

# Solutions for controlling water supply source for urban areas and industrial zones in Phu Yen province to climate change

Giải pháp kiểm soát nguồn nước cung cấp cho các đô thị và KCN tỉnh Phú Yên ứng phó với biến đổi khí hậu

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## 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.

**Keywords:** Water supply reserves; water supply quality; urban areas; industrial zones; climate change.

BOD: Biochemical Oxygen Demand; COD: Chemical oxygen demand; WQI: Water Quality Index

## TÓM TẮT

Hiện nay cùng với sự phát triển kinh tế, quá trình đô thị hóa đã và đang diễn ra mạnh mẽ, gây áp lực lớn tới nguồn cung cấp nước cho các đô thị và KCN, làm nảy sinh các xung đột, chồng chéo và gây trở ngại cho công tác quản lý. Đề xuất giải pháp kiểm soát trữ lượng và chất lượng nguồn cung cấp nước bằng các giải pháp kỹ thuật như: kiểm soát quản lý theo quy hoạch trữ lượng nguồn cung cấp nước; quan trắc, giám sát, quy trình cảnh báo sớm chất lượng nguồn cung cấp nước để đạt được mục tiêu cấp nước an toàn (đủ trữ lượng và đảm bảo chất lượng nguồn cung cấp nước) cho các đô thị và KCN. Công tác quản lý nguồn cung cấp nước tỉnh Phú Yên có ý nghĩa hết quan trọng đối với sự phát triển bền vững của các đô thị và KCN.

**Từ khóa:** Trữ lượng nguồn cấp nước; chất lượng nguồn cấp nước; các khu vực đô thị; các KCN; biến đổi khí hậu;

## 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

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 - 2,100 mm. 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 System

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 System

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 System

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, avoiding overlap or lack of capital.

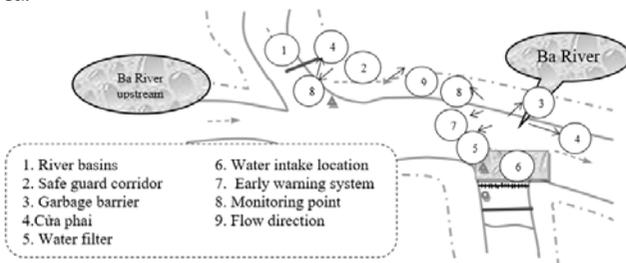
- Prioritize the exploitation of surface water sources, on river systems with abundant reserves
- Prioritize the exploitation of raw water sources for people's living needs.
- Reduce and move towards limiting the use of groundwater in the direction of gradually turning into a strategic backup water source 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)**

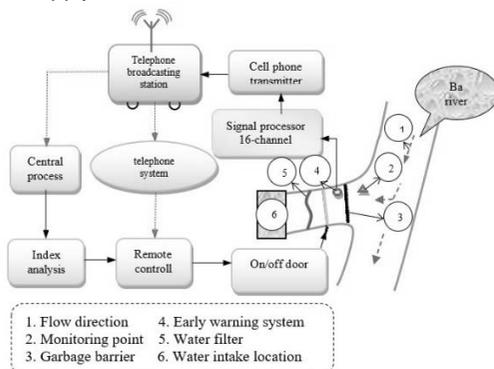
Proposal for management of surface water supply in Ba River, water grab location in Hoa Thang commune provided for Tuy Hoa city urban area.



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

**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



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

- 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 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 work for 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.

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