MINISTRY OF EDUCATION AND TRAINING MINISTRY OF CONSTRUCTION

HA NOI ARCHITECTURAL UNIVERSITY

VU BINH SON

WATER SUPPLY MANAGEMENT FOR URBAN AREAS AND INDUSTRIAL ZONES OF PHU YEN PROVINCE TO RESPONSE TO CLIMATE CHANGE

FIELD OF STUDY: URBAN AND CONSTRUCTION MANAGEMENT

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SUMMARY OF DOCTORAL THESIS

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INTRODUCTION

1. The necessity of the thesis.

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 economy, serving the growing population. 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 of Vietnam, including Phu Yen province. Water supplies are increasingly scarce, declining in both quantity and quality. Accompanied by severe droughts and floods in both scale, extent and time, it is the cause of difficulties in water supply for the needs of use. Under the impact of climate change, the reserve and quality of water supply for urban areas (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.

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 management apparatus (management) and mechanisms and policies on management of water resources already exist, but need to be supplemented and perfected and 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.

To achieve the goal of safe water supply (enough reserve 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 survival and sustainable development of cities and industrial zones. So research "Managing water supply for urban areas and industrial zones in Phu Yen province to respond to climate change" is a practical and urgent study.

2. Research purpose

Managing water supply for urban areas and industrial zones in Phu Yen province in response to climate change, aiming to manage and control the quantity and quality of water supply to meet the water supply demand. safety for urban areas and industrial zones in particular and socio-economic sectors in general in Phu Yen province.

3. Research subject and research scope

- Research subjects: *The management of water supply for urban areas and industrial zones in Phu Yen province in response to climate change (surface water)*

- Research scopes:

+ Spacial scope: Including all urban areas, industrial zones and economic zones of South Phu Yen within the administrative boundaries in Phu Yen province.

+ Time scope: Period: from now to 2030 and vision to 2050

4. Research contents

- Research on current status of water supply, impacts of climate change on water supply

- Analysis and assessment of the current status of water supply management.
- An overview study of domestic and foreign research works related to water supply management.
- Establish a scientific basis to propose models and some solutions for water supply management.
- Summary of experience in water supply management.
- Proposing solutions to balance raw water sources, control reserves and quality of water supply.
- Propose models and some solutions to manage water supply.

5. Research methodology

The thesis uses 07 research methods: Method of investigation, survey to collect data; Statistical methods; Synthetic analysis methods; Method of comparison and contrast; forecasting method; Professional solution; Inheritance method.

6. Theoretical and practical contribution of the thesis

a. Theoretical contribution:

+ The thesis has gathered and analyzed relevant domestic and international scientific works, pointed out the researched issues and the contents that need to be further researched in order to supplement and gradually complete the researches. Research on water supply management for urban areas and industrial zones in Vietnam under climate change.

+ The thesis contributes to supplement and concretize the theoretical basis for the management of water supply for urban areas and industrial zones to respond to climate change (in general) and for Phu Yen province in particular.

+ Contributing to supplementing and perfecting the legal institutional framework on water supply management.

+ Proposing an innovative model, improving the effectiveness and efficiency of synchronous management of water supply (from central to local level) according to the criteria of safe water supply.

+ Proposed solutions to control the volume and quality of surface water sources with a balanced use of raw water.

b. Practical contribution

+ The research results of the thesis help to synthesize practical experiences in the management of water supply for urban areas and industrial zones to respond to climate change in the world and Vietnam, from which to draw practical lessons on applying the technology. Water supply management for urban areas and industrial zones in Phu Yen province

+ The research results of the thesis can help professional and state management agencies to manage water supply for urban areas and industrial zones in Phu Yen province to better cope with climate change

+ The research results of the thesis can be used as a reference to contribute to improving the efficiency of water supply management for urban areas and industrial zones in Phu Yen province to respond to climate change in particular and the South Central coastal cities general set

7. The new scientific contributions of the thesis

- Proposing a plan to balance water supply for urban areas and industrial zones in Phu Yen province by 2030 in the direction of safe water supply taking into account climate change.
- Proposing procedures for early warning and quality control of river water supply (Take the water source of Song Ba at the location of the water collection work for Tuy Hoa thermal power plant as a typical example).
- Proposing a model of water supply management for urban areas and industrial zones in Phu Yen province to respond to climate change on the basis of selectively combining management methods that are flexible and suitable to specific local conditions.
- Proposing policies and solutions to mobilize financial resources to manage water supply, create a legal corridor and serve as a basis for attracting development investment capital, ensuring CNAT objectives.

8. Some relevant concepts

Related concepts of water resources; Water supply management; Climate Change; Responding to climate change; Sea level rise; Salinization; Safe water supply; Environmental monitoring and water security.

9. Organization of the thesis

The thesis includes the introduction, the content (including 3 chapters) and the conclusion - recommendations along with the list of published works, references and appendices.

CONTENT

resources, used colors to show water scarcity and assessed each other threat into a summary table.

1.1.2. Water resources management in Vietnam

a. Overview of water resources in Vietnam

Vietnam's water resources are currently facing many challenges: More than 2/3 of the water in Vietnam's river systems is formed from outside the territory, while mechanisms and policies for cooperation and sharing Water resources between countries are not efficient. Pollution, degradation, depletion of water sources, natural disasters, storms, floods, floods, droughts, saltwater intrusion, inundation, sea level rise, etc. increase in both severity and scope.

b. Integrated water resources management in Vietnam

Managing water resources in an integrated and comprehensive manner has become a consistent view of Vietnam and has been reflected throughout the National Strategy on Water Resources. In particular, the concept of integrated and comprehensive management of water resources has been legalized and stipulated in the Law on Water Resources No. 17/2012/QH13 - the highest legal document in the field of water resources. However, the management and protection of water sources has not yet met the requirements, there are still shortcomings in organizational structure, policy mechanisms, management capacity as well as the implementation of the Industrial Safety plan.

1.2. Overview of water supply for urban areas and industrial zones in Phu Yen province to response to climate change.

1.2.1. General introduction about Phu Yen province .

Phu Yen province has a total of 9 urban areas. According to urban classification, there are one Class-2 Urban of Tuy Hoa City, two Class-4 Urban of Song Cau Town and Dong Hoa Town; and 6 Class-5 Urban 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 concentrated industrial zones including Hoa Hiep Industrial Zone, An Phu Industrial Zone, and Northeast Song Cau Industrial Zone, specially 10 industrial clusters established in the province, investing in infrastructure and operating.

1.2.2. Overview of water sources and water reserves for urban areas and industrial zones in Phu Yen province

a. 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 flow depends on rainfall.

b. Lake water source.

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

c. Groundwater resources.

The current survey documents show that the underground water source in Phu Yen province is quite complex, the level of this water has medium and small reserves, which can be exploited and used for other users. individual water.

d. 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 9 to 12. The dry season lasts 9 months, from I to IX with the dry season water volume reaching 25-35% of the whole year. Morevoer, there are two dry periods In IV and VIII, the amount of water in the dry season is only approximately 2% of the annual volume.

1.2.3. Current status of water supply quality for urban areas and industrial zones in Phu Yen province, impacts of climate change on water resources

a. Current status 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.

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 shows signs of decreasing gradually. Especially in the dry season, water sources are polluted locally at monitoring points: Nutrient pollution through nitrate content (NO3-); organic pollution through the content of BOD5, COD; microbiological contamination through the content of Coliform, E. Coli.

The Ban Thach River System

The WQI index at locations in the Ban Thach river basin is low, the water is polluted, most of it is only used for irrigation purposes.

General comments on the current state of river water quality: In general, the water quality of the main rivers is relatively good and demand for using enough water in Phu Yen province.

b. 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, urban water supply stations that use raw water from reservoirs.

c. 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.

1.2.4. Current status of exploitation of water supply for urban areas and industrial zones in Phu Yen province

Currently, the urban water supply system is managed by Phu Yen Water Supply and Sewerage Joint Stock Company with 9 water plants providing clean water for 9 cities and 3 KCN big with a total capacity of **47,400 m3/ngđ**. Of which, the supply for 09 phones is **33,940 m3/ngđ** and 3 KCN big is **13,460 m3/ngđ.**

1.3. Actual situation of impacts of climate change on surface water supply to urban areas and industrial zones in Phu Yen province

1.3.1 The trend of changing climate factors in Phu Yen province

a. Average temperature: The highest monthly average temperature occurs mainly in June (29.4oC), July (29.1oC), the lowest monthly average temperature occurs in January (23, 3oC).

b. Rainfall: The average annual rainfall is about 1,838mm. Rainfall distribution throughout Phu Yen province varies significantly and unevenly among areas in the province.

c. Storms and tropical depressions: The activity of storms and tropical depressions tends to shift towards the end of the storm season, the period when storms operate mainly in the South. If dividing levels, the number of storms mainly tends to decrease while the number of strong to very strong storms tends to increase significantly.

d. Monsoon: The onset of the Asian summer's monsoon may occur earlier and the end later, resulting in a longer monsoon period. Total precipitation and precipitation extremes during the summer monsoon are likely to increase due to increased atmospheric moisture content.

e. Deep cold, chilly, baking hot, drought:

Deep cold, chilly: the number of days with deep cold and chilly tends to decrease from 10 - 20 days, the largest decrease is in some stations in the Northwest and Northeast (over 20 days), at least under 10 days in Vietnam. some stations in the North Central region.

Baking hot: the number of hot sunny days (the number of days with the highest temperature Tx $\geq$ 350C) tends to increase in most of the country, common 25 ÷ 35 days compared to the baseline period, increasing the most (up to 40 days) in South Central Coast, at least (less than 20 days) in the Central Highlands and the South. By the end of the century, the number of hot days has increased significantly compared to the middle of the century nationwide, the largest increase (over 100 days) compared to the baseline period in the South Central and South.

Drought: Drought tends to increase globally, especially in tropical and subtropical regions from about 1970 to present. However, drought only increases in some seasons and areas due to decreased rainfall and/or increased evaporation.

f. Sea level rise: from Phu Yen to Ninh Thuan, the highest storm surge is 170 cm in the future, possibly up to 220 cm.

1.3.2. Impact of climate change on surface water

a. 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 changes in rainfall will lead to changes 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 changes in rainfall, rainfall distribution in different regions and changes in the duration of the rainy season. These changes can cause flooding in the rainy season but prolonged drought in the dry season.

b. 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.

d. 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.

1.3.3. Assessing the abilily to exploit surface water sources for urban areas and industrial zones in Phu Yen province, the impact of climate change on water sources

a. Regarding reserves: In the shallow season, due to the decrease in river and stream flows, especially in March and August, while the amount of water to use in the year is concentrated mainly in the shallow season, the amount of water to meet the needs of the whole province is in short supply. During the flood season, due to the large flow of rivers and streams, the amount of water to use is not much, accounting for only a small part of the amount of river water that can be exploited. This excess of spring river water will be regulated, partly stored in reservoirs for use in the shallow season.

b. Regarding quality: the results of monitoring surface water sources in the main river systems of Phu Yen province in recent years show that the quality of surface water sources is still guaranteed as a raw water source for water treatment plants for daily life and production.

1.4. Situation of water supply management for urban areas and industrial zones in Phu Yen province

1.4.1. Situation of organizational structure and water supply management capacity

Currently, the water management in the province is carried out by water resources management agencies and Phu Yen water supply and drainage joint stock company. The structure of the water management apparatus is organized as follows:

- *About water supply management*: The Department of Construction shall perform the function of water source management on water supply management for urban areas and industrial parks in the province with a very large workload leading to overload of work. On the other hand, the Department of Construction is also assigned as the permanent unit of the Safety Industry Steering Committee, so personnel are both lacking and professional capacity in water management is limited.
- *About water resources management tasks*: Based on regulations on functions and tasks of The Department of Natural Resources and Environment of Phu Yen province is assigned by the People's Committee of Phu Yen province. However, not only personnel are in short supply but also take on additional responsibilities with some other tasks, so it is difficult to complete the task well with high quality.
- *Allocation and decentralizion of water supply management for urban centers and industrial zones in the province*: Currently, the coordination of management between departments, branches and localities has not been paid attention and attention. there are many shortcomings in organizing activities, assigned tasks as well as coordination between water management units and investment certification activities in Phu Yen province are causing many difficulties and challenges for state management, especially in the conditions of increasingly serious climate change.

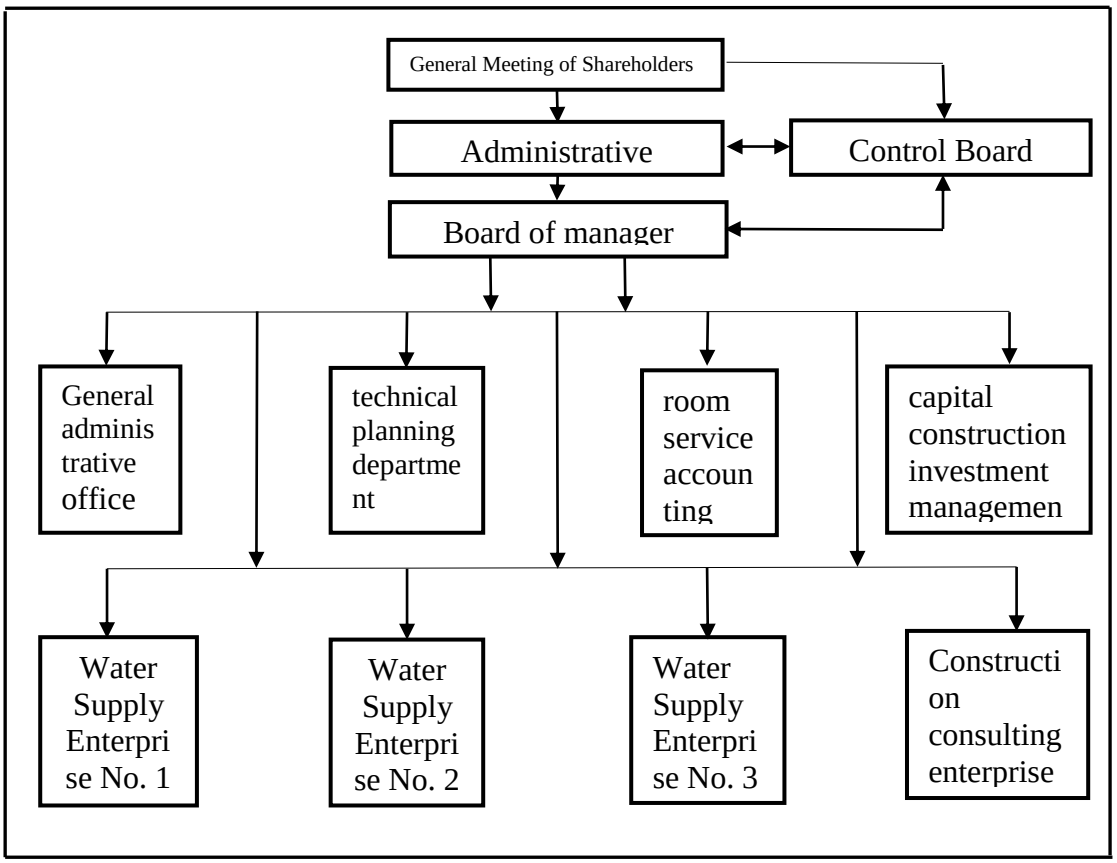

Figure 1.1. Organizational chart of Phu Yen Water Supply and Drainage Joint Stock Company

- *Operation management:* Phu Yen Water Supply and Drainage Joint Stock Company (performing the task of directly exploiting and trading clean water for the whole Phu Yen province from raw water to clean water supply to urban areas and Industrial Parks of Phu Yen province) under the supervision of relevant departments.

Organizational structure: The organizational structure of the Company according to the equitization model has a General Meeting of Shareholders including all shareholders, the Board of Directors, the Supervisory Board, the Board of Directors and related departments and professional departments.

Advantages: The implementation of equitization from state-state enterprises helps the unit to overcome some limitations and weaknesses in production and business activities.

Limitations and difficulties: No specialized departments have been established for water management, and specific water management tasks have not been assigned to departments in the unit; Carrying out safe industry work has not really focused and lacks flexibility.

1.4.2. Current situation of water supply management policy mechanism

Lack of investment capital is one of the major challenges in the context of very limited local budgets. However, Phu Yen has not created a well-ventilated policy mechanism to attract investors.

1.4.3. Implementation of safe water supply activities

The current situation of the Steering Committee for safe water supply in the current water management of Phu Yen province is still in many forms, all members of the steering committee of safe water supply are concurrently assigned so it has not identified an

important role in water management, so there are many gaps and overlaps in management work.

1.4.4. Assessment of water supply management

+ There is no interdisciplinary and interdisciplinary coordination.
+ The water supply management capacity is still limited and inadequate.
+ There is no comprehensive coordination in the operation and exploitation of the National Highway.
+ The current system of legal documents is still not complete.
+ Methods, ql models and water supply operation are still limited.
+ Monitoring points for lack of water supply and out-of-the-scenes warning technology.
+ There is no early warning tool when the water source is contaminated.
+ Protect water safety corridors and parallel water drains.
+ Supervision of the water source protection community.
+ Missing zone link.
+ Not using the surface water source of urban water supply lake.

1.5. Scientific research works at home and abroad related to thesis

The project has also seen an overview of 17 research projects including 11 domestic works (05 Doctoral the the diss ors and 06 research works) and 06 foreign works related to water supply management. Studies have noted the unfavorable impact of climate change on water supply and water supply systems. These researches have contributed positively to the construction of foundations for water supply management and practical organizational solutions. However, the solution is only at the level of orientation, not yet specific. Regarding the management of water supply for enterprises and industrial parks responding to climate change has not been mentioned.

1.6. Issues to be studied

- It is necessary to develop specific views and objectives in water management in accordance with the national urban water supply development orientation and in accordance with the planning of Phu Yen province to meet the water use needs of water supply in Phu Yen province and industrial zones according to the criteria for safe water supply.
- In order to manage water sources effectively and achieve the set goals, we need to come up with technical solutions to control the reserves and quality of water supply
- State management solutions for water sources play an important role in the management of water supply.

Chapter 2: SCIENTIFIC BASIS FOR WATER SUPPLY MANAGEMENT FOR URBAN AREAS AND INDUSTRIAL PARKS IN PHU YEN PROVINCE IN RESPONSE TO CLIMATE CHANGE

2.1. Legal basis for management of water supply for urban areas and industrial parks responding to climate change

2.1.1. Main legal documents related to management

a. Laws related to water management

Law on Water Resources; Law on Environmental Protection; Law on Natural Disaster Prevention and Control; Law on Irrigation

b. Documents under the Law

- The Government's Decree No. 117/2007/ND-CP of July 11, 2007, on production, supply

and consumption of clean water (herein additions to Decree No. 117/2007/ND-CP) and amended and supplemented by the Government's Decree No. 124/2011/ND-CP of December 28, 2011, amending and supplementing a number of provisions of the Government's Decree No. 117/2007/ND-CP

- Decree No. 201/2013/ND-CP: Detailing the enforcement of a number of provisions of the Law on Water Resources
- Decree No. 43/2015/ND-CP of May 6, 2015, on establishment of water source protection corridor management
- Circular No. 08/2012/TT-BXD of November 21, 2012 of the Ministry of Construction guiding the implementation of ensuring safe water supply
- Decision No. 1055/2020/QD-TTg of the Prime Minister on July 20, 2020 on promulgating the National Plan to Adapt to Climate Change for the period 2021 - 2030, with a vision to 2050

2.1.2. Regulations and standards in the exploitation and management of urban water sources

- Regulations and standards related to water supply management include: QCVN 01:2019/BXD; QCVN 01-1:2018/BYT; QCVN 08-MT:2015/BTNMT; QCVN 09-MT:2015/BTNMT; QCVN 04-05:2012/BNNPPTNT;

2.1.3. Water planning of Phu Yen province to 2025 and vision to 2050

a.Raw water source planning:

Prioritize the use of surface water for domestic and production needs, while reducing and moving toward limiting the use of groundwater in the direction of gradually turning into a strategic backup water source in the future.

b. Water supply partition:

By the period of 2025, the water supply partition is a region called Tuy Hoa - Nam Phu Yen region, the total demand for this area is about 97,900 m3 / day, accounting for about 62% of the water demand of the province. Phu Hoa - Phu Tho area has a total demand of 4,800 m3/ day in 2025, about 7,100 m3 / day in 2030. In addition to the ationed water supply area, in other water supply areas, 35% of the remaining total needs, will be supplied separately without connection with each other.

c. Exploited water sources for water plants in Phu Yen province

The source of exploited water for factories in Phu Yen province by 2030 is the surface water source: Ba River, Tam Giang River, Cai River, Ky Lo River and reservoirs: Xuan Binh Lake, Ky Chau Lake, Suoi Di Lake, Phu Xuan Lake, Tan Lap Lake, Suoi Phèn Lake, Lo Chai Lake.

2.1.4. Synthesis of water demand forecast for the period 2030

- Objectives and specific targets by 2025: Clean water supply services in urban areas reach 100%, an average of 120lliters / person / day.night, water quality meets the prescribed standards. industrial parks are fully watered according to pressure and flow requirements.
- Vision to 2050: Meet all needs and ensure safe water supply for living and production of urban areas, concentrated residential areas and industrial parks.

It is forecasted that the demand for water for industrial parks and industrial clusters in Phu Yen province by 2030 is 107,489,310 m3/day. Water demand for each district of Phu Yen province by 2030 is 240,000m3/ day and night.

2.1.5. Phu Yen climate change script and flood map

- Sea level rise script: Late 21st century, rcp2.6 sea level rise is estimated to be 44 cm (27 cm ÷ 66 cm), according to RCP4.5 is 53 cm (32 cm ÷ 76 cm), according to RCP6.0 is 56 cm (37 cm ÷ 81 cm), and according to RCP8.5 is 73 cm (49 cm ÷ 103 cm).
- Main climate change script: CC and extreme weather situation. Natural disasters such as sea intrusion, saltwater intrusion, typhoons, flooding, droughts etc. tends to increase.

2.2. Factors affecting water supply management for urban areas and industrial zones

2.2.1 . Terrain, soil geology

- Terrain factors: significantly affecting water resources are height, shape, level of surface cutting, slope and slope length. The terrain makes climatic factors strongly differentiate horizontally and vertically. Horizontally, the mountain ranges create climatic dividing lines and water dividing lines. Vertically, the higher the temperature and evaporation decreases, while the rain increases on the side to catch the humid wind
- Soil geology affects surface water, ground water in both mode, quantity and substance decided by it

2.2.2. Urbanization

As of February 2019, the country has 819 municipalities, it is forecasted that by 2025 will increase to about 1,000 municipalities with an average urbanization rate of 38.4%. The urban population is over 34 million. Therefore, the high population density that entails the demand for water also increases constantly.

2.2.3. Impact of climate change on water supply management for urban areas and industrial zones

The actual forecasting is not keeping up with CC, the system of ccTP legal policies is not timely and synchronized. Moreover, not only the level and management capacity have not met the requirements but also the management model is not complete. Besides, the sense of responsibility for protecting water supply is not high. The control, prevention and response to environmental incidents, natural disasters and CC in investment projects in the field of investment certification have not been taken care of.

2.3. The basis for reasoning on water supply management for urban areas and industrial zones in Phu Yen province in response to climate change

2.3.1. Principles of state management of water supply reserves and quality

a. Principles of reasonable use of power
b. Principles of powers commensurate with responsibilities
c. Principles of unity in management
d. Principles of implementation of management procedures
e. Principles of harmonious combination of benefits
f. Principles of combining resources
g. Principles of saving and efficiency

2.3.2. Some research methods and some predicted calculation methods according to water use needs

a. Some research methods: comprehensively synthesized on the research method diagram
b. Some methods of calculating forecasts according to water demand

- Method of calculating forecasting water demand and water quality
- Method of forecasting water demand for 2020 and 2030

- Method of partitioning water resources according to water use needs

2.3.3. Basis for reasoning on safe water supply

a. Requirements on ensuring safe water supply

b. Contents of safe water supply plan

c. Identify measures to control, prevent and overcome risks and make plans for application

d. Make a plan for inspection and assessment of the implementation of measures to control, prevent and overcome risks and risks

e. Planning, process to respond to changes occurring in operating conditions with incidents, loss of control and emergency situations

f. Develop criteria, monitoring indicators and control limits to assess the implementation of a safe water supply plan

g. Management of relevant databases on safe water supply

h. Develop support programs and deployment plans

i. Develop a plan to assess the results of safe water supply

j. Water supply safety management process

k. Drafting processes for management reserves and quality of raw water sources

2.3.4. Regulations on water supply protection corridors and water collection works

a. Regulations on scope of protection of water supply

b. Regulations on establishment of water source protection corridors

c. Regulations on water collection works

2.4. Experience in managing water supply for urban areas and industrial parks responding to climate change

2.4.1. Experience in integrated management of water resources of river basins in climate change conditions in the world

a. Experience in general management of water resources in some river basins in the US

The Clean Water Act enacted in the U.S. is the most successful in U.S. environmental laws. The greatest value that this law brings is that most of America's rivers and lakes from heavy pollution, hardly a living being can survive, so far the rivers have met the water quality for the criteria water supply and recreation services.

b. Integrated management of Murray - Darling River basin water resources in Australia

Oxygen has made reforms such as strengthening management in states on the basis of integrated management of river basins, close cohesion of water sectors, land, irrigation works, and other infrastructure. In addition to the purpose of using water for household activities, all activities of exploiting water resources must have a permit.

c. Experience in general management of water resources in some river basins in China in response to climate change

General management of Liaoning River basin water source:

Pollution has decreased by 60% and river water quality has improved significantly. The conflict between upstream and downstream decreased, deforestation was halted. Drinking water used from the river basin has been safer and ecosystems along several tributaries have been restored. Groundwater pollution decreased, and people's awareness of water demand management and water pollution risk was raised.

Integrated management of Yangtze River basin water resources in response to climate change:

Currently, the Yangtze River is also facing a series of challenges of climate change causing storms, floods, landslides, water pollution and biodiversity decline. The integrated management framework is built for the Yangtze River basin based on 4 topics including Completion of the framework of institutions and laws, Establishment of a coordinated management framework of relevant sectors, raising public awareness and capacity for integrated management of river basins. On the other hand, strengthening financial capacity and applying incentive mechanisms to ensure procedures for assessing costs related to the environment, economy and society of economic development activities; especially the initiatives on methods and techniques related to the general management of river basins.

d. Economical use of water resources in Singapore adapts climate change

To generate more revenue for the country, Singapore also turns the "new water" production line into a tourist destination for visitors to explore the "rebirth of the country". With the success of the "new water" project, Singaporeans have made the dream of more than 20 years come true with greater than expected results.

2.4.2. Experience in water management in CC conditions in Vietnam

a. Water management for climate change response in Ho Chi Minh City

Sources of pollution from industrial parks and residential areas discharge directly pollute water sources of large rivers. Built a small-scale raw water storage lake, combining the relocation of the raw water pumping station on the Saigon River with the solution of building a raw water reservoir. This solution will enhance water storage capacity, ensure continuous supply of raw water to water plants, respond well to pollution and saltwater intrusion in the short and medium term for water sources.

b. Water management in response to climate change in Binh Thuan province

Lessons of Binh Thuan province on water supply, adding reservoirs to get more water sources during the dry season to overcome prolonged drought, continue to build and complete networked canals, upgrade reservoirs and reservoirs, solidification of canals. In 2018, in Binh Thuan province, a number of programs, topics and projects on water resources for CC response have been implemented.

Chapter 3: PROPOSING WATER SUPPLY MANAGEMENT MODELS AND SOLUTIONS FOR URBAN AREAS AND INDUSTRIAL PARKS IN PHU YEN PROVINCE TO RESPOND TO CLIMATE CHANGE

3.1. Attitudes and targets of water supply management for urban areas and industrial parks in Phu Yen province in climate change conditions

3.1.1. Standpoint of water supply management

1. To manage water sources on the basis of compliance with the Law on Water Resources and documents under law related to regulations on water source management.
2. In line with the orientation of development of urban water supply and national industrial parks to 2025 and vision to 2050
3. In accordance with urban water supply planning and industrial parks, water source planning of Phu Yen province to 2025 and vision to 2050
4. There is close and effective coordination between the provincial state management agencies (Department of Construction, Department of Natural Resources and Environment, Department of Agriculture and Rural Development,...) and units and organizations exploiting the use of water supply

5. It is necessary to strictly comply with regulations related to control of saltwater intrusion, drought, floods, landslides affecting the reserves and quality of water supply

6. Prioritize investment in building automatic water quality monitoring system according to the planning

3.1.2. Objectives of water supply management

1. To ensure safe water supply for urban areas and industrial parks according to the plan on safe water supply.
2. Ensure the balance of water supply for water users
3. General management of water supply to ensure quality and response to CC
4. Models and solutions for comprehensive and comprehensive water source management from central to local level in response to CC

3.2. Proposing solutions to balance water supply for urban areas and industrial zones in Phu Yen province under climate change conditions

3.2.1. Balanced partition of water supply.

a. Partitioning base and criteria for selection of water supply balanced partitioning plan

- Water supply balance partition is based on the analysis of characteristics of surface water capacity, demand for water supply, factors of natural conditions (terrain, climate, geology, hydrological), water supply capacity in river basins and factors related to CC (Figure 3.1).
- Proposing 04 criteria for selecting water supply balance plans for industrial zones and industrial zones including based on natural characteristics, corresponding to terrain division of main flows; the system of works on exploitation and use of water resources in combination with administrative boundaries; system calculation of water supply; needs and characteristics of water use.

b. Water supply partitions of urban areas and industrial parks in Phu Yen province.

Water supply partitions are based on the distribution of future use of clean water, the location and scope of water supply of water plants. As well as considering the operation of the existing water supply system, the trend of urban space development in the future.

For the purpose of safe and reasonable water supply, creating favorable conditions for management and operation, the water supply system will be divided into water supply areas, these regions have independent water supply systems.

c. Water supply partitions for urban areas and industrial parks in Phu Yen province

Water supplies to water plants in the regions are mainly surface water sources from rivers and reservoirs that have been and will be built (table 3.1).

3.2.2 Plan to balance raw water sources for industrial zones and industrial parks by 2030

According to calculations, it is forecasted that the total amount of raw water to be supplied to the industrial zones of Phu Yen province by 2030 is 280,806 m3 / day, an increase of 197,421 m3 / day compared to 2017 (41,256 m3 / day). The total capacity of irrigation reservoirs in the province is 468,024 million m3 (about 2.57 million m3/day) for 6 months (182 days) of the dry season. With 13.6% of the water supply for DT and INDUSTRIAL PARK compared to the total water demand for the sectors equivalent to about 349,520 m3 / day.

Therefore, the amount of raw water meets about 124% compared to the demand for raw water by 2030 is 280,806 m3 / day. Based on data on the total demand for raw water and the

capacity of reservoirs today, propose a plan to balance the raw water supply for the provinces allocated according to the terrain areas (Table 3.3).

3.3. Proposing solutions for controlling water supply reserves and quality

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

- Develop plans for development of water supply systems to meet the needs of clean 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.

3.3.2. Proposing solutions for monitoring and monitoring water supply quality for urban areas and industrial parks in Phu Yen province under climate change conditions

Develop a map of water supply monitoring points for urban areas and industrial parks in Phu Yen province by 2030 (Figure 3.3). Proposing 21 water supply monitoring points for urban areas and industrial parks of Phu Yen province 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 (Table 3.4).

3.3.3. Proposing the process of early warning and quality control of River water supply (Take Ba River water source at the location of water collection works for Tuy Hoa Water Company as typical)

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

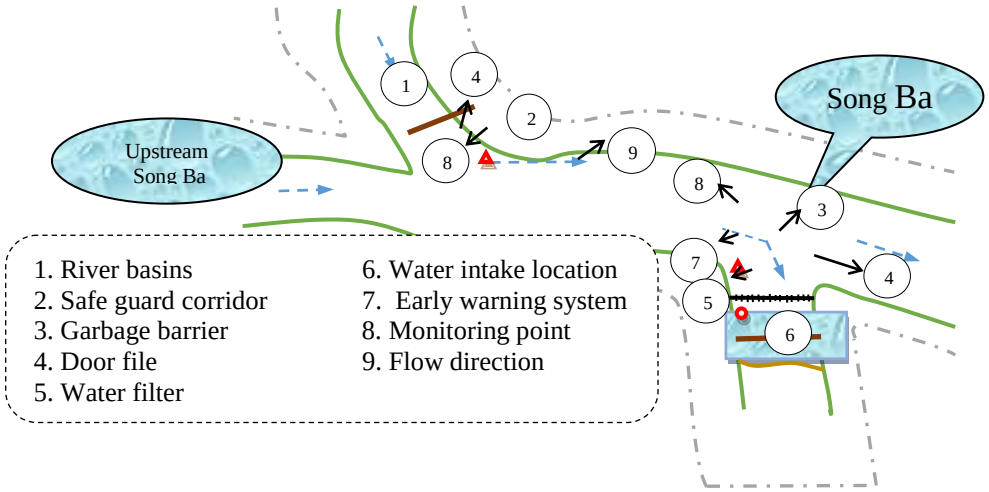

Figure 3.4. Proposed management diagram of River Ba surface water supply

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 pictured 3.4

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

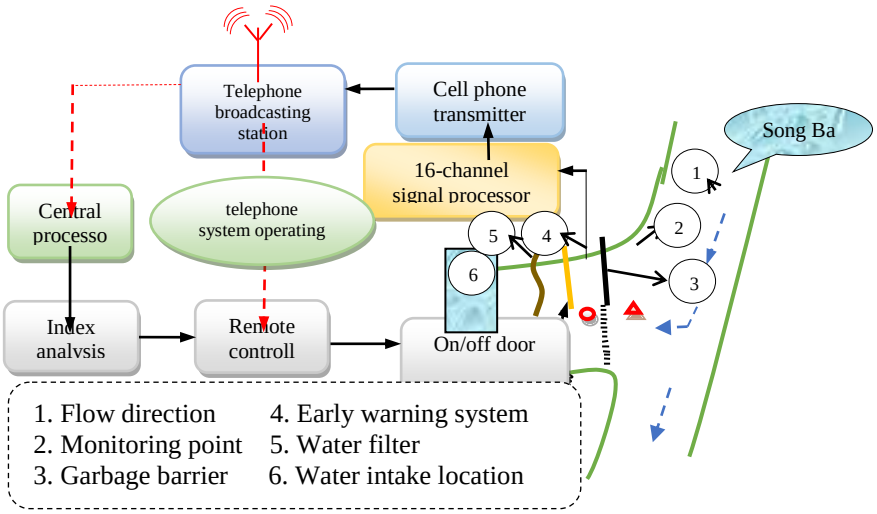

Figure 3.5. Proposing the operation process of the early warning system, controlling the quality of the River Ba surface water supply

- 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 door fades*.
- When the central processor receives the sensor signal transmitted from the phone wave, automatically analyze if the water exceeds the allowable index and the controller will close itself.

3.4. Proposing models and a number of solutions to manage water supply for urban areas and industrial parks in Phu Yen province under climate change conditions

3.4.1. Proposed model of water supply management organization

The model of proposed management has links between all levels and departments in the province in order to enhance the role of the Steering Committee for safe water supply. In this proposed model, the State plays a leading role in supporting institutions as well as promulgating mechanisms, policies and laws to attract development investment resources. In addition, the allocation or decentralization to ministries, branches and localities (nationally) with departments, branches and urban governments (provincial scale) in the implementation of water source management tasks so that safe water supply activities are carried out in a unified direction of view , objectives, effectiveness and efficiency. State

management agencies need to strengthen the management, inspection, inspection and handling of violations in the field of water source management according to their assigned functions and tasks. The proposed model of water supply management in Phu Yen province should be clearly defined the role of each subject and stakeholders according to the uniform allocation from central to local levels, in order to bring high management efficiency and overcome weaknesses. , shortcomings of the current water management model. The proposed water supply management model for Phu Yen province's industrial parks and industrial parks is shown on The Figure 3.6 and Figure 3.7

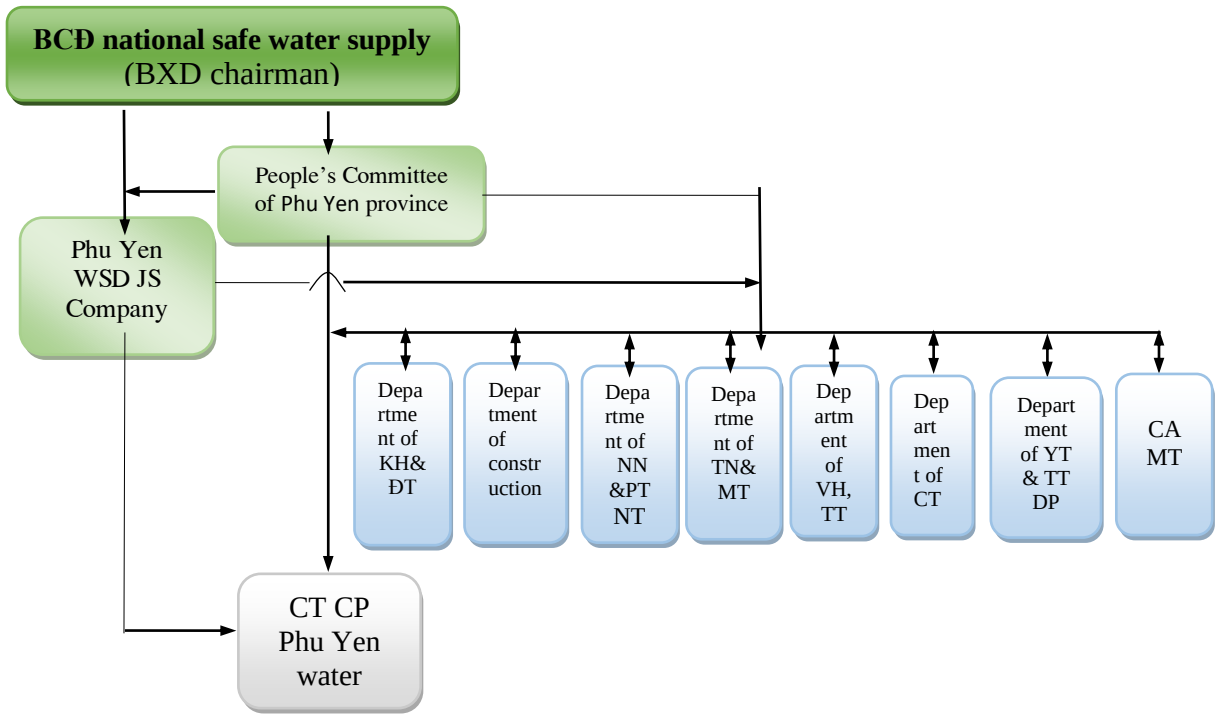

Figure 3.6. Proposing a model of state management of water supply for urban areas and industrial zones in Phu Yen province

a. National Safe Water Supply Steering Committee

The Ministry of Construction is the standing agency of the Program Steering Committee, responsible for ensuring the operational conditions of the Steering Committee and using its apparatus as a clue, presiding over the performance of the tasks of the Steering Committee.

b. People's Committee of Phu Yen province:

- The Provincial People's Committee shall have to generally manage finance and techniques; specify functions, tasks, assigned and decentralized management to relevant departments and branches and localities to manage water supply sources for eias and industrial zones in the province

- Establish a Steering Committee for safe water supply in accordance with the Government's regulations. The Provincial People's Committee is the subject of state representative performing the function of macro-management and regulation, encouraging socio-economic development of the sector or sector according to the strategic orientation of the province.

c. Relevant departments:

Based on the functions and tasks assigned and decentralized by provincial People's Committees to departments, branches and equivalent units related to the state management of safe water supply activities in the area, especially the following key tasks:

The Department of Natural Resources and Environment is responsible for the management of water resources (including management of exploitation, use and protection of water sources)

The Department of Construction is not only responsible for performing the function of appraising construction investment projects but also formulating plans, programs, targets and mechanisms for the development of water collection works and water production plants in the province.

The Departments of Agriculture and Rural Development are responsible for managing surface water sources from rivers and reservoirs;

The Department of Industry and Trade is responsible for managing hydroelectric lakes;

The Department of Culture, Sports and Tourism is responsible for tourism at hydroelectric reservoirs and reservoirs;

The Environmental Police is responsible for investigating the discharge of polluting water sources;

The Department of Finance is responsible for the price determination;

The Department of Planning and Investment is responsible for appointing and balancing the province's short-to-long-term plans, relying on priority projects in the approved planning to invite investment in the construction of water supply projects in the province.

The Department of Health and the Preventative Medicine Centre are responsible for the quality control of water sources.

d. Phu Yen Water Supply and Drainage Joint Stock Company:

- Phu Yen Water Supply and Drainage Joint Stock Company is responsible for managing water supply for enterprises and industrial parks in the province.
- The new model of Phu Yen Water Supply and Drainage Joint Stock Company adds the functions and tasks of building and implementing the plan for safe water supply for the planning and technical department; at the same time, add 01 deputy head of specialized department on safe water supply under the direction of the Company's Safe Water Supply Board.
- Moreover, improving the capacity of the investment management department and building qualified staff in the management of water supply for the enterprises and industrial parks. Enhance the role of the company's Safe Water Supply Board in the implementation process.
- Enterprises under the company will manage water sources in accordance with regulations of Phu Yen water supply and drainage company under close supervision from the Company and the Company's Safe Water Supply Board.
- Proposing the model of Phu Yen water supply and drainage joint stock company will manage the water supply for the industrial parks of Phu Yen province on Figure 3.7.

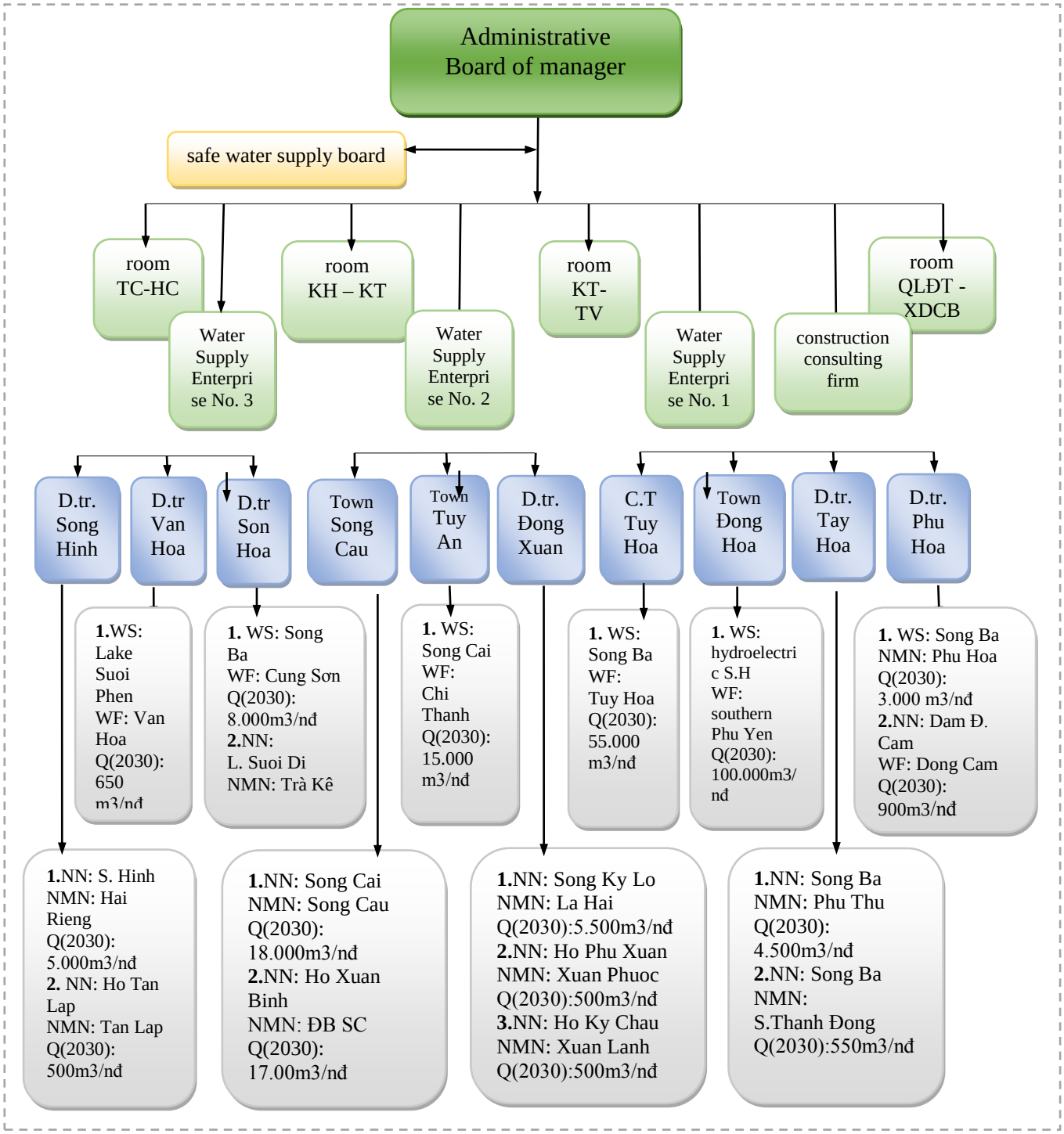

Figure 3.7. Proposing a model of Phu Yen water supply and drainage joint stock company to manage water supply for the enterprises and industrial zones of Phu Yen province

Directly manage water sources assigned to enterprises. Phu Yen Water Supply and Drainage Joint Stock Company directly manages river and lake water supply for provincial enterprises and industrial parks, according to the model that clearly states the water supply and water production plant to 2030 of each specific district in Table 3.5.

Table 3.5. Proposing water supply for industrial zones and industrial parks, building new and lifting the production of water plants in Phu Yen province to 2025-2030

TT	Waterworks	NMN now	NMN 2025	NMN 2030
	Tuy Hoa region - South Phu Yen		**105.000**	**155.000**
1	Tuy Hoa City	28.000	55.000	55.000
2	Dong Hoa town	200	50.000	100.000
	Area Phu Hoa - Tay Hoa			
3	Phu Hoa town	2.000	3.000	3.000
4	Phu Thu town		4.500	4.500
	Water supply systems of independent cities			
5	Song Cau town	5.000	14.000	18.000
6	Northeast Area Song Cau	900	9.000	17.000
7	Chi Thanh town	3.000	9.000	15.000
8	Hai Rieng	3.000	5.000	5.000
9	Cung Son	2.000	5.000	8.000
10	La Hai	3.000	4.500	5.500
11	Xuan Lanh town		500	500
12	Son Thanh Dong town		500	500
13	Dong Cam town		500	900
14	Tra Ke-Son Hoi, Son Hoa district		500	500
15	Xuan Phuoc town,Dong Xuan district		500	500
16	Tan Lap town, Song Hinh district		1.000	1.000
17	Van Hoa, Van Hoa district		500	1.000
	Total	**47.100**	**163.000**	**240.000**

3.4.2. Proposing policies and solutions to mobilize financial resources to manage water supply

- Complete the mechanism of allocation and exploitation of water sources
- Supplementing policies to improve water supply management capacity for IPs and industrial parks responding to climate change
- Mobilize financial resources to manage water supply

3.4.3. Coordination mechanism for management of water supply for urban areas and industrial parks in Phu Yen province under CC conditions

To promote the construction and promulgation of the Regulation on coordination of water management in the province among agencies and organizations of Phu Yen province. At the same time, it is assigned the responsibilities of organizations and individuals in the implementation of safe water supply management

3.4.4. Proposing solutions for CC response to water supply management

a. For state management organization

Establish specialized organizations and prepare financial resources and equipment in time to respond to climate change. In addition, actively propagating to raise public awareness about the impact of climate change on water resources.

b. For planning and construction

- Population concentration planning
- Planning for construction of up areas for people to evacuate
- Planning of boat mooring areas to avoid floods;
- Designing solid houses and public works;

- Consolidation, upgrading, finishing and additional construction of systems of works for exploitation and use of water sources

c. For specialized agencies in charge of water resources and environmental sanitation

- Develop a water safety plan for all situations
- Fully prepare necessary facilities, facilities and chemicals for environmental sanitation when natural disasters occur and general environmental sanitation after natural disasters
- Provide free environmental treatment chemicals, water treatment to households.

d. For the people

- Living concentratedly into a residential community;
- Prepare plans to ensure the safety of life and financial safety of floors and pets;
- Keep track of updates on monitoring information and disaster forecast information;
- Make cooked food and boil water before use.

3.4.5. Proposing solutions to improve water supply security management capacity

- Develop a database on fluctuations and use of water resources related to climate change, enhance the investigation, research, evaluation, forecasting, quality and quantity observation in the exploitation and use of water resources.
- Develop and finalize standards for economical, efficient, integrated and multi-objective exploitation and use of water resources adapted to climate change and sea level rise.
- Renovating, upgrading, renovating and building new irrigation works, hydropower, river systems, sea to ensure effective response to floods, droughts, sea level rise, saltwater intrusion in CC conditions.
- Complete the general management processes and works of scientific exploitation, protection and use of water resources in CC conditions by 2050.
- Improve the capacity of water resources management as well as strengthen the implementation of planning and the synchronization of measures for sustainable development of national water resources in the context of climate change which is basically completed in 2020 and completed in the next phase.

In particular, it is necessary to build effective and expanded partnerships with many stakeholders, both public and private sectors, inside and outside the province. At the same time, strengthening water education, empowering young scientists. In addition, it is necessary to improve the capacity of local communities in places with water problems, implement solutions and take advantage of indigenous knowledge, turning negative effects into development advantages.

3.5. Discussion of research results

3.5.1. Discussing solutions for controlling water supply and quantity

a. Discussing solutions to balance raw water supplies

The proposal of a plan to balance raw water supply has overcome a number of limitations in the planning and partition of water supply and quality assurance. At the same time, it helps the management and safe water supply tasks to be widely deployed with the participation of stakeholders to perform well in the coming time.

b. Discussing solutions to control water supply reserves

Prioritize the exploitation of surface water supplies, on river systems with abundant reserves such as the Ba River. Currently in Phu Yen province, there is a very rich reservoir system with large water storage capacity such as Suoi Bai Lake, Xuan Binh Lake, Phu Xuan Lake, Dong Tron Lake,... consider the possibility of using raw water supplies from reservoirs to ensure water supply safety in the dry season and harnessing the use of sustainable water supplies.

c. Discussing water supply quality control solutions

- To offer overall management solutions and measures for environmental quality monitoring and supervision;
- Solutions to closely monitor and control the situation of saltwater intrusion, water supply pollution and prevention of water supply pollution;
- Responding to and remedying incidents of pollution of water supply and restoration of contaminated and depleted water supply;
- Supplement and upgrade the water supply monitoring system in the direction of automation; - Proposing the installation of an early warning system to ensure the quality of water supply for the enterprises and industrial parks of Phu Yen province in response to climate change.

3.5.2. Discussing the proposed water supply management organization model

- The model has overcome the limitations and limitations of the current management apparatus as well as improved the safe water supply in the management.

3.5.3. Discussing the mechanism for coordination in water supply management of proposed water supply

In order to ensure safe water supply for urban areas throughout the province, the management of water supply by province is very important. The proposal to complete the coordination mechanism among agencies and organizations in the implementation of water management in the province on the basis of allocation, decentralizion and clearly defined responsibilities in the direction and coordination of implementation between the authorities and water supply units with the Phu Yen provincial government is necessary and soon deployed. effectively in the near future.

3.5.4. Discussing solutions to respond to climate change in water supply management

a. For state management:

- Establishing a full-time local or inter-regional organization for river basins and developing mechanisms for operation and coordination of actions;
- Prepare financial resources, human resources and technical equipment to ensure
- Propaganda to raise public awareness about the impact of climate change on water resources.

b. For planning and construction work:

- Elaboration of planning for sustainable development of water resources in river basins and regions on the basis of association with socio-economic development planning of the whole country.
- First review and build irrigation and hydroelectric lakes; systems that take climate change into use
- Strengthening, upgrading, completing and constructing additional systems of works for exploitation and use of water sources
- Strengthening and upgrading the system of river dykes, sea dykes, flood-slow zones, flood escape routes, flood-resistant embankments, preventing saltwater.

c. For specialized agencies in charge of water resources and environmental sanitation:

- Develop water supply safety plans for all situations;
- Fully prepare the necessary facilities, facilities and chemicals for the response to climate change.

d. For residents:

- To live in a community for mutual support and support;
- Preparing response plans for CC;

- Regularly monitor and update disaster forecasts in a timely manner;
- Carry out safety and hygiene during natural disasters and after natural disasters
- Promptly notify the management authorities of water resources when the impact of climate chnage affects water sources.

Water resources management units coordinate with relevant units in closely supervising and reporting promptly in the prevention of climate change. Especially clearly distinguish the responsibility for supervision between the adjacent areas of the two localities.

e. Water resources security:

- Strengthening the investigation, research, evaluation, forecasting, monitoring of quality and quantity in the exploitation and use of water resources;
- Develop and finalize standards on water resources management adapted to climate change conditions.

CONCLUSIONS AND RECOMMENDATIONS

I. Conclusion:

1. The thee has analyzed and assessed the current status of water supply, the current situation of water supply management models, factors affecting the management of water supply as a basis for proposing models and solutions for water supply management for industrial zones and industrial parks in the province. The topic has also seen a number of research works at home and abroad related to water supply management; these works have contributed positively to the construction of foundations for urban water supply management and practical organizational solutions.

2. The thesis also systemaized basis of reasoning to clarify the principles, contents and roles of state management in safe water supply activities; the reasoning for building a management model. The system of legal basis for urban water supply management includes legal documents, system of regulations and national standards of water sector; climate change script and sea level rise script for Phu Yen province. On the other hand, factors affecting water supply management and experience in urban water supply management in response to climate change of urban areas around the world and Vietnam in order to draw lessons applied to Phu Yen province.

3. The thesis has given 06 rules and 04 targets for water supply management for industrial zones and industrial parks in the province. Based on the principles found out, the proposals in chapter 3 on models and practical management solutions to achieve the goals set.

4. The thesis has proposed solutions to balance water supply in order to allocate reasonable raw water sources to water users in the province. Based on the calculation data on the total demand for water use in urban areas and industrial zones, the current status of the capacity of industrial parks and the capacity of water sources, thee proposed the plan to divide into 09 allocation zones according to the administrative boundaries take into account climate change to balance the raw water supply for the urban areas and industrial zones and other water use needs in the province by 2030 towards safe water supply.

5. The thesis has 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 and monitoring the quality of water supply for urban areas and industrial parks in Phu Yen province under climate change conditions. Moreover, proposing the process of early warning, controlling the quality of River water supply (Take The Ba River water source at the location of the water collection project for Tuy Hoa water Company as typical).

6. The the theory proposed a model of water supply management for urban areas and industrial parks to respond to climate change in the direction of ingesting current management models on the basis of selectively combining new, flexible and suitable management methods to apply to urban areas and industrial parks of the province. This is a model with a close combination between the State of enterprises and people. Therefore, the model proposes to supplement and overcome shortcomings and limitations in the organization of the current operation management apparatus, especially the shortcomings in the division, decentralizing and decentralizing responsibilities of the parties in state management as well as the coordination between stakeholders in the management of water supply for urban areas and industrial parks in the province as well as improving water supply security management capacity

7. The the the thee proposed policies and solutions to mobilize financial resources to manage water supplies to create legal corridors and facilities to attract development investment capital, ensuring safe water supply targets. Moreover, the solution to develop a mechanism for coordination between agencies and organizations in the management of water resources by Phu Yen province includes: Promoting construction activities and promulgating the Regulation on coordination of water management in the province between agencies and organizations of Phu Yen province. To determine responsibilities of organizations and individuals in the implementation of safe water supply management. solutions to prevent and mitigate the effects of natural disasters on water resources. solutions to improve water supply security management capacity, need to build cooperation relationships with many stakeholders, to limit adverse effects on water supply for industrial zones and urban areas in Phu Yen province

8. The results of the proposed study of thee are practical, which can help Phu Yen provincial managers to objectively see the current status of water supply and the situation of water supply management urban areas and industrial zones in Phu Yen province. Therfore having 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

II. Recommendations

1. Phu Yen province should soon issue (within its competence) or propose the Central Government to permit the promulgation of a specific mechanism to attract investment in the development of urban water supply infrastructure in the modern direction in order to ensure stable, safe water supply and towards the goal of sustainable development.

2. To request the People's Committees of Phu Yen province to regularly direct departments, branches and urban governments to strengthen the general management of water resources and management of urban water supply in relation to climate change. In addition, the study builds a coordination mechanism in the management of water supply, and clearly defines responsibilities among relevant agencies, units, organizations and individuals in order to improve the effectiveness and efficiency of urban water supply management in the province in the coming time.

3. Request the People's Committee of Phu Yen province to establish a specialized department on CC prevention, to minimize the impact of CC on the water supply of the province

4. Request the Department of Natural Resources and Environment and the Department of Construction to advise the People's Committee of Phu Yen province to make plans to install more mixed monitoring stations, and build a new water source early warning system to ensure the quality of water supply for urban areas and industrial parks of Phu Yen province.

LIST OF THE AUTHOR'S SCIENTIFIC ARTICLES RELATED TO THE THESIS THEME

1. Vu Binh Son. *Management of water supply system - reality and some solution proposals (survey in Tuy Hoa city – Phu Yen province).* No. 51/2017, ISSN 1859 – 3119, Journal of Construction and Urban Development, Ministry of Construction

2. Vu Binh Son. *Factors affecting water supply management for urban areas and Industrial Parks of Phu Yen province in response to CC.* No. 11/2019, ISSN 1859 - 459X ,Vietnam Bridge and Road Magazine.

3. Vu Binh Son. *Management of water supply for urban areas and industrial parks responding to CC (survey in Phu Yen province).* No. 66/2019, ISSN 1859 – 3119, Journal of Construction and Urban Development, Ministry of Construction.

4. Vu Binh Son. *Proposing solutions to control the reserves and quality of water supply for urban areas and industrial parks responding to climate change (Survey in Phu Yen province).* No. 73/2020, ISSN 1859 – 3119, Journal of Construction and Urban Development, Ministry of Construction.

5. Vu Binh Son. *Proposing water supply management model for urban areas and Industrial Parks of Phu Yen province to respond to climate change*. No. 74+75/2021, ISSN 1859 – 3119, Journal of Construction and Urban Development, Ministry of Construction.