

Assess the Present Status of the Water Quality of Banthach River Belonged to Tamky City, Quangnam Province and Propose Protected Solution

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Abstract: This paper assess the status and changes in quality of Ban Thach river running through Tam Ky City, Quang Nam province, and propose practical solutions to protect water quality and contribute to the management of Ban Thach river towards sustainability. Research results show that the water quality of Ban Thach river is relatively good except Fe sometimes exceeding the standard and can supply water for many different purposes. However, it should take measures to control, protect river water quality consistent with the actual situation in the locality towards sustainability.

Key words: assess status, water quality, Banthach river, Quangnam province

1. Introduction

Ban Thach river is a large river of Tam Ky city, from the West to the East around 9km. At the end of this river is the confluence of the Truong Giang river, and then flows out to the sea through An Hoa estuary. It is an essential surface water resource in the area, which service for domestic, farming activities, irrigation, fishing, and aquaculture... However, because of natural ruins and human activities, it has been a substantial impact on the quality of river water. Along with the local social-economic growth, the quality of river water is being threatened, which is at the risk of pollution. Moreover, the management in recent years has not given adequate attention. Hence, it is crucial to assess regularly the quality of surface water, catch up the situation of water quality to have appropriate management measures, promptly handle polluting sources aiming to guarantee the quality of both

domestic and production water for people in the river area.

2. Object, Scope and Research Methods

2.1 Object and Scope Research

Research object is the quality of Ban Thach river water, the part cross through Tam Ky city, Quang Nam province. Water quality indexes selected for assessment include: Physics index (pH, TSS); Chemical index (DO, COD, BOD₅, NH₄⁺, PO₄³⁻, Cl⁻); metal ionic (Fe, Hg, Pb, Cd) and microorganism (coliform bacteria). The sampling spots transmit from the surface water the network environs monitoring of Quang Nam province (Table 1).

Table 1 Position and coordinates of sampling spots.

Position	Coordinates	
	Longitude	Latitude
M1	1725724	576434
M2	1722052	580148
M3	1722371	582520

2.2 Research Method

Method of sampling and storage sample: Conduct sample from surface water according to Vietnam standard 5999-1995 via using special equipment at 2 locations on the river (left and right), then mixing them to analyze parameters of water quality.

Analysis parameters of water quality method: parameters of surface water quality carry out by Apha: determination of pH, Dissolved oxygen (DO): at the spot with a meter; determination of chemical Oxygen (COD) by reflux method - photometer; determination of biochemical oxygen determination (BOD₅) using implantation and dilution methods; determination of Ammonium (NH₄⁺) by Nessler method; determination of phosphate (PO₄³⁻) by the Molybdenum blue reaction; Determine total coliform by the MPN (Most Probable

Number) method. Heavy metals such as Fe, Pb, Cd, Hg were analyzed by AAS atomic absorption spectroscopy.

Methods of statistics and data processing: The results of the study summarize and processed according to descriptive statistic and analysis of variance (ANOVA) with significance level selected a = 0.05. Data were processed using SPSS computer software.

3. Results and Discussion

3.1 Assessment the quality of Ban Thach River Water

The result of analysis parameters Ban Thach water quality at the crossing through Tam Ky city, Quang Nam province in Table 2.

Table 2 The result of analysis Ban Thach water quality.

	M1		M2		M3		Quality standards
	Min ÷ Max	Average±S	Min ÷ Max	Average±S	Min ÷ Max	Average±S	
pH	6.5-7.5	7.7±0.36	6.5-6.7	6.6±0.1	6.5-7.5	7.08±0.37	6.0-8.1
DO (mg/L)	5.0-6.5	5.62±0.6	6.1-6.2	6.15±0.07	3.4-6.3	5.36±1.15	≥6
TSS (mg/L)	25-45.5	35.64±8.2	24-34.5	29.25±7.42	9-22	15.18±4.96	20
BOD ₅ (mg/L)	3.0-5.0	3.84±0.8	2.5-2.9	2.7±0.2	2-2.8	2.38±0.28	4
COD (mg/L)	5.76-9.6	7.52±1.6	3.9-6.72	5.31±1.99	3.84-5.44	4.16±0.56	10
NH ₄ ⁺ (mg/L)	0.076-0.249	0.15±0.08	0.082-0.09	0.086±0.005	0.098-0.439	0.25±0.15	0.3
Clorua	9.9-60.4	26.12±20.08	10.2-67.7	38.95±40.6	12.1-1800	505.22±753	250
PO ₄ ³⁻ (mg/L)	0.003-4	0.81±1.7	0.062-0.08	0.071±0.012	0.005-0.114	0.043±0.04	0.1
Fe (mg/L)	0.821-3.18	1.6±0.92	0.13-2.63	1.38±0.76	0.254-12.1	2.74±5.23	0.5
Hg (mg/L)	0.0003-0.0006	0.00045±0.00017	0.0003-0.0004	0.00035±0.00007	0.0003	0.0003±0	0.001
Cd (mg/L)	< LOD _{Cd}	< LOD _{Cd}	< LOD _{Cd}	< LOD _{Cd}	< LOD _{Cd}	< LOD _{Cd}	0.005
Pb (mg/L)	< LOD _{Pb}	< LOD _{Pb}	< LOD _{Pb}	< LOD _{Pb}	< LOD _{Pb}	< LOD _{Pb}	0.02
Coliform (MPN/100 mL)	4300-9300	6300±2738	3500-4300	3900±565	2400-4300	3540±1040	2500

Notes: “-”: Unspecified sign

LOD_{Cd}: Cd limit of detection: 2×10⁻³ (mg/L)

LOD_{Pb}: Pb Limit of detection: 3×10⁻³ (mg/L)

LOD_{Hg}: Hg Limit of detection: 0.3×10⁻³(mg/L)

3.1.1 pH

The fluctuation of the pH of Ban Thach river water of Tam Ky city shows: all monitoring events have pH values in the range of 6-8.5. Also, it reaches the allowable limit according to the AI type surface water quality standards. (QCVN 08-MT: 2015/BTNMT).

Overall, the pH at sampling spots is quite stable, the difference between batches is not large. It is still within the limits of the permissible standards and is suitable for the life of many aquatic animals as well as for the use of water for human domestic. The pH of river water depends on many factors such as the season of the year,

the flow of water from small rivers and streams to the river and the impacts of people on the banks of the river ...

3.1.2 TSS

The fluctuation of TSS content of Ban Thach river water by months and points during the survey is presented in Table 2. From the chart above, most of the locations with TSS value exceed the permissible limits (20 mg/L) according to QCVN 08-MT: 2015/TNMT column A1 (except for M3 position in the monitoring period in the March, June, September, and October). Specially in November, TSS at the monitoring points are many times higher than that of Column A1 because this is the time of the rainy season, the heavy rainfall and 12th storm cause large floods in the study area, leading to many suspended solids on the banks of the river and upstream increases the concentration of suspended solids in the water. On the other hand, at M1, the TSS results are higher than other areas because the area upstream of Ban Thach river is affected by many small rivers and streams and the activities of people around the river banks compared to the other areas.

3.1.3 Dissolved Oxygen

Dissolved oxygen (DO) content is an important parameter in assessing water quality because of its influence on the organisms living within water. From Table 2, it can observe that the DO value in the water of Ban Thach River is not homogeneous over time and space. Water shortage frequently occurs in June and October in both M1 and M3 locations. When compared with QCVN 08-MT: 2015/BTNMT column A I (≥ 6 mg/L). Therefore, it can be realized that the water quality of Ban Thach River in My Cang and Tam Ky bridges is at a high risk of water degradation.

3.1.4 COD

Through sample analysis shows, COD at the study sites all meet the A1 surface water standards. However, the results of COD analysis at M1 are varied greatly between observance. Meanwhile, at the M3 position, there is not much change in COD, so we can see the stability of COD at the M3 position.

The diagram in Table 2 shows that the COD content tends to decrease from M1 to M3 or there is a slight decrease in the downstream of the river. This is partly due to the significant reduction of the chemical compounds in the water during the movement of the water. As well as the increase of chemical pollution activities in Ban Thach River when passing through Tam Ky City.

3.1.5 BOD₅

The results in Table 2 show that the BOD according to the monitoring stages at M1 has very large fluctuations, 02 times in June and October exceeding QCVN 08-MT: 2015/BTNMT, the remaining periods are in QCVN standard. At the M2 and M3 points through the monitoring, BOD₅ are in QCVN 08: 2008/BTNMT column AI (4 mg/L). At M1 (My Cang) BOD₅ tended to increase over time and M3 (Tam Ky Bridge) decreased over time. BOD₅ values ranged from 2.4 to 5 mg/L at the study sites through monitoring observations, showing that the organic matter content of Ban Thach River in Tam Ky City is showing signs of reduction.

3.1.6 Chloride Content

For water with high chloride content exceeding the threshold for QCVN 08-MT: 2015/BTNMT, the grass water is likely to be saline not used for domestic purposes as well as fish farming. Therefore, for the Ban Thach river section which runs parallel to the coast and suffers numerous impacts, it is essential to assess the chloride indicator to determine the ability to use water for different purposes.

The analysis results in Table 2 show that Chloride is always in the permitted level. However, in October, at the M3 test site, Chloride content increased to 1800 mg/L and 7.2 times higher than QCVN 08-MT: 2015/BTNMT (250 mg/L). At this time, there is no rain in Tam Ky, the possibility of saline water from the Truong Giang River (the river runs parallel to the boundary), adding the discharge of two riverside causes the concentration of Chloride in the water to increase mutation. The chloride content occurs only a

few times a year, not frequently, which shows that the water quality of Ban Thach river is quite stable in terms of Cl content. Simultaneously, the results show that the Chloride content is likely to increase gradually downstream of the Ban Thach River.

3.1.7 The content of Nutrients

Nutrients in water are assessed by the content of ammonium (NH_4^+) and phosphate (PO_4^{3-}). In Table 2, the ammonium content at the survey points permit limit of type A1 according to QCVN 08-MT: 2015/BTNMT. Particularly, the content of ammonium increases not consistently among the months in the year. It is noteworthy that at the study site M1 (October), PO_4^{3-} has a value exceeding the allowed level (0.1 mg/L) of the A1 surface water standard of QCVN 08-MT: 2015/BTNMT 40 times. This shows that the river water quality has shown signs of PO_4^{3-} pollution upstream before flowing through Tam Ky city and decreasing towards the downstream.

3.1.8 Heavy Metals Pb, Hg Cd and Fe Total

Based on the analysis of Fe content at the monitoring points, Fe content always is much higher than QCVN 08-MT: 2015/BTNMT column A1 prescribed (0.5 mg/L). For the index of Cd, Pb, Hg in Table 2 shows, the content of these heavy metals at all study sites on the Ban Thach River of Tam Ky city through sampling is very low, many times smaller than the permitted standard type A1 according to QCVN 08-MT: 2015/BTNMT. The content of these heavy metals is almost no significant change over time and space. This proves that the water of Ban Thach River through Tam Ky city has not shown signs of pollution of metals Pb, Hg and Cd.

3.1.9 Total Coliforms

The breakthrough of E.coli bacteria in water shows that the water source has shown signs of pollution. Permissible limits for domestic conform according to standard 08-MT: 2015/BTNMT AI column are 2.500 MPN/100 mL.

According to the results of the analysis, the total coliform both at the study sites of the 3 monitoring

periods almost all locations and the monitoring time exceeded the permissible limits (2.500 MPN/100 mL), except for M3. March and November. When comparing the monitoring locations as well as the monitoring time, the Coliform content decreases gradually downstream of the Ban Thach River. This shows that the water quality of Ban Thach river before entering Tam Ky city has shown signs of Coliform pollution but gradually decreases towards the downstream.

3.2 Proposing Solutions for Water Quality Management of Ban Thach river

In general, the water quality of Ban Thach River has signs of iron pollution, partly due to the geological structure of the area, so the water quality at some points has a concentration of iron exceeding that of QCVN 08-MT: 2015/BTNMT.

Compared with other parameters of QCVN 08: 2015/BTNMT column A1, the river water quality is good, but there have been signs of coliform pollution, the content of TSS, BOD_5 in some locations exceeded the allowed limit. In addition, at the end of the river (M3) the confluence of the Tam Ky river shows signs of salinity intrusion at some time of the year, but does not affect the water quality of the river during the period. Therefore, there should be solutions to strengthen the management of water resources, control and protect river water quality according to the actual situation in the locality in a sustainable manner.

3.2.1 Legal Solution

Develop plans and plans for environmental protection management in each field, especially in the areas of agricultural production, business and services on both sides of the river. For each ward, an action plan on environmental protection and protection of river water needs to be developed.

It is essential to strengthen management personnel and technical equipment to serve the inspection, supervision and strictly handle all violations regarding mechanical facilities and individuals that cause

pollution and degradation of Ban Thach river water source.

For Agriculture Department of Tam Ky city, it is necessary to strengthen the supervision of aquaculture on Ban Thach river. Simultaneously, guide farming households to prevent and control diseases, use feeds for aquatic animals, plant protection chemicals and other chemicals in aquaculture to ensure standards and regulations aim not to pollute water sources.

It is important to strengthen the inspection and supervision about the discharge of wastewater into Ban Thach upstream before flowing through Tam Ky city, especially at Tam Thanh Industrial Zone. Concurrently, apply the fee level of wastewater according to the actual situation in the locality.

3.2.2 Technical Solution

Measures to overcome riverbank erosion: Current technical measures need to be carried out by planting Vetiver grass alternately with bamboo trees to protect the riverbank. This model is suitable for deep flooded areas with strong currents. In which, bamboo is a tree with cluster roots, strong soil holding power, grows into large bushes, creating a network to keep the soil, high stem resistant to deep flooded areas to limit landslides very effectively.

The local government needs to invest in building the drainage infrastructure and concentrate the solid waste collection system in the area, in the densely populated areas, to limit the people to dump garbage into the river.

Improve the environment of riverside markets, especially the investment in building a concentrated collection and treatment system of standardized water in these areas. From there, the river water quality can be improved, limiting environmental pollution.

There should be studies and forecasts of the impact of the two sides of the river on the water quality of Ban Thach River in recent years.

It is necessary to inspect and evaluate the sources of waste generated from animal husbandry and aquaculture activities, which are likely to cause

pollution to the river, thereby proposing a plan to treat and minimize the effectiveness and conservation of river water quality.

Establish an appropriate and scientific monitoring network of water quality in Ban Thach river: propose 3 monitoring points as selected, build a sampling observation map; frequency of monitoring every time to compare analysis results with QCVN 08-MT: 2015/BTNMT Column A1

3.2.3 Other Solutions

Strengthen propaganda and education to raise awareness and responsibility of local people and local authorities of environmental protection.

Promote the active and positive role of social-political organizations, mass organizations, and communities in participating in the supervision of river water environment protection.

Supplementing the investment budget and focusing primarily on strengthening the capacity of management, protection, maintenance of water quality in Ban Thach River and preventing

4. Conclusion

The water quality of Ban Thach river running through Tam Ky city and Quang Nam province is quite good. Parameters such as pH, COD, BOD₅, NH₄⁺, Cd, Pb, Hg and microorganisms (Coliform) all meet the permitted standards according to QCVN 08: 2008/BTNMT column A1, but still worrying about the function. The amount of iron Fe in the country is higher than that of QCVN 08-MT: 2015 Column A1 for domestic water supply. For DO at the survey sites, there are a few months of decline and below the specified level but not significant.

In order to manage the water quality of Ban Thach River in Tam Ky City, Quang Nam province is stable and developed in a sustainable manner, it is necessary to stick implement many synchronous management solutions, water resource management and management of waste resources. In particular, the establishment of a system to collect and completely

treat waste generated from production activities, activities on both sides of the river, propagandize environmental protection, raise awareness of the conservation of the masses is the key solution of management.

It is necessary to build an appropriate monitoring network to monitor and evaluate the changes in water quality in Ban Thach river. Strengthen activities of inspection, examination and strictly handling illegal activities of exploiting sand and grit on rivers, acts causing pollution of river water.

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