is ammonium concentration transcends stipulation according to standard for Surface Water Quality – Level A (TCVN 5942- 1995) but they absolutely satisfy the standard for Surface Water Quality - Level B (TCVN 5942- 1995).

Ammonium concentration imparity between wet and dry season is not big and subordinating much in monitoring time (in month and different months in year). On the whole Ammonium concentration is having chronological increment sign (especially on dry period).

- *Nitrate concentration*

Nitrate concentration of many domestic sewages recipient positions (A part of Huong river flows through Hue city) and productive sewages (include whole agricultural production) are greater than the positions do not try to affect of wastewater, especially the biggest is MF position. As well as Ammonium concentration, nitrate concentration are having chronological increment sign (especially on dry season).

- *Total phosphate concentration*

Since monitoring results and string of data was collected from the different resources showed that phosphate concentration changes the little on the time and at the high level with surface water quality. With the concentration, Huong river's eutrophication happens easily. And practically on Huong river that there was abloom some of alga phenomena somewhere (such as: at the branch of Dong Ba river (MF), Con Hen, Bao Vinh areas,...).

### 3.6. Total- Fe

From monitoring results show that Total- Fe in the Huong river water at survey section of river is quite low and decreasing from MB to MI position. As well as the total suspended solid (SS) and turbidity, Total- Fe is the highest at MB point and decrease gradually to lower section. According to geological study result, the upper reaches side of river branches is the gold yellow feralit soil with great iron quantity. When this territory is wash away descented river exacerbated total- Fe in shallow water. However, all of monitoring positions have total- Fe satisfy Surface Water Quality Standard – Level A (TCVN 5942 – 1995) urthermore, concentration imparity total- Fe in water between rainy and dry period is not big. From upper results there might affirm density of iron iron water owing to geologic element government and impact of human is not major.

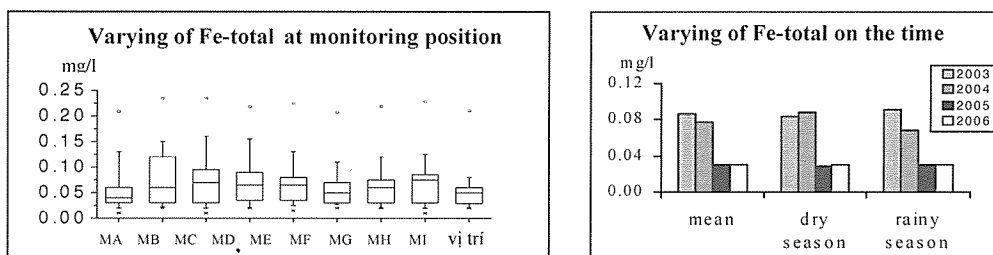


Fig. 9. Variability of total-Fe according monitoring position and time.

### 3.7. Total Coliform

Among the monitoring points, total Coliform at MF points is the highest. All points ME, MF, MG, MH total Coliform is rather high compared to satisfy Surface Water Quality Standard – Level A (TCVN 5942- 1995) 1.2 to 2.0 but they absolutely satisfy Surface Water Quality Standard – Level B.

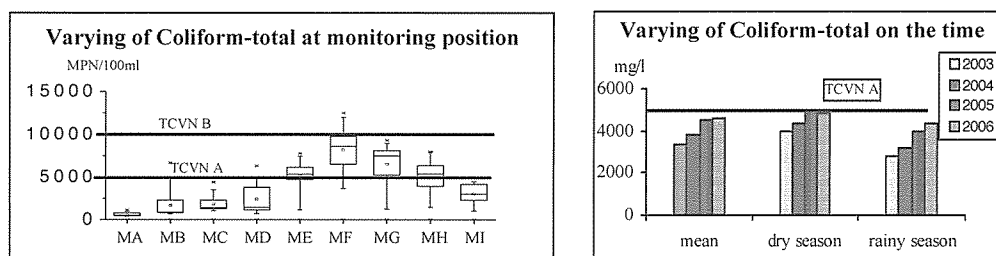


Fig. 10. Variability of total Coliform according monitoring position and time

## 4. Conclusion

By the data of monitoring and analysis during for 4 years, it can find out some conclusions follow:

- The Huong river water quality is situation little pollution, almost figures monitoring (except COD and  $\text{NH}_4^+$ ) satisfy Surface Water Quality Standard – Level A (TCVN 5942 – 1995) permanently.  $\text{PO}_4^{3-}$  - total is under the influence of the geological structure, many specific figures to nutrition ingredients ( $\text{NH}_4^+$ ,  $\text{NO}_3^-$ ), chemical compositions ( $\text{BOD}_5$ , COD) and total coliform in the Huong river water are highly by the effect of human on environment (from domestic waste, city waste or the waste from activities agricultural), which contain chemical fertilizers in excess.
- Section of Huong river passing Hue city occurred local pollution in somewhere. The time, the scope and pollution level is on the increase, special in the dry season. The scope of pollution will extend all the river, unless we have a opportune and sensible solution.
- Although the Tam Giang – Cau Hai lagoon system is far away from Hue city ( 12 km the eastward), but the Huong river water quality to impact on this lagoon is remarkable (Huong river cross the Tam Giang Lagoon before emptying into the Dong sea).

To control the Huong river water quality and protect the quality of Tam Giang – Cau Hai lagoon system water (It has highly economic potential of Thua Thien Hue province for exploit and aquaculture) is the immediate task and great importance to citizen's Hue city and inhabitant of Thua Thien Hue province.



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