ASSESMENT OF THE IMPACT OF FULL- DYKE SYSTEM ON WATER QUALITY USING GIS

CASE STUDY: VI TAN COMMUNE, HAU GIANG PROVINCE

Nguyen Quoc Cuong[1], Nguyen Dinh Giang Nam[1], Thach Kim Chau Ly Na[1] and Cao Duy Luan[1]

1College of Environmental and Natural Resources, Can Tho University,
Campus II, 3/2 street, Xuan Khanh Ward, Ninh Kieu District, Can Tho City, Viet Nam.
Email: cuongb1508879@student.ctu.edu.vn

ABSTRACT

The study aimed to assess the water quality index in order to evaluate the water quality of the irrigation canal network in a full-dyke system situated in Vi Tan commune, Hau Giang province. Eleven physic – chemical parameters, namely, pH, EC, TSS, TDS, DO, COD, BOD5, N-NH4+, P-PO43-, Turbidity and Total Coliform were considered in the analysis by monitoring fifteen sampling locations within 513ha study area for a period of 4 months. Geographic information system is used to represent the spatial distribution of the parameters and the water quality index map was generated. It is apparent from WQI values that the irrigation canal water with WQI values ranging from 68 to 73 (before-building dyke system period) and 10 to 28 (post construction period) were categorized as class II (fairly good) and class IV (grossly polluted), respectively. It was mainly because of high concentration of N-NH4+ due to agricultural activities. The results indicated that the surface water of the areas was highly polluted and it is unsuitable for domestic usage and irrigation purpose unless treated properly.

1. INTRODUCTION

Water is an indispensable part in the daily life, the water is also used for the development of agriculture, industry, transportation ... and other economic sectors (Pham, 2006). In addition, water is one of the factors that ensure the survival and development of all life on the earth, and human society (Pham, 2006).

However, under the impact of population and economic growth, water resources, especially surface water, are increasingly being abused. Water issues are becoming more serious, also, demand for water continues to increase, while availability is limited by pollution (Utama & Suharta, 2018). According to the World Health Organization (2011), it is estimated that 70% of people in suburban areas and 25% in urban areas in under-developed countries do not have clean water enough to use.

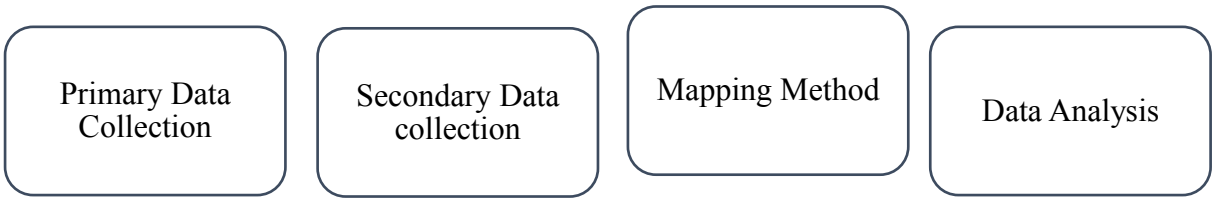
Water pollution is a matter of great concern to the public and society. Wastewater from agricultural activities is major problem due to increasing use of pesticides, which has a negative impact on water resources. Wastewater from agricultural production also contains large amounts of pesticides, heavy metal content, and organic matter. Fertilizers and pesticides residues in the soil are washed away by surface runoff and flow into rivers. This is toxic to the environment and human health.

The Mekong Delta is an area of great potential for economic development, especially in the agricultural sector. In agriculture, most of the water used is surface water. In order to have enough water for irrigation, irrigation systems are often used to drain water. This water is taken along the canal system under the planning of irrigation of the area. In rural areas, people use water from rivers and canals to supply drinking water, so toxins in the food chain,

affecting human health and environmental pollution on the whole scale of cultivation. This is the main source of pollution and dangerous disease transmission. Surveys show that water-borne diseases account for 80% of all diseases in developing countries (Nguyen, 2002). Therefore, we need to monitor and assess the quality of surface water to provide appropriate management measures.

The project is one of the proposed projects in the Irrigation Management Project for Rural Development in the Mekong Delta. The project has been completed and in the process of operation, the assessment of water quality in the dyke needs to be concerned because the dyke plays an important role in improving water use efficiency in agricultural production, irrigation and drainage of agricultural land in the project area, improvement of agro-ecological environment, prevention of salinity intrusion, increasing the coverage of water services for the needs of people. Therefore, the assessment of the surface water quality in the dyke is essential and plays an important role in the management and it may suggest the operation of the system for mitigating the impact of full dyke on the surrounding environment outside the dyke.

2. METHODS



Collection of water samples for analysis of indicators was applied in accordance with QCVN 29/2011/TT-BTNMT and QCVN 21/2012/TT-BTNMT.

Data and related documents at (i) the Department of Natural Resources and Environment Vi Thanh City, (ii) Preventive Medicine Center of Hau Giang Province, and (iii) General Hospital of Vi Thanh City.

Using QGIS 2.16.3 to digitize and publish surface water quality monitoring.

Using WQI to assess water quality and the process includes the following steps:

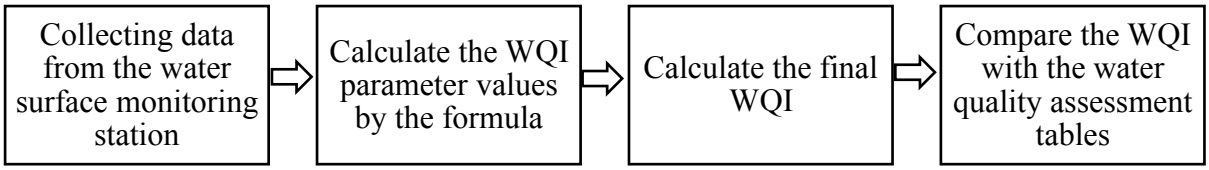


Table 1. Water quality classification according to WQI

WQI	Water quality assessment	Color
91 - 100	Used for water supply	Blue
76 - 90	Used for water supply and appropriate handling measures are needed	Green
51 - 75	Used for irrigation and other similar purposes	Yellow
26 - 50	Used for waterways and other similar purposes	Orange

0 - 25	Extremely polluted, appropriate handling measures are needed in the future	Red

3. RESULTS AND DISCUSSION

3.1. Results of water quality assessment before and after built the dyke

3.1.1 Sources affect surface water quality

Domestic waste is discharged directly into the river or treated at home such as burning or burial. For agricultural waste such as plastic bottles, pesticides after use can be put into large bags for centralized pits, in some cases other agricultural waste is collected at the farm's edge or discharge directly to the canal. Livestock waste is discharged directly into the river without treatment.

3.1.2 Water quality assessment before and after built the dyke

Table 1. WQI and water quality assessment of the area before having dyke (2015)

Sample	WQI	Water quality assessment	Color
NM1	**73**	Used for irrigation and other similar purposes	Yellow
NM2	**68**	Used for irrigation and other similar purposes	Yellow
NM4	**69**	Used for irrigation and other similar purposes	Yellow

Table 2. WQI and water quality assessment of the area after having dyke (2017)

Sample	WQI	Water quality assessment	Color
NM1	**20**	Extremely polluted, appropriate handling measures are needed in the future	Red
NM2	**23**	Extremely polluted, appropriate handling measures are needed in the future	Red
NM3	**10**	Extremely polluted, appropriate handling measures are needed in the future	Red
NM4	**26**	Used for waterway and other similar purposes	Orange

NM5	**28**	Used for waterway and other similar purposes	Orange

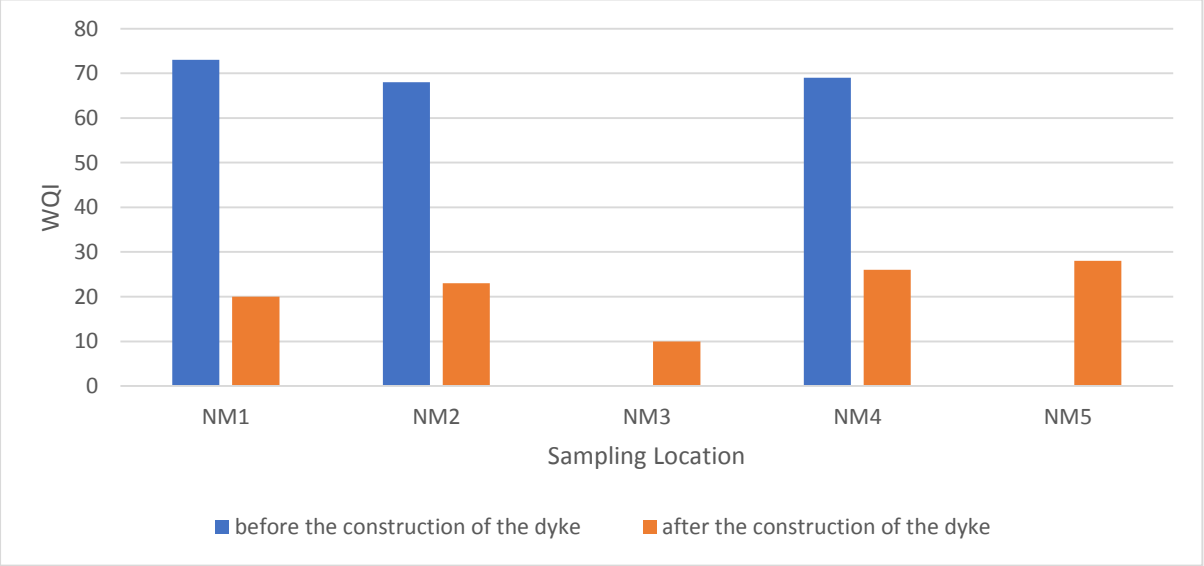


Figure 1. Compares the WQI values before and after the dyke was built

Figure 1 shows that the WQI value before and after the dyke has a large difference at the comparison points. The WQI in 2015 ranged from 68 to 73, comparing the WQI water quality rating to the criteria used for irrigation and other similar purposes. The WQI value after in 2017 clearly decreases the variation between 10 and 28, the water quality is reduced, and there are places where the pollution is severe, the need for treatment in the future as in points NM1, NM2 and NM3. Only two ones, NM4 and NM5, can be used for navigation and other similar purposes.

3.2 QGIS application for the dyke management

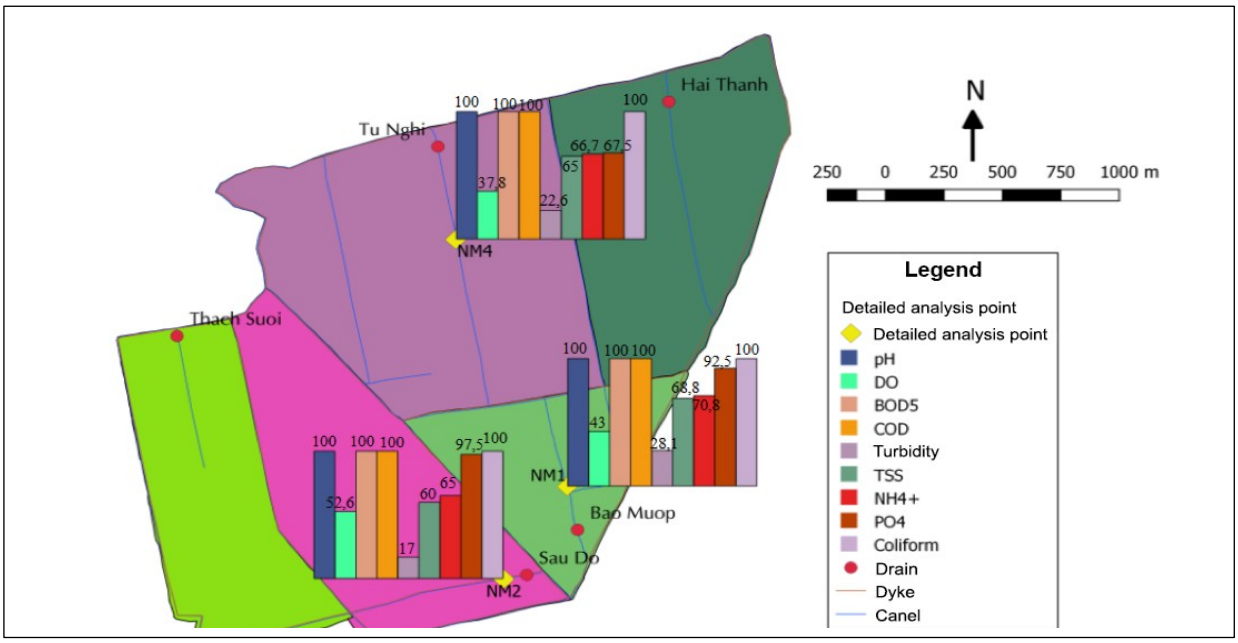


Figure 2. Water quality map according to WQI at 3 detailed analysis points

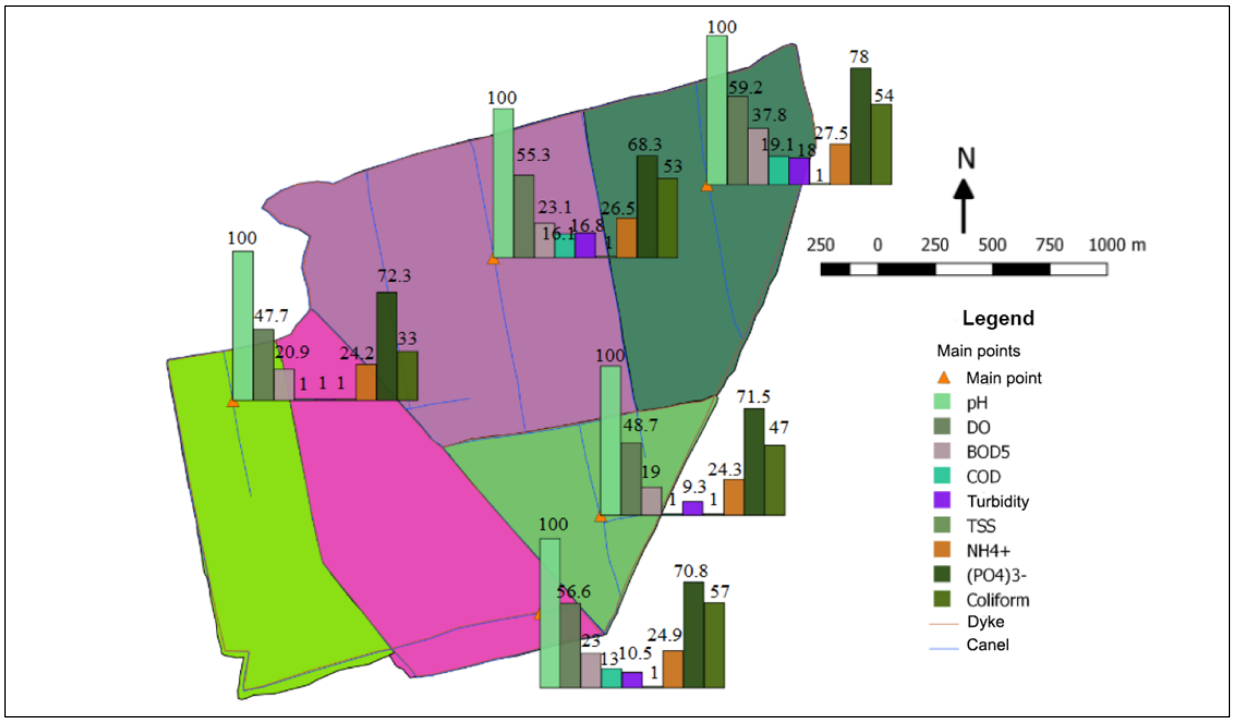


Figure 3. Water quality map according to WQI at 5 detailed analysis points

4. CONCLUSIONS

From the results of the water quality analysis before the construction of the dyke, it found that the parameters monitored were rated as QCVN 08:2015/BTNMT B1. Only DO in NM1 and NM4 are lower than QCVN 08:2015/BTNMT B1. In general, the quality of water before the dyke is not contaminated.

The results of water quality analysis after the construction of the dyke showed that the BOD_5, COD, Coliform, TSS, Ammonium, turbidity levels exceeded the original level before the dyke and did not meet QCVN 08:2015/BTNMT column B1, DO parameters are not reached at two points NM1, NM3. The pH value, phosphate reached QCVN 08:2015/BTNMT type B1. In general, the quality of water after pollutants is contaminated.

The reason for the increase of the analysis criteria and failure to meet the standards after the construction of the dyke is due to the effect of residues of fertilizer in the soil remaining, the decomposition of straw, agricultural by-products and waste of domestic and livestock. After the dyke was built, the crop season increased in triple crops compared with double crops as before, the amount of fertilizer residue in agriculture increased, the by-products in agriculture are in the process of decomposing strongly combined with the waste of domestic and livestock. Thus, water quality has been affected and unsatisfactory.

5. REFERENCES

Nguyễn, Đ. K., 2002. *Môi trường và sức khoẻ.* NXB Lao Động - Xã Hội. Vietnam.

Pham, N. H., 2006. *Giáo trình Quy hoạch và thiết kế hệ thống thủy lợi,* Tập 1. NXB Xây Dựng. Vietnam.

Utama, I. M. A., & Suharta, I. N., 2018. *The Challenges of Water Pollution: Enforcement of Water Pollution Control*. Hasanuddin Law Review, 4, 81–87.

WHO, and UNICEF., 2011. *Vietnam water and sanitation sector assessment report.*

Lê, T., 1997. Quan trắc và kiểm soát ô nhiễm môi trường nước. Nhà Xuất Bản Khoa Học và Kỹ Thuật. Ha Noi, Vietnam.

Decision No.879/QD-TCMT on the issuance of the water quality index calculation, 01/07/2011.

Vietnamese standard QCVN 08-MT:2015/BTNMT, National technical regulation on surface water quality, 21/12/2015.

John Glasson, Riki Therivel and Andrew Chadwi (2005), I*ntroduction to environmental impact assessment*, pp 4-6. OXFORD. New York, USA.