

# Proposing solutions to control watersupply reserves and quality for urban areas and industrial zones in Phu Yen provinceto response to climate change

Nguyễn Thị Ngọc Dung, Nguyễn Văn Nam, Vũ Bình Sơn

## Abstract

Currently, along with the economic development, the urbanization process has been taking place strongly, putting great pressure on the water supply for urban areas and industrial zones, leading to conflicts, overlapping and obstacles to the water supply management. Proposing solutions for controlling water supply reserves and quality with technical solutions such as: controlling the management according to the water supply reserve planning; monitoring; the process of early warning and quality control of water supply source to achieve the goal of safe water supply (ensuring the reserves and quality of water supply) for urban areas and industrial zones. The management of water supply sources in Phu Yen Province is very important for the sustainable development of urban areas and industrial zones.

**Key words:** water supply reserves; water supply quality; urban areas; industrial zones; climate change

*BOD: Biochemical Oxygen Demand*

*COD: Chemical oxygen demand*

*WQI: Water Quality Index*

## 1. Introduction

Our country is implementing the fourth industrial revolution (Industry 4.0) in the fields of social life, along with the rapid urbanization process, the demand for water use for economic development, serving the growing population is increasing. The economic restructuring requires an appropriate change in the structure of water use. On the other hand, climate change is causing many threats to the water resources in Vietnam, including Phu Yen Province. Water is increasingly scarce, declining in both quantity and quality. Accompanied by severe droughts and floods in both scale, extent and time, leading to difficulties in water supply for the needs of use. Under the impact of climate change, the reserves and quality of water supply for urban areas and industrial zones (IZs) in Phu Yen Province are unstable. Droughts caused by heat, waterlogging due to rain and floods, water pollution from sewage and waste and salinization by sea water intrusion due to the influence of sea level rise have become common in many areas of Phu Yen Province. [1] [2]

The management of water supply for urban areas and industrial zones in Phu Yen Province is still limited, inadequate, not meeting the actual requirements and there is no solution to actively respond to the increasing climate change. Currently, along with the economic development, the urbanization process has been taking place strongly, putting great pressure on the water supply for urban areas and industrial zones, giving rise to conflicts, overlapping and obstacles to the water supply management. The apparatus, mechanisms and policies on management of water resources already exist, but need to be supplemented and completed to be suitable for the renovation period. At the same time, it is necessary to improve the water resource management capacity to approach the 4.0 industrial revolution in Phu Yen water industry in particular and Vietnam in general. [1][2]

To achieve the goal of safe water supply (ensuring reserves and quality of water supply) for urban areas and industrial zones, the management of water supply in Phu Yen Province is very important for the sustainable development of urban areas and industrial zones. Therefore, "Controlling water supply reserves and quality for urban areas and industrial zones in Phu yen Province to response to climate change" is a practical and urgent study.

## 2. Overview of water supply for urban areas and industrial zones in Phu Yen Province to response to climate change

Phu Yen Province has a total of 9 urban areas. According to urban classification, there is one Class-2 Urban area of Tuy Hoa City, two Class-4 Urban areas of Song Cau Town and Dong Hoa Town; and 6 Class-5 Urban areas such as La Hai Town, Phu Hoa Town, Cung Son Town, Hai Rieng Town, Chi Thanh Town and Phu Thu Town. In the province, there are 3 centralized industrial zones including Hoa Hiep Industrial Zone, An Phu Industrial Zone, and Northeast Song Cau Industrial Zone, especially, there are 10 industrial clusters established in the province, investing in infrastructure and operating. [2] [3]

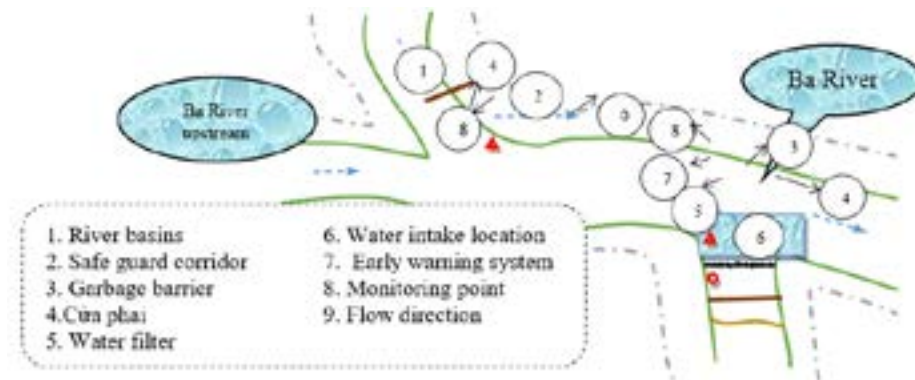
Currently, the urban water supply system is managed by Phu Yen Water Supply and Sewerage Joint Stock Company with 9 water treatment plants providing treated water for 9 cities and 3 big industrial zones with a total capacity of 47,400 CMD. Of which, the supply for 09 urban areas is 33,940 CMD and 3 big industrial zones is 13,460 CMD. [2] [3]

### a. Overview of water sources and water reserves for urban areas and industrial zones in Phu Yen Province

- River water source

*Assoc.Prof.Dr. Nguyen Thi Ngoc Dung*  
*Dr. Nguyen Van Nam*  
*Dr. Vu Binh Son*  
*Hanoi Architectural University*

Date of receipt: 03/10/2023  
Editing date: 24/11/2023  
Post approval date: 8/12/2023



**Figure 1. Proposed management diagram of River Ba surface water supply**

Mainly based on surface water of 4 main river basins. Most rivers and streams in the area have narrow basins, large river bed slopes, and the flow depends on rainfall.

- Lake water source

There are many reservoirs with large useful capacity to be considered as a source of water for domestic use. [4] [5]

- Groundwater source.

Current exploration and survey documents show that underground water resources in Phu Yen Province are quite complex, this water level has medium and small reserves, and can be exploited and used for various users. individual water.[4] [5]

- Rain water source

The rainy season in Phu Yen Province comes late and ends early, lasting only 3-4 months (from September to December), the average annual rainfall is from 1,600 - 2,100mm. There are 4 months of average rainfall over 100mm from September to December. The dry season lasts 9 months, from January to September with the water volume reaching 25-35% of the whole year. Moreover, there are two dry periods in April and August, the amount of water in the dry season is approximately 2% of the annual volume. [4] [5]

*b. Current situation of water supply quality for urban areas and industrial zones in Phu Yen Province, impacts of climate change on water resources*

- Current situation of river water quality

The Ba River

According to the results of monitoring the quality of surface water environment in the Ba River basin over the years, it is still quite good. However, compared to the 2011-2015 period, the water quality of the Ba River in the 2016-2020 period tends to decrease, especially in the dry season, the water source is locally polluted at some monitoring points.[4] [5]

The Ky Lo River

In general, the results of water quality monitoring in the Ky Lo river basin from 2016 to 2020 are still quite good. However, compared to the 2011-2015 period, the water quality in the 2016-2020 period showed signs of gradual decrease. Especially in the dry season, water sources are polluted locally at monitoring points: Nutrient pollution through nitrate content (NO<sub>3</sub>-); organic pollution through the content of BOD<sub>5</sub>, COD; microbiological contamination through the content of Coliform, E. Coli.[4] [5]

The Ban Thach River

The WQI index at locations in the Ban Thach River basin is low, the water is polluted, it is mostly used for irrigation purposes.

General comments on the current situation of river water quality: In general, the water quality of the main rivers is relatively good and ensures enough reserves for use demand in Phu Yen Province. [2] [3]

- The quality of the Lake water

Most of the lakes have good water quality, which can be used as raw water for domestic purposes. But at present, there are no factories, or urban water supply plants that use raw water from reservoirs.[4] [5]

- The quality of groundwater

Coliform content at all underground water monitoring points in the province has exceeded the standard value. On the other hand, in saline aquifers. It is forecasted that after 2020, Phu Yen groundwater level may decrease significantly. Therefore, according to the water source planning, priority should be given to using surface water for daily-life and production needs, reducing and eventually limiting the use of groundwater in the direction of gradually transforming it into a strategic backup water source in the future.[4] [5]

c. Impacts of climate change on surface water

Climate change impacts on surface water resources: changing rainfall, rainy season distribution and increasing evaporation will change the water balance of the region. The rainy season will be shifted, expanded, narrowed, and the changes in rainfall will lead to the change in the flow.

It can be said that the impact of climate change on water resources is reflected in factors such as: flow regime of rivers in the province due to change in rainfall, rainfall distribution in different regions and change in the duration of the rainy season. These changes can cause flooding in the rainy season but prolonged drought in the dry season.[5] [6]

Tides and saltwater intrusion: The tidal regime in Phu Yen is mainly diurnal and irregular. During the dry season, the tides bring salt into the estuary every day.

*c. Situation of sedimentation and erosion of riverbanks and estuaries.*

According to survey data, riverbeds and estuaries of Da Rang, Ky Lo and Da Nong rivers have been eroded and accreted regularly.[5] [6]

Situation of saltwater intrusion

The rivers in Phu Yen Province all directly flow into the East Sea, so salt from the sea follows the tides to infiltrate into rivers, canals and fields, especially in the dry season when the river water dries up.[5] [6]

### 3. Proposing solutions for controlling water supply reserves and quality

*a. Proposing management control solutions according to the water supply reserve planning*

- Develop plans for the development of water supply systems to meet the needs of treated water use in urban areas and industrial zones.

- Make short, medium-term and long-term investment plans for the development of water supply systems in each period.

- Monitor, control and manage the process of increasing water demand according to the development of urbanization in practice.

- Search, arrange and allocate investment capital appropriately, to avoid overlap or lack of capital.

- Prioritize the exploitation of surface water sources, on river systems with abundant reserves

- Prioritize the exploitation of raw water sources for people's living needs.

- Reduce and move towards limiting the use of groundwater in the direction of gradually turning into a strategic backup water source in the future.[2] [8]

*b. Proposing solutions for monitoring water supply quality for urban areas and industrial zones in Phu Yen Province under climate change conditions*

Develop a map of water supply monitoring points for urban areas and industrial zones in Phu Yen Province by 2030. Proposing 21 water supply monitoring points for urban areas and industrial zones including 11 monitoring points for separate water supply for urban and industrial zones; 05 monitoring points for combined water supply for urban areas, industrial parks and irrigation. Moreover, we have 05 observation points for water sources affected by sea level rise: sugar factories, starch production, industrial activities in upstream areas and waterway traffic as well as irrigation. [2] [8]

*c. Proposing the process of early warning and quality control of rivers used for water supply (Taking Ba River at the location of the water intake work for Tuy Hoa Water Company as typical)*

Proposal for management of surface water supply in Ba River, water grab location in Hoa Thang commune provided for Tuy Hoa city urban area.

Control of basins flowing into the Ba River: Currently, on the Ba River there are many small basins flowing into the Ba River, so it is necessary to review and strictly inspect each basin to take measures to handle. For small tributary basins only when the rainy season flows from the mountainside, connecting with each other to the basin with water flowing all year round will flow into the Ba River basin. Conduct water quality control from the basins by placing monitoring points at the adjacent location between the basins with the Ba River as in Figure 3.1[2]

Proposing the process of early warning and quality control of Ba River water supply

- The water quality sensor is responsible for measuring the water quality at the installation site, then transmits the signal to the signal processor; and then the signal processor has the function of analyzing indicators of water quality. Indicators are installed into the signal processor automatically projected on current regulations and standards.

- When the water signal exceeds the allowed index, the signal processor acts on the telephone broadcaster alerts the registered subscriber number (System Operations Center). The person responsible for deciding whether to close or open the doors.

- When the central processor receives the signal transmitted from the phone wave, it automatically analyzes if the water exceeds the allowable index and the controller will close itself.[2]

The proposed technical solutions have high practical significance and can be applied in the management of water supply for urban areas and industrial zones in Phu Yen

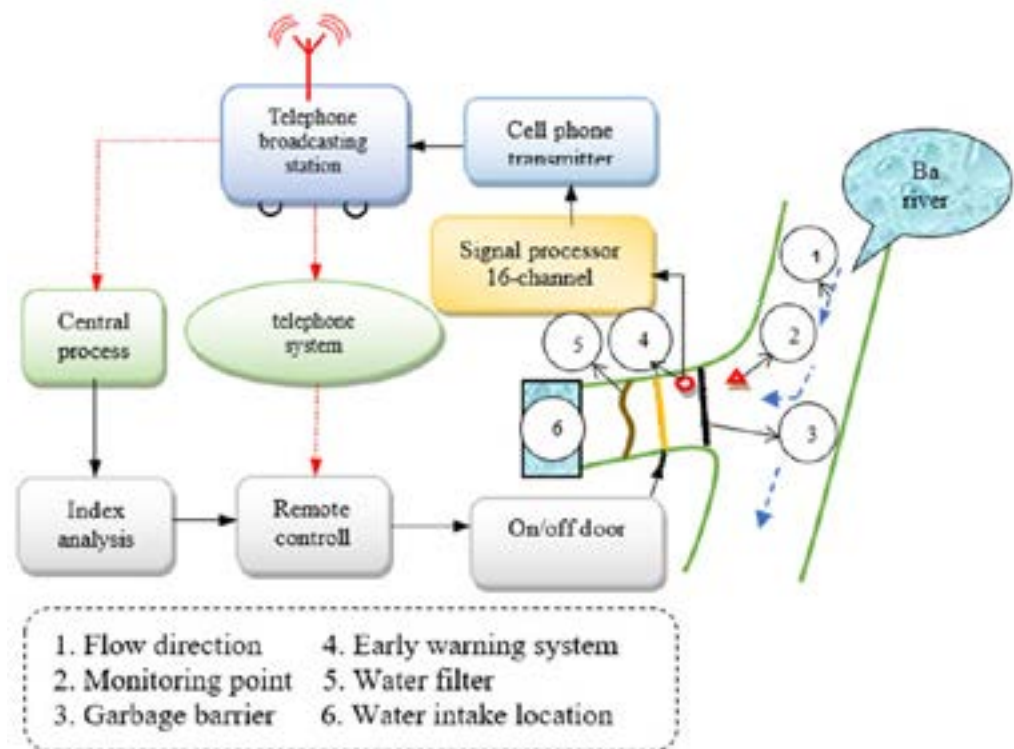


Figure 2. Proposing the operation process of the early warning system, controlling the quality of the Ba River [7]



Province, contributing to improving the quality of water supply services according to Orientation of water supply services in urban and industrial areas until 2025 and vision to 2050.

#### 4. Conclusions

The study proposed solutions to control water supply reserves and quality in order to achieve management objectives including management control solutions according to the water supply reserve planning; solutions for monitoring the quality of water supply for urban areas and industrial zones in Phu Yen Province under climate change conditions. Moreover, proposing the process of early warning, controlling

the quality of River used for water supply (Taking the Ba River at the location of the water intake workfor Tuy Hoa Water Company as typical).

The results of the proposed study are practical, which can help Phu Yen provincial managers to objectively see the current situation of water supply and the solutions to control water supply reserves and quality for urban areas and industrial zones in Phu Yen Province. Based on the study results,proposing plans, solutions and decisions for urban water supply activities in general and expanding the scale of urban water supply projects in the province in particular to achieve the set goals./.

#### References

1. Circular No.08/2012/TT-BXD dated November 21, 2012 of Ministry of Construction on Guiding the implementation of safe water supply ensuring.
2. Vu Binh Son. Doctoral thesis (2021) Managing water supply for urban areas and industrial zones in Phu Yen Province to respond to climate change.
3. Decision No. 2502/QĐ-TTg of the Prime Minister dated December 22, 2016: Approving the Adjustment of the Orientation of water supply services in urban and industrial areas until 2025 and vision to 2050
4. People's Committee of Phu Yen province (2020), Decision No. 749/QĐ-UBND dated May 11, 2020 of the People's Committee of Phu Yen province on plans to prevent and combat drought and salinity causing lack of domestic water in 2020 in the area. Phu Yen province table.
5. Vu Binh Son. Factors affecting water supply management for urban areas and Industrial zones in Phu Yen Province in response to climate change. No. 11/2019, ISSN 1859 - 459X,Vietnam Bridge and Road Magazine.
6. Public disclosure authorized (2010), Climate Change and Urban Water Utilities: Challenges and Opportunities.
7. Phu Yen Water Supply and Sewerage Joint Stock Company (2019) – Report on the implementation of the water supply management plan in Phu Yen province.
8. Anna Hurnimann and Elizabeth Wilson (2018): "Sustainable Urban Water Management under a Changing Climate: The Role of Spatial Planning"

## Smart city management and development...

(continued on page 37)

urban spatial planning, thereby proposing smart solutions for operating technical infrastructure systems, construction and construction management, and introducing experience in applying GIS in implementing general urban planning in Hanoi and Vietnam. These are important studies to effectively implement the three main pillars of smart city development associated with digital transformation in Vietnam as stated in Project 950/2018.

Currently, in the localities in Vietnam, each different province/city is gradually building its own "smart city" according to different criteria and fields, depending on the size, nature of the city, economic conditions, culture - society, desired level of investment and the problems the city faces; In addition, the current government policies for smart city construction are lacking specific studies and guidelines.

Based on practical experience, by studying the effectiveness of technology in system operation and inheriting the achievements of the 4.0 industry revolution, the research of the article will be the basis for localities to effectively apply and deploy the management and development of smart cities, as well as an important premise to realize the sustainable smart city development project in Vietnam associated with digital transformation.

#### Acknowledgements

This work is partially supported by Academy of Managers for Construction and Cities,Vietnam Institute for Urban and Rural Planning. Author also gratefully acknowledges the helpful comments and suggestions of the reviewers, which have improved the presentation./.

#### References

1. Government of the Socialist Republic of Vietnam, Resolution No. 50/NQ-CP dated April 17, 2020 promulgating the Action Program to implement Resolution 52/NQ-TW
2. Government of the Socialist Republic of Vietnam, Decision No. 950/QĐ-TTg dated August 1, 2018 approving the Project "Sustainable smart city development in Vietnam for the period 2018 - 2025 and orientation to 2030"
3. Luu Duc Minh (2022) Smart City – An important motor for Vietnam's comprehensive development, Construction and Urban Magazine, Academy of Managers for Construction and Cities
4. Luu Duc Minh (2021) Chapter 4: Some technology solutions in management and Smart City development, Training materials on Smart City development management, Academy of Managers for Construction and Cities
5. Notes summary Smart City construction Project vinh phuc province 2022-2025 orientation to 2030 (2023) Department of Construction of Vinh Phuc rovince.
6. Politburo of the Communist Party of Vietnam, Resolution No. 52-NQ/TW dated September 27, 2019 on a number of guidelines and policies to actively participate in the 4th industrial revolution
7. Rotterdam-Delft3D-Flexible-Mesh-using-3D-interactive-modelling3-1366x768.png (1×1) (deltares.nl)
8. Le Hoang Trung, Nguyen Hoang Minh "Urban development approach to-wards smart cities", Journal of construction 01-2023, 86-92.