MINISTRY OF EDUCATION AND TRAINING MINISTRY OF CONSTRUCTION

HA NOI ARCHITECTURAL UNIVERSITY

CHAU THANH HUNG

URBAN WATER SUPPLY MANAGEMENT IN BINH THUAN PROVINCE UNDER CLIMATE CHANGE CONDITION

MAJORITY: URBAN AND CONSTRUCTION MANAGEMENT

CODE: 62.58.01.06

SUMMARY OF PhD THESIS

Ha Noi - 2019

The thesis was fulfilled at Ha Noi Architectural University

Scientific supervisor: Assoc Prof. Nguyen Thi Ngoc Dung

Reviewer 1:.....

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Reviewer 3:.....

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1. National Library of Vietnam
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INTRODUCTION

1.Rationales of the thesis

In recent years, thanks to the development of urban areas in Binh Thuan province, urban water supply system has begun to be constructed synchronously which contributes to socio-economic development and people's life improvement; management of urban water supply is hereby gradually stable and effective.

Besides its achievements, urban water supply system in Binh Thuan province is suffering severe impacts of climate change, storms, tropical low pressure, heavy rain, flash flood which have destroyed constructions/water supply systems in urban areas. Flood water causes landslide in many riversides, affecting the quality of water source. In addition to flood, climate change also causes severe droughts in some regions in the North and the Southwest of the province. Long-lasting drought decreases seriously water source which results in difficult life of people due to the shortage of domestic and producing water. Water supply management in urban areas in Binh Thuan province still remains a lot of limitations and hasn't been able to meet the real necessity and hasn't had suitable methods to actively to deal with more and more increasing climate change.

In order to achieve the goal of safe water supply (sufficient quantity and clean water quality) for urban areas, urban water supply management in Binh Thuan province plays a significant role in the existence and sustainable development of urban areas. Therefore, the thesis ***"urban water supply management in Binh Thuan province under climate change condition"*** is an essential research, helpfully contributing to orientation of water supply planning as well as urban water supply management in Binh Thuan province under climate change condition.

2. Objectives of the thesis

The thesis makes assessments on water supply and water supply management current situation in urban areas in Binh Thuan province under climate change condition in order to give suggestion on: (1) Raw water and clean water balancing methods for urban areas until 2025; (2) Model and solutions to urban water supply management; (3) Participation of relevant units in urban water supply management in Binh Thuan under climate change condition.

3. Subject (s) and scope of the thesis

Subjects of the thesis

Water supply management in urban areas in Binh Thuan province under climate change condition.

Scope of the thesis

- *Spacial scope:* Urban areas in Binh Thuan province includes: 01 provincial city (Phan Thiet), 01 district and 13 towns of 08 districts.

- *Time scope:* Upto 2025, with vision upto 2050.

4. Research methodology

The thesis uses 07 researching methods: doing survey; statistics; analysis and synthesis**;** comparison and collating; expert method; inheritation method; forecasting method.

5. Scientific and practical significance of thesis

- ***Scientific significance***

Giving out scientific arguments on urban water supply management in Binh Thuan under climate change condition. Making suggestion on new management model and solutions which are appropriate with real local conditions.

- ***Practical significance***

Result of the thesis helps promote thereotics for implementing urban water supply management, giving more experiences for specialized units and state monitoring units in Binh Thuan province to implement urban water supply management more effectively.

6.New contributions of the thesis

- Giving 08 opinions and 05 goals in safe water supply management for urban areas in Binh Thuan under climate change condition;

- Suggesting water balancing solutions for urban areas in Binh Thuan until 2025 distributed to terrains under impacts of climate change;

- Suggesting urban water supply management model in Binh Thuan under climate change condition in direction of integrating 04 current WSM models;

- Suggesting participation of relevant units in urban water supply management.

7.Structure of the thesis

The thesis includes 3 main parts: Introduction; Content; Conclusion and Suggestion. Among these, Content part includes 3 chapters: Chater 1 (46 pages); Chapter 2 (43 pages); Chapter 3 (50 pages).

8.Some relevant concepts

Relevant concepts of water resource, urban water supply, urban water supply management, climate change.

CONTENT

CHAPTER 1: OVERVIEW OF URBAN WATER SUPPLY MANAGEMENT IN VIETNAM AND BINH THUAN PROVINCE UNDER CLIMATE CHANGE CONDITION

1.1. Overview of urban water supply management in Vietnam under climate change condition

1.1.1. Overview of water supply situation in Vietnam

Up to 2018, there have been 111 water supply enterprises managing more than big and small water supply systems in urban areas with total capacity of 9,0 million m^3/day and night; percentage of urban people provided with clean water through water supply system was 85,5 %; percentage of water loss and revenue loss was about 21,5%; the quantity of domestic water used was 110 litre/person/day on average. 70% of urban water supply system was guaranteed for supplying water 24/24h and service quality has been improved.

Besides such results, water supply at present is also facing much difficulty and many challenges because water supply developing investment hasn't met actual requirements due to rapidly increasing speed of urbanization, increase of population.

1.1.2. Overview of urban water supply management in Vietnam

Urban water supply management in Vietnam is also facing a lot of problems in policy mechanism, urban water supply management capability as well as implementation of safe water supply plan and urban water supply financial investment.

1.1.3. Problems and difficulties in urban water supply operation

a) Orienting and programming: Investment into developing water supply between urban area and rural area has got many limitations, overlapping and non-efficiency.

b) Investing water supply development: Insufficiency of synchronism between water plant and water supply pipes net.

c) Managing water supply risks: Not implementing yet or ineffectively implementing. Pipes net often gets leaking, broken problems causing discontinuous supplying and weak water pressure.

d) Managing urban water supply service: Equitization of water supply enterprises is being promoted but state management hasn't promptly responded. In addition, exclusiveness will limit the development competition, business and manufacturing promotion and cannot improve quality of service and water user care.

đ) Clean water price: hasn't been adjusted appropriately with actual situation, hasn't guaranteed business and production of enterprises.

e) State management of urban water supply: Overlapping of functions and tasks of Ministries, Divisions and local authorities. Legal document system is in short of regulations on water supply operations and on responsibilities of enterprises for water supply development and safe water supply guaranty.

1.2. Overview of climate change situation in urban areas in Binh Thuan province

1.2.1. Brief introduction of urban areas in Binh Thuan province

In 2018 in Binh Thuan province has 10 administrative units including: 01 city (Phan Thiet), 01 county town and 08 districts among which is 01 island district (Phu Quy). Over the province there are 15 urban areas (01 area type II, 01 area type III, 01 area type IV and 12 areas type V) with 127 communes, wards and towns.

1.2.2. Impacts of climate change on urban areas in Binh Thuan

Urban system in Binh Thuan province is often influenced by climate change, natural disasters such as flood, drought with more and more increasing severity and frequency which affects seriously every field of life and socio-economy of the whole province in general.

1.3. Urban water supply current situation in Binh Thuan province

1.3.1. Water source current situation

a) Surface water source: Mainly depends on surface water of 07 main basins. Majority of rivers, streams in province have narrow basins, big incline degree of the river bed and flows depending much on rainfall.

b) Underground water source: Distributed unevenly and not various due to dry climate, low rainfall, high vapor, inclined terrain, complicated geological structure.

1.3.2. Water supply current situation in urban areas

a)Water supply constructions current situation: In the whole province, there are 24 water plants supplying 15 urban areas with total capacity of 317.650 m^3/day and night (in 2017); total length of about 1.706 km of transmission pipe line at level I and II and distributing pipe line at level III and 22 pumping stations (not including aid pumping station), with total designed irrigating capability of about 14.862 ha focused in La Nga delta with 17 stations with irrigating capability of 14.182 ha.

b) Urban water supply current situation:

- Percentage of urban people using hygiene water: 98,36%;
- Percentage of urban people using clean water in National technical Standard QCVN 02:2009/BYT according to to regulation of Ministry of Health: 92,42%.

1.3.3. Impacts on urban water supply system

According to to Department of Construction, urban water supply system in Binh Thuan province at present hasn't been fulfilled and safe enough to deal with natural disaster due to climate change.

1.4. Current situation of urban water supply management in Binh Thuan province.

1.4.1. Organization and structure of urban water supply management in Binh Thuan province

a) Organization of state management of urban water supply:

- *In terms of water supply management duty for urban areas*: Department of Construction manages clean water supply operation in urban areas and

industrial zone with duties: Making, assessing, submitting People's Committee of province planning project of water supply in urban area and industrial zone as well as planning project of water supply in urban area and rural area,… for approval.

- *Duty of managing water resource:* Undertaken by Department of Natural Resources and Environment.

- *Assinging, devolving urban water supply management in province:* The shortage of cooperation among state managing offices causes many difficulties and challenges in state management of urban water supply operation.

b) Managing urban water supply system operation: Among 21 current water plants, 18 plants are managed by state offices with capacity of 185.700 m^3 day-night.

1. *Binh Thuan water supply and drainage Joint Stock Company*

Organization and machinery: According to to equitization model; equitization of state enterprises helps the unit solve some difficulties in business and production. However, unit hasn't had specialized section managing water supply system; managing qualification and capability are limited and can't meet requirement of undertaking tasks…

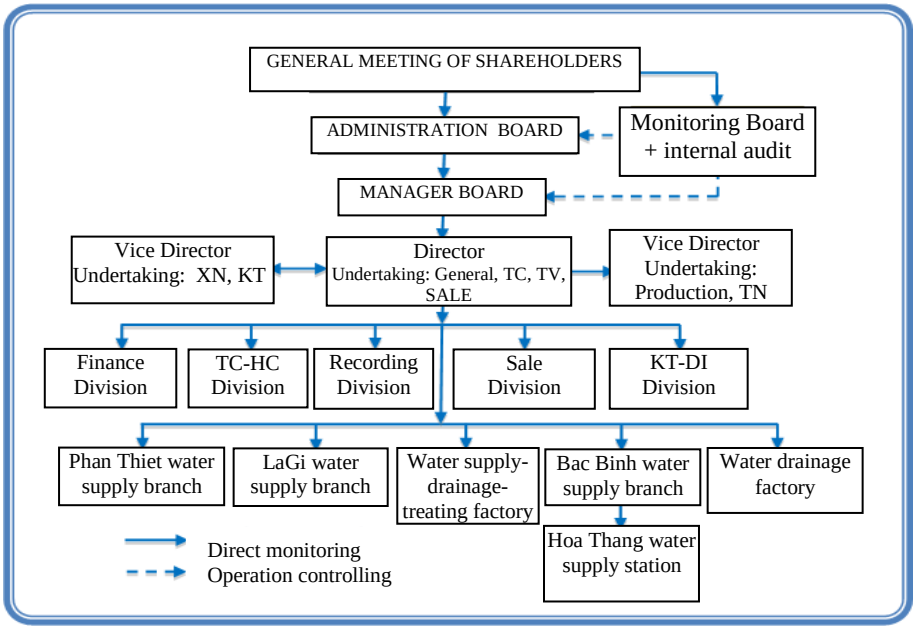

Figure 1.1. Water supply model of Binh Thuan water supply and drainage Company

2. Binh Thuan clean water and Rural environment hygiene Center

It is a public business unit of Department of Agriculture and Rural Development of Binh Thuan province. Besides duty of supplying clean water for rural area, the Center also extends supplying clean water for most of small urban areas (type V) such as towns in province (07/12 urban areas).

+ *Advantages:* Self-controlling and self-taking responsibility for finance, guaranteeing 100% frequent operation expenditure; meeting the requirement of qualification of managing and operating work/water supply system invested by the unit.

+ *Limitation, difficulties:* Implementing safe water supply plan, protecting water source are difficult due to the shortage of expenditure and limitation of personel.

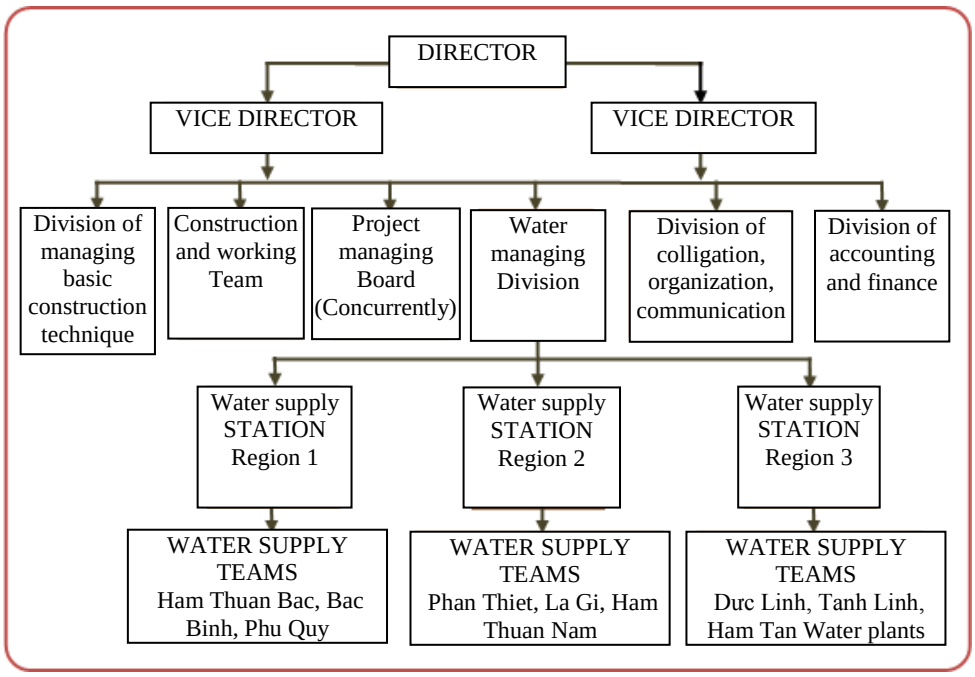

Figure 1.2. Water supply management model of Binh Thuan Clean water and rural environment hygiene Center

3. Model of enterprise managing, operating

Binh Thuan now has 03 private enterprises which operate according to model of enterprise managing and operating water supply system with total capacity of 59.500 m^3/day-night. This model focuses on wastewater treatment,

contributing to environmental pollution reduction, at the same time on technique improvement. However, cost of input production of the model is high resulting in high water price.

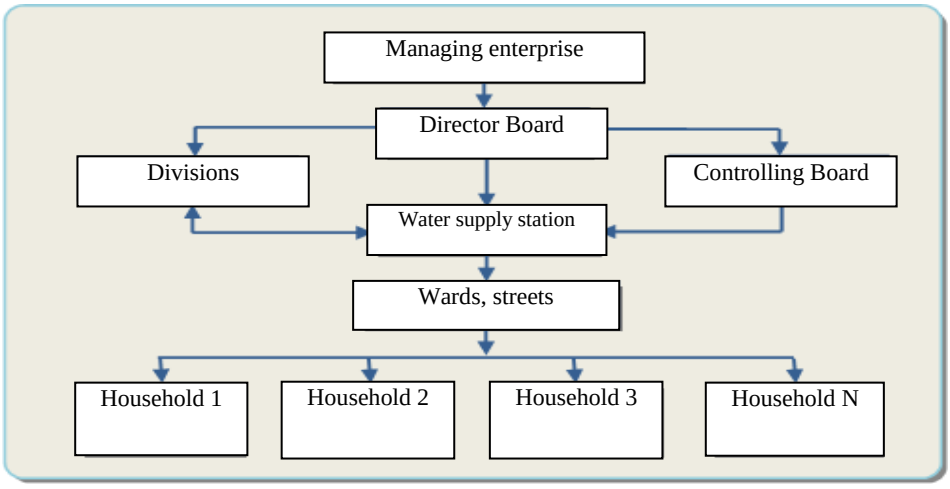

Figure 1.3. Model of enterprises managing and operating water supply system

4. Model of private enterprise managing, operating

This model is simple with work scale of 50-300 m^3/dn and simple technology. Capability of managing and operating is low or medium. This model is applied in some areas and effective.

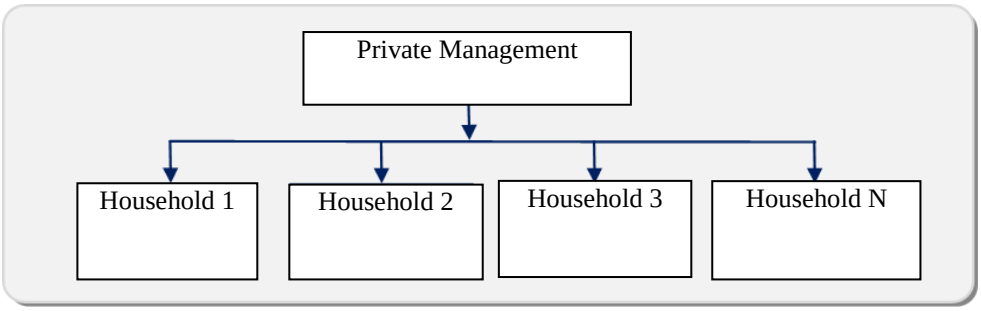

Figure 1.4. Model of private enterprise managing and operating water supply system

1.4.2. Current situation of policy mechanism of urban water supply management in Binh Thuan province

The shortage of investing capital is one of important challenges under circumstance of limited local budget. However, Binh Thuan hasn't given opening mechanism to attract investment, exspecially from private units. Implementation of regulation on private units joining urban water supply in locality has got some difficulties due to the absence of concrete guide documents.

1.4.3. Current situation of participation of relevant units

Besides positive contributions, participation of relevant units in urban water supply management in Binh Thuan province hasn't been focused and considered appropriately (due to the shortage of cooperation among state managing offices; the fact that political and social organizations haven't played well their roles in propagandizing people to enhance their awareness of responsibility for managing and protecting water source and environmental hygiene...)

1.4.4. General assessment of urban water supply management in Binh Thuan province

- There hasn't been cooperation among branches and localities;
- Capability of state management has some limitations and problems;
- Current legal documents system hasn't been completed;
- System of urban water supply service is not competitive;
- Methods, model of managing, operating urban water supply system still have some limitations;
- Awareness of responsibility for protecting water source and water supply system of Owner, offices and community is still limited;
- Forecasting hasn't caught up with real climate change, legal policy of climate change is not prompt and synchronic.

1.5. Relevant researches

The thesis gave an overview of 15 researches including 10 domestic ones and 05 foreign ones relating to urban water supply management. Researches have focused on negative impacts of climate change on water resource and water supply system. These researches have contributed to building platform of urban water supply management and solutions to implementation in practice. However, given solutions are only orientations and not concrete. Additionally, urban water supply management, especially urban water supply management under climate change condition hasn't been mentioned.

CHAPTER 2: SCIENTIFIC BASIS OF URBAN WATER SUPPLY MANAGEMENT IN BINH THUAN PROVINCE UNDER CLIMATE CHANGE CONDITION

2.1. Theoretical basis

2.1.1. Theory of building model of managing focused water supply works

a) Approaching method of Gallen: Stable development of focused water supply system in improvement and optimization direction should be built on basis of the organization machinery with concrete strategies, current organization and appropriate statute.

b) Approaching method of MadeleenWegelin-Schuringa: Specifying expressly factors affecting ways of managing focused water supply work, changing model of focus water supply, enhancing performing efficiency of State offices and aid organization.

2.1.2. Theory of participation of units in urban water supply management

a) Relevant units include: State managing offices, water supply service units, political and social organization and urban residential community.

b) Purpose of participation of units: Maintaining and promoting state management of functional offices; bringing into play potentiality and advantages of water supply companies; enhancing awareness of responsibility of community in managing and protecting water source/urban water supply work, as well as solving conflicts of water branch.

c) Role of relevant units in urban water supply management: State plays score role in supporting policy institution of attracting investment for development.

2.1.3. Theory of water balancing solution up to 2025

- Standard of water supply.
- Forecasting necessity of using water.
- Total necessity of clean water up to 2025.
- Total water quantity for water plant up to 2025.
- Total raw water required quantity up to 2025.

2.2. Legal basis

2.2.1. Legal documents system

Laws on water supply include Law of Water Resource, Law of Environmental Protection, Law of Natural Disaster Prevention, Law of Irrigation; Decree No. 117/2007/NĐ-CP; Decree No. 124/2011/NĐ-CP; Decision No. 2502/QĐ-TTg; Circular No. 01/2008/TT-BXD; Circular No. 08/2012/TT- BXD and some relevant documents of Binh Thuan province.

2.2.2. Code, standard

Code and standard system of Urban water supply branch in Vietnam or relating to water supply field is pursuant to Law No. 68/2006/QH11- Law of Technical Standards and Codes, including: QCVN 07:2016/BXD; QCXDVN 01:2008/BXD; TCXDVN 33:2006.

2.2.3. Climate change scenario of Binh Thuan province

- *Seawater rising Scenario:* At the end of 21st century, it is estimated that seawater level increases from 53cm (RCP4.5 Scenario) to 73cm (RCP8.5 Scenario).

- *Main climate change scenario:* Average temperature may increase from 0,6 to 4,0 °C according to 4 models; Rainfall at the beginning of 21st century fluctuates from 2% to 15%; from 0% to 40% (in the middle of the century) and from 1% to 75%.

Climate change and the weather have been developing complicatedly. Natural disasters such as marine erosion, soil salinity, storm, flood, drought, etc… tend to increase.

2.3. Factors affecting urban water supply management

2.3.1. Natural conditions

Binh Thuan has dry climate with low rainfall and many high vaporing areas in comparison with rainfall; inclined terrain, easy-water absorbing geology, declining vegetation and decreasing capability of water keeping. In Binh Thuan, surface and underground water source is not various and changes into seasons.

2.3.2. Urbanization and urban population growth

Up to February, 2019, in the country there are 819 urban areas, and it is predicted that in 2025 there will be about 1.000 urban areas with average

urbanization rate of 35,2%. Urban population will be more than 32 million people, covering 35,2% of country's population. High residential density results in the increase of water using necessity…

2.3.3. Impacts on urban water supply management

Forecasting performance can't keep up with actual climate change, policy and law on climate change hasn't been brought in promptly and synchronically; qualification and capability of managing hasn't meet the requirement; model of managing and operating water supply system hasn't been completed. In addition, awareness of responsibility in protecting water resource, urban water supply system is not good. Performance of controlling, preventing, dealing with unexpected problems of environment, natural disaster, climate change in water supply branch is not actually considered to implement.

2.3.4. Factors of mechanism, policy

Capital source invested into basic construction from annual budget is limited while Binh Thuan hasn't created any opening mechanism to encourage, attract investment from economic units, especially private ones in providing urban water supply service.

2.3.5. Organizing state managing machinery

Structure and machinery of urban water supply management of Departments, divisions is not reasonable and can't specify exactly and expressly managing roles and functions of State; Assignment and decentralization of duties and functions are still overlapping; effectiveness of management is still rather low.

2.4. Experience of urban water supply management under climate change condition

In some Asian countries, model of water supply companies operated by both State and private unit is quite popular. Attracting private units for investment will increase efficiency of providing water supply services. However, State must have legal tools to guarantee competitiveness.

In Vietnam, a lot of urban clean water supply companies has transformed its business model from state enterprise into equitized one and performed effectively. Water supply enterprises can self- control its finance which is a decisive condition for stable development of water supply branch.

CHAPTER 3: SUGGESTING MODEL AND SOME SOLUTIONS TO URBAN WATER SUPPLY MANAGEMENT IN BINH THUAN PROVINCE UNDER CLIMATE CHANGE CONDITION

3.1. Opinions and targets of urban water supply management in Binh Thuan province

3.1.1. Opinions

1. Serving the target of safe water supply, meeting the necessity of using clean water in urban areas under climate change condition;

2. Urban water supply management is a progress supervised by State;

3. Establishing environment, orienting promotion of water supply developing;

4. Creating mechanism of attracting developing investment and managing, operating water supply system;

5. Combining with developing and protecting water source;

6. Renovating water supply management on the basis of renovating management in the orientation of compacting, not overlapping among functions and duties;

7. Urban water supply management is responsibility of relevant units;

8. It is needed to build water price under principle of correction, sufficiency of investing expenditure, input materials and payment capability of people.

3.1.2. Targets

1. Guaranteeing safe water source for urban areas under climate change condition.
2. Applying model of urban water supply management suitable with each province up to 2025.
3. Guaranteeing 100% clean water supply service for urban areas of the province up to 2025.
4. Building cooperation mechanism in urban water supply management.
5. Mobilizing participations of relevant units in urban water supply management.

3.2. Suggesting water balancing solutions for urban areas in Binh Thuan province up to 2025 according to each terrain

3.2.1. Water supply balancing regional distribution

On the basis of analyzing features of natural conditions, surface water and underground water capability and necessity of using water, suggest water balancing solution for urban areas of dividing into 05 regions (Figure 3.1)

3.2.2. Raw water balancing solution for urban areas

Up to 2025 raw water quantity needed for urban areas of province is 425.228 m^3/day and night, but the actual quantity only covers about 56,9% (241.930 m^3/day and night) of the necessity. So suggest raw water balancing solution for urban areas of terrain distribution (table 3.1)

3.2.3. Clean water balancing solution for urban areas

On the basis of current situation of water plants and necessity of using water in urban areas, suggest water balancing solution in orientation of upgrading current water plants, simultaneously planning and building some new water plants in order to guarantee urban water supply according to terrains of province up to 2025.

3.2.4. Schedule of implementing water balancing and prior projects in phase 2020-2025

a) Suggesting water balancing schedule: Under the circumstance of limited local budget, phasing investment or offering investment from other capital sources, especially from private units are extremely necessary. At the same time, a schedule should be created to implement water balancing for urban areas according to standards of assessing "priority order" for each work/project, each particular region in order to choose time and expenditure source, guaranteeing feasibility and high effectiveness for the project.

b) Projects implemented in phase 2020-2025: Priority and feasibility must be implemented first. List of projects to deal with climate change in phase 2020-2025.

Table 3.1: Raw water balancing solutions for urban areas in Binh Thuan province

ORDER NO.	Water supply region	Necessity of water (m^3/dn)	Extra Water quantity (m^3/dn)	Water balancing solutions
1	Region 1	38.456	3.084	Improving some reservoirs (Da Bac, Long Song, Phan Dung); building new reservoir Song Luy with capacity of 65 million m^3.
2	Region 2	29.921	2.332	Improving, dredging Ca Day reservoir to exploit maximum designed capacity (73 million m^3)
3	Region 3	173.951	32.286	Building and completing water supply system (reservoir, pumping station, pipe line…)
4	Region 4	167.248	113.768	Investing and completing Song Dinh 3 reservoir projects; building a reservoir of <10 million m^3 to moderate flow and reserve water.
5	Region 5	16.652	9.539	Improving current reservoirs (Bien Lac, Tra Tan, Da Guiry reservoir,…

Figure 3.1: Planning map of water supply plants for urban areas in Binh Thuan province until 2025

3.3. Suggesting model and solutions of urban water supply management in Binh Thuan province under climate change condition

3.3.1. Suggesting model of urban water supply management under climate change condition

Management model at present still has some limitations to solve. Therefore, suggesting new management model with coordination between State and private units in water supply to surmount limitation of old model in providing water supply service to urban people. (figure 3.2).

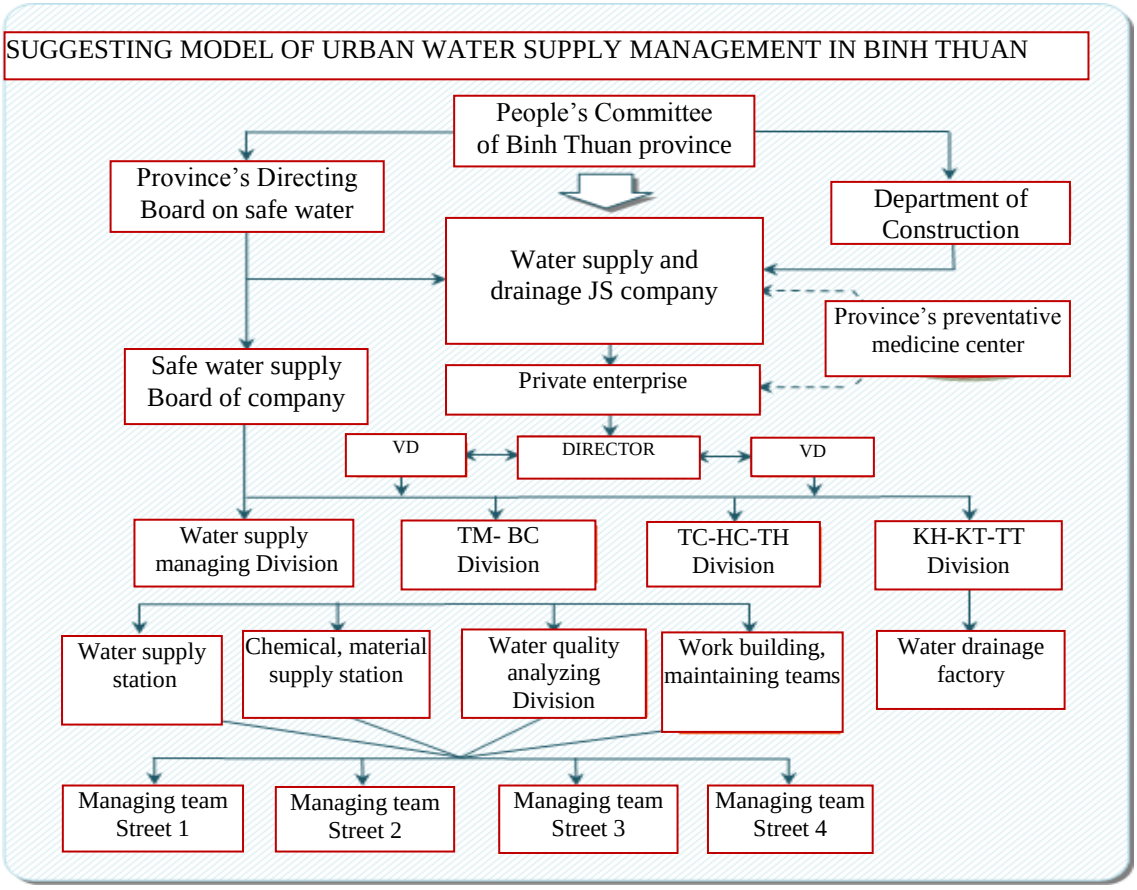

Figure 3.2: Suggesting model of managing and exploiting urban water supply service in Binh Thuan province

Duties of province water supply and drainage Joint Stock Company: Suggesting Director of Construction Department, Safe water supply Board of province building up mechanism, policy, programme on National goals of clean water in province; Receiving, managing and using effectively assigned capital source and projects.

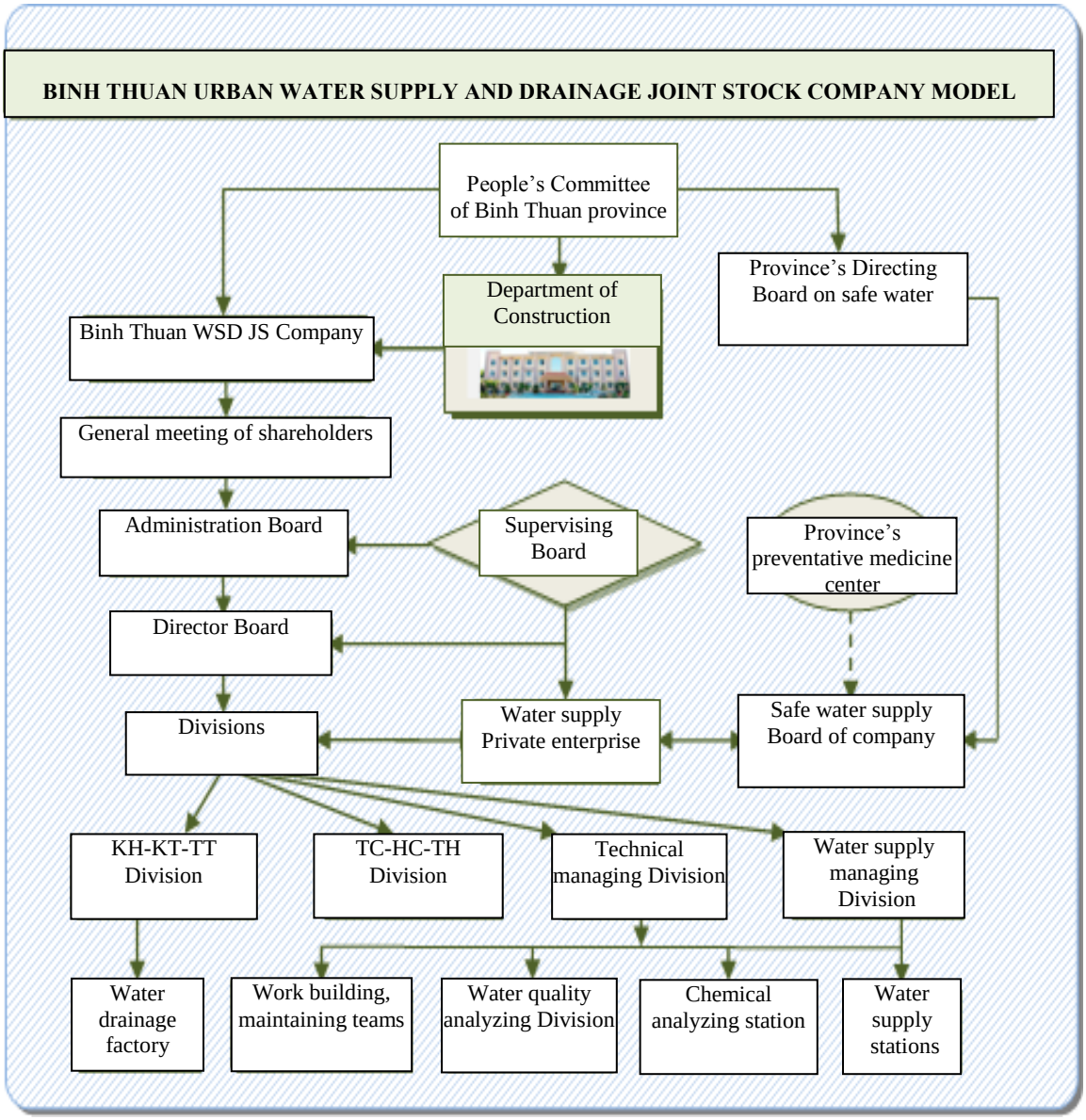

Figure 3.3: Diagram of model of Urban Water supply and drainage Joint Stock Company of Binh Thuan province

This is a model with the close combination between State and private enterprises, so in order for the model to perform effectively there should be frequent management and supervision of State as well as people's awareness of taking responsibility in using and protecting wwater source and urban water supply system in the region.

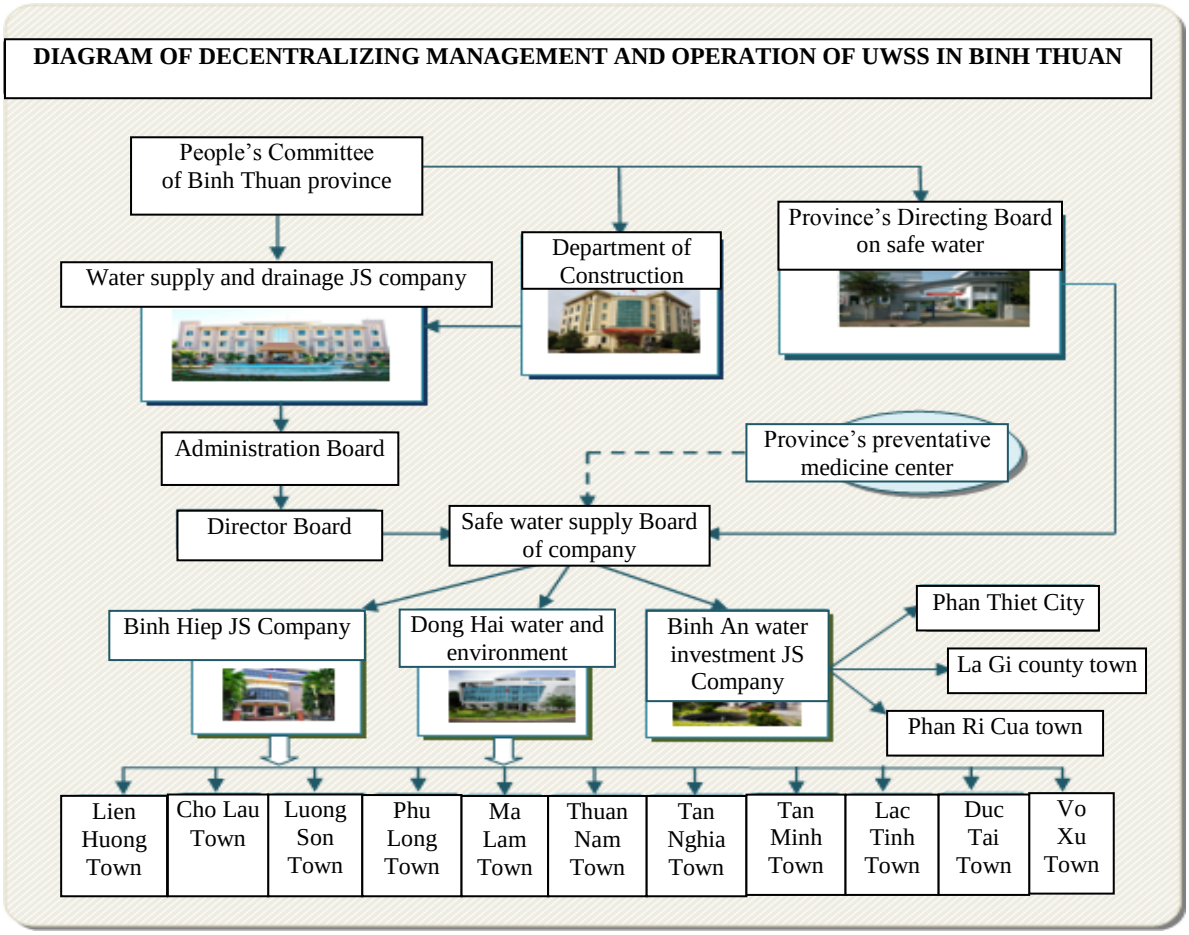

Figure 3.4: Diagram of decentralizing management and operation of urban water supply system in Binh Thuan province

3.3.2. Completing policy mechanism of urban water supply management

- Completing mechanism of distributing and exploiting water source;

- Supplementing policy and enhancing capability of water supply management for urban areas;

- Completing mechanism of finance and distribution of investing into water supply system.

3.3.3. Building cooperation mechanism between: Promoting construction and promulgating provincial cooperation statute on water supply among offices, organizations in Binh Thuan province. At the same time clarifying responsibility of organizations, individuals in managing safe water supply.

3.4. Suggesting participation of relevant units in investing, developing and managing urban water supply in Binh Thuan province under climate

change condition

3.4.1. Roles of state managing offices: People's Committee of province regulates, assigns and decentralizes functions and duties to Departments, divisions and local authorities in implementing urban water supply management. Relevant Departments and divisions manage water resource field and urban water supply operation according to their assigned duties in province.

3.4.2. Participation of private enterprises in investing into water supply: Binh Thuan needs to apply national guide to build up its particular mechanism in order to attract capital source, especially to encourage private enterprises to invest in developing water supply.

3.4.3. Participation of community: Promoting participation of community in water supply management also means promoting decentralizing management for facilities. "Community institution should be soon established, promulgated and approved; enhancing awareness of leaders and managers about the importance of managing urban water supply operation basing on community to influence their decisions relating to water supply operation in urban areas.

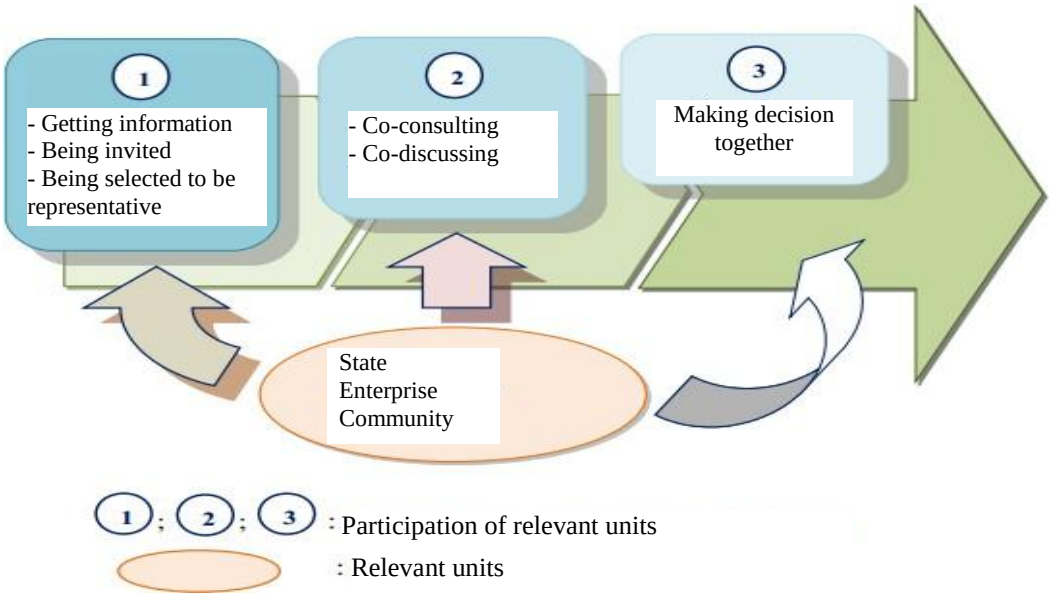

Figure 3.5: Diagram of participation of relevant units in water supply management in urban areas in Binh Thuan province under climate change condition

3.5. Discussing about some research results

Discussing about water balancing solution according to safe water supply criteria: Suggesting solution of balancing water supplied to urban areas helps surmounting some limitations in planning, distributing water supplied regions and supplementing stable water source with guaranteed quality; at the same time helps managing urban water supply as well as duty of supplying water widely with participation of relevant units in well implementing in coming time.

Discussing about suggesting model of urban water supply management: The model's superiority (new points) in comparison with current managing model is that it has overcome limitations and problems of managing organization and machinery, especially of assignment and decentralization of responsibility to water supply managing subjects (between state managing and managing and operating system) as well as cooperation among relevant units in urban water supply.

Discussing about building cooperation mechanism: In order for regional water supply management to be effective, the decisive condition is to establish a cooperation mechanism in water supply management among offices and organizations and it is necessary to ensure that the mechanism will be soon performed synchronically and timely.

Discussing about effectiveness of participation of relevant units in urban water supply management: The model will bring many benefits in organizing management thanks to the active cooperation among units in which main benefits are: (1) Considerably saving water; appropriately distributing water source among terrains, between upstream and downstream; (2) improving self-controlling and responsibility; improving capability of managing water supply in urban areas; (3) Keeping clean surface water source on rivers, streams thanks to waste collection of people and their good awareness of managing and protecting water source.

CONCLUSION AND SUGGESTION

I. Conclusion:

1. The thesis gives analysis and assessment of current situation of water supply system and models of urban water supply management at present; impacts on urban water supply management which becomes the basis of suggesting water balancing solutions, models and urban water supply management solutions. The thesis has summarized several relevant domestic and foreign researches; these researches contributed actively to the construction of platforms of urban water supply management and to solutions of implementing in practice.

2. The thesis also systematized theoretic basis of building managing model, participations of relevant units and estimation of balancing water in urban areas. Legal basis system of urban water supply management includes legal documents, criteria system, national standard of water field; climate change – seawater rising scenario for Binh Thuan province;

3. Basing on estimated figures of total necessity of using water in urban areas, actual capacity of water plants and capability of water source, suggesting solutions of balancing raw water, clean water in urban areas in the province up to 2025, distributing in terrains under taking climate change into account. Solution of balancing water is suggested to guarantee water source (clean, raw) for safe water supply according to necessity of urban areas in the province. At the same time suggesting schedule of implementing and prior projects to make plans of time and using expenditure source appropriately and effectively.

4. The thesis suggested model of managing water supply in urban areas in Binh Thuan in orientation of integrating current models basing on selectively combining new managing methods which are flexible and suitable with particular conditions of urban areas in the provinces.

5. The thesis suggested some main solutions to enhance capability of managing water supply in urban areas in Binh Thuan province under climate change condition, including:

- Group of solution of supplementing and completing policy mechanism in urban water supply, creating legal framework and basis to attract capital source for investing and developing water branch, guaranteeing goal of safe water supply;

- Group of solution of building up cooperation mechanism among

offices, organizations in managing water supply in regions in Binh Thuan province;

- Solutions of participation of relevant units in investing, developing and managing water supply in urban areas in Binh Thuan province under climate change condition;

6. Result of the research is practical, helping managers in Binh Thuan province get an objective view on current situation of water supply system and urban water supply management, and hereby giving solutions and decision on urban water supply operations in general and extending scale of urban water supply projects in provincial regions in particular in order to achieve given goals.

II. Suggestion:

7. Binh Thuan province needs to soon issue (under its authority) or suggest the Centre allowing it to issue particular mechanism in order to attract investment into developing urban water supply infrastructure according to orientation of modernity in order to guarantee stable and safe water supply and towards the goal of stable development.

8. Suggest People's Committee of Binh Thuan province frequently directs Departments, divisions and local authorities of urban areas to promote managing and combining water sources in relation to climate change; researching to build cooperation mechanism in managing water supply, at the same time clarifying responsibility of relevant offices, units, organizations, individuals in order to enhance strength, effectiveness of urban water supply management in the province in coming time.

9. Suggest Department of Natural Resources and Environment advising People's Committee of Binh Thuan province to make a plan on developing net of specific hydrometeorology on basis of extra installing complex monitoring stations to serve effectively prevention of natural disaster and managing technical infrastructure system in general and urban water supply system adaptably to climate change of Binh Thuan province in particular.

LISTS OF PUBLISHED SCIENTIFIC WORKS OF AUTHOR RELATING TO THE THESIS

1. Published scientific articles

1. Chau Thanh Hung, *Current situation of urban water supply management model in Binh Thuan province in climate change condition,* Environmental and Urban Magazine, No. 6 (119), in October, 2018.

2. Chau Thanh Hung, *Factors affecting on urban water supply management in Binh Thuan province,* Financial Magazine period 1, No. 690, October, 2018.

3. Chau Thanh Hung, *Suggestion of urban water supply management in Binh Thuan province in climate change condition*, Water drainage and supply Magazine No. 6 (122), October 2018.

2. Published relevant scientific researches

ORDER NO.	Title of the research	Supervising unit	Year of fulfillment
1	Managing synthesis of water resource and development of urban areas in relation to climate change in Binh Thuan province.	Board of Monitoring and Managing synthesis of water resource in Binh Thuan province	2016
2	Promoting underground water resource management in coastal area in Binh Thuan province.	Department of Natural Resources and Environment of Binh Thuan province	2017