

MINISTRY OF TRAINING  
AND EDUCATION

MINISTRY OF  
CONSTRUCTION

**HANOI ARCHITECTURAL UNIVERSITY**

**HO VAN DANG**

**URBAN ROAD NETWORK MANAGEMENT IN URBAN  
CENTERS IN THE SOUTHWESTERN COASTAL  
PROVINCES IN THE MEKONG DELTA TO ADAPT TO  
CLIMATE CHANGE**

MAJOR: URBAN AND WORKS MANAGEMENT

**NUMBER: 62.58.01.06**

**SUMMARY OF DOCTORAL THESIS**

The thesis was completed at Hanoi Architectural University

Science instructor:

- 1. Assoc. Prof. Dr. Vu Thi Vinh
- 2. Dr. Nguyen Thanh Nghi

Reviewer

1:.....

Reviewer

2:.....

Reviewer

3:.....

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The thesis can be found out at:

- 1. National Library of Vietnam
- 2. Library of Hanoi Architectural University

## **LIST OF SCIENTIFIC NEWSPAPERS**

1. Ho Van Dang (2018), “The impact of climate change on coastal provincial urban area network in the South-West of the Mekong Delta, Construction Planning Journal, No. 95 + 96 in 2018”.
2. Ho Van Dang (2019), “Experience of urban road network management adapting to climate change in some cities in Southeast Asia, Construction Planning Journal, No. 97+ 98 in 2019”.
3. Ho Van Dang (2019), “Solution to Rach Gia city's provincial coastal urban road network of the Mekong Delta adapting to climate change, Constructionmagazine, number 10, 2019”

## INTRODUCTION

### 1. Rationale

The towns in the southwestern coastal region of the Mekong Delta, including **Rach Gia City** (Kien Giang Province) and **Ca Mau City** (Ca Mau Province), are facing the most serious challenges, namely impacts of climate change leads to rising sea levels, increasing saline intrusion and are facing many difficulties due to increasingly complex climate change changes, as shown in Table I below:

Province	Area (ha)	Flood rate (% of area) corresponding to sea level rise					
		50cm	60cm	70cm	80cm	90cm	100cm
<b>Ca Mau</b>	528870	8.74	13.7	21.9	30.3	40.9	57.7
<b>Kien Giang</b>	573690	7.77	19.8	36.3	50.8	65.9	76.9

Table I shows, with the topography of Kien Giang province, if the sea level rise is 0.5m high, there will be more than 7.77% of the area submerged in water, if the sea level rise is higher than 1m, it will be near 76.9% of the area is submerged in water, and if the sea level rises to 1.5m, more than 95% of the area is submerged in water.

Currently, the urban road network of urban centers in the southwestern coastal province in recent years has been invested by the State to upgrade transport infrastructure, so there have been many changes. However, the management of urban road network in the context of climate change adaptation of urban areas has not been proactive and has not had solutions to adapt to increasing climate change. In particular, Rach Gia is a city with many area built on polder land, and Ca Mau city is a coastal city, which will greatly impact the urban road network when sea level rise is combined with heavy rain. Therefore, choosing the thesis topic "*Urban road network management in urban centers of southwestern coastal provinces in the Mekong Delta to adapt to climate change*" is very necessary, has high scientific and practical significance.

### 2. Research objectives

To propose solutions to manage the urban road network to adapt to climate change in urban centers of the southwest coastal region of the Mekong Delta in the context of increasingly severe climate change impacts.

### **3. Research subject and scope**

#### *Research subjects:*

The management of the urban road network of urban centers in the southwestern coastal region of the Mekong river delta. In particular, it focuses on: Urban road network and management entities are local departments, the City People's Committee and the community.

#### *Research scope:*

- Focusing on urban road network management adapting to climate change to overcome flooding and landslides caused by sea level rise is a big problem of the two urban centers of the southwest coastal province.

- Regarding time: In accordance with the development orientation of urban centers in the southwestern coastal region of the Mekong Delta region to 2030 and vision to 2050

- In terms of space: Urban centers in the southwestern coastal region of the Mekong Delta, including 2 urban areas of Ca Mau and Rach Gia cities.

### **4. Methodology**

The thesis uses 7 research methods: Investigation survey method, Inheritance method, Expert method, Comprehensive analysis method, Forecast method, System approach, and Application positive method.

### **5. Significance**

#### *\* Scientific significance*

- The thesis contributes to supplementing and concretizing the theoretical basis for the management of urban road network of provincial urban areas in the southwestern coastal region of the Mekong River Delta adapting to climate change.

- Provide the basics of urban road management adapting to climate change as a reference for specialized teaching: urban management, urban transport management, construction management and industry urban technical infrastructure.

- Contributing to supplementing and completing the content of some state management documents on urban road network management in the context of climate change.

#### *\* Practical significance:*

Proposing additional tasks for professional management agencies and state management on the management of urban road adaptation to climate change for the southwestern coastal provincial urban areas in the Mekong Delta.

- Proposing to add a number of regulations for the management of urban road networks to adapt to climate change.
- Identifying mechanisms and policies in road network planning management from a climate change adaptation perspective.
- Proposing solutions to Ca Mau and Rach Gia cities from which to serve as a reference base for provincial urban areas in the country.

### **6. New contributions of the thesis**

1. Identifying 4 factors affecting climate change to urban road network in urban areas of southwest coastal provinces in the Mekong Delta

2. Formulating 5 criteria for managing urban road networks in urban areas in the southwestern coastal region in the Mekong Delta region to adapt to climate change.

3. Proposing a zoning map of urban areas to provide solutions to manage the urban road network of urban centers in the southwestern coastal region of the Mekong Delta adapting to climate change.

4. Proposing solutions to organize the apparatus of urban road management in urban centers in the southwestern coastal region in the Mekong Delta region to adapt to climate change.

5. Proposing to supplement regulations on mechanisms and policies in the management of urban road networks in urban centers of the southwestern coastal provinces in the Mekong Delta region to adapt to climate change.

### **7. Concepts and terminology related to the topic**

The thesis introduces a number of concepts and terminology related to the topic such as urban road network management, urban technical infrastructure and climate change.

### **8. The structure of the thesis**

In addition to the introduction, conclusions and recommendations, the thesis content has 3 chapters:

Chapter 1: Overview of urban road networks management adapting to climate change

Chapter 2. Scientific basis for managing urban road networks in urban centers in the southwestern coastal region of the Mekong river delta to adapt to climate change.

Chapter 3. Proposing a number of solutions to manage urban road networks in urban centers in the southwestern coastal region of the Mekong Delta adapting to climate change.

## CONTENT

### **CHAPTER 1. OVERVIEW OF URBAN ROAD NETWORKS MANAGEMENT ADAPTING TO CLIMATE CHANGE**

#### **1.1. Overview of urban road network management adapting to climate change in some cities in the world and in Vietnam**

##### *1.1.1. Cities in developed countries.*

Developed countries like the United States in the Americas or the Netherlands in Europe are also affected by climate change, but with economic conditions and science and technology, these countries have solutions to manage the issue. The management of advanced urban road network to adapt to climate change such as building a process to adapt to climate change of New York City and the construction of the sea dyke system of Afsluitdijk city to avoid floods in combination with Highway on the sea.

##### *1.1.2. Cities in developing countries.*

###### *1.1.2.1. Cities in Latin American countries*

Developing countries in Latin America in the Caribbean region are responding primarily to a number of areas: Awareness raising for people in climate change adaptation as well as in agriculture to address livelihoods. Particularly, the management of road network has not been paid attention because there are more concerns in daily life.

###### *1.1.2.2. Cities in Southeast Asian countries.*

Southeast Asia has 10 countries with a long coastline, high population density and many economic activities in coastal areas, areas vulnerable to the impacts of climate change such as: sea level rise, floods and drought. Countries like Myanmar and the Philippines are also affected.

**Yangon-Myanmar and Olongapo-Philippines** have tried in managing road networks to adapt to climate change by following solutions:

- Increase awareness of policy makers and the public about climate change.

- Establish an information center related to climate change, because only when sufficient and reliable data are available can accurate directions and action plans be made.

- Integrate climate change content into land use planning, organizing units responsible for planning and implementing adaptation strategies and interdisciplinary cooperation of many stakeholders. Determine the road system that is dangerous where vehicles and people cannot travel because of dangers such as landslides and floods.

Check if there are sufficient means of transporting people and equipment when relocating to safer locations.

### ***1.1.3 Cities in Vietnam***

#### ***1.1.3.1. Tuy Hoa City - Phu Yen Province***

Tuy Hoa city is the provincial capital of Phu Yen province. It is currently a class-II city. Because of its proximity to the sea, the city is also strongly affected by climate change and greatly affects the technical infrastructure system in general. and urban road network in particular In the past, the city had not been adequately prepared to deal with floods due to rivers, seas and rain. Although the city has delineated the risk of erosion as 3 regions with different levels to arrange appropriately for each area, the attention to road network planning and management solutions is also a big problem.

#### ***1.1.3.2. Ha Long City - Quang Ninh Province.***

Ha Long City is the provincial capital of Quang Ninh province in the northern coastal region and is the first-class city directly under the province and heavily affected by climate change. As Ha Long City is located close to the sea, the terrain is divided into two separate areas, namely Hon Gai and Bai Chay areas with different topographic conditions, so the impacts of climate change are different. The landslide inundation in the urban area according to the leaders of Quang Ninh province is the opposite of the rapid socio-economic development, so the city has taken measures to ward (communes). In the city, to review locations with high risk of landslides to proactively move people out of this area.



## 1.2. Current situation of urban road networks of urban centers in the southwestern coastal region of the Mekong river delta

### 1.2.1. General introduction about the urban centers of the southwestern coastal town in the Mekong river delta.

According to the Vietnamese-Vietnamese Dictionary and Wikiwand, the provincial capital is the state administrative center of a province, that is, the place where the state administrative agencies are headquartered. So Ca Mau City (the capital of Ca Mau province) and Rach Gia City (city of Kien Giang province)

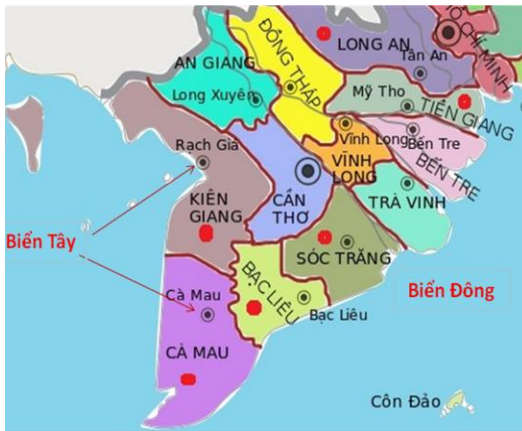


Figure 1.13- Location of Ca Mau City and Rach Gia along the southwest coast

#### 1.2.1.1. Ca Mau City

Ca Mau city is the provincial capital located on the southwestern coast of the country, with topographic features adjacent to the sea, forests, and intermittent rivers, so Ca Mau is considered as a miniature Mekong Delta. The coastal area with mangroves creates the characteristics of Ca Mau City and these forests contribute to the coastal protection of the city.

##### 1.2.1.1.1. Rach Gia city

Rach Gia is the provincial city of Kien Giang province, which is a second class urban area running along the southwestern coast and is the political, economic, cultural and scientific center of the province. Because of its low latitude and bordering the sea, the tropical monsoon climate, hot and humid year-round average monthly

temperature from 27–27.5°C, is not directly affected by the storm but the rainfall due to storms accounts for one significant proportion, especially at the end of the rainy season

### ***1.2.2. Current situation of urban road networks of urban centers in the southwestern coastal region of the Mekong river delta.***

The road networks of both urban areas has been planned and invested but it is still in the stage of construction, upgrading and renovation. Some sections of the road still use ferries to cross the river, so the speed and traffic connections are limited. Financing for road maintenance is lacking. Currently, the speed of strong urbanization has begun to appear congestion and traffic safety disorder in these two cities. The rate of using personal vehicles including cars, motorbikes, bicycles accounts for over 80%, of which motorbikes account for over 70%.

#### ***1.2.2.1. Current situation of urban road networks in Ca Mau***

It is an urban area close to the sea and routes running along rivers and canals, urban road network and waterway transport system synchronously connected by the system of wharves and ports.



*Figure-1.17 Current status of Ca Mau city road network*

According to the survey, the width of main roads in the inner city is larger than 20m and the remaining routes are larger than 6.5m, with a road structure in accordance with urban road standards; Of the total roads of the city account for 90% (asphalt, concrete) the remaining 10% is other roads.

### 12.2.2. Current situation of Rach Gia city road networks

Situation of Rach Gia MLM includes the main axes running perpendicular to the coast, combined with the system of roads throughout the city and parallel to the coast, forming the urban road in the form of chessboards. The road network in the province has 352 routes with 220,163km inner city roads and 41,776 km of rural roads, including 47 main roads and 305 regional and rural roads.

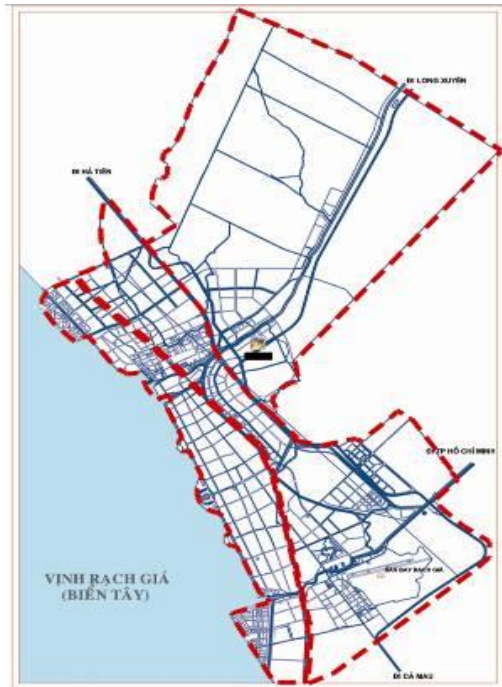


Figure 1.23- Current status of urban road network Rach Gia

### 1.2.3. Effect of climate change on urban road networks

Impact due to temperature increase; Impact of flooding, causing erosion of coast and river banks; Impact when increasing rainfall; Impact of saline intrusion (shown in the table above)

*Assessment of climate change effecton Ca Mau and Rach Gia Cities*

NO.	City	Climate change signs					
		Storm	Flood	River / sea erosion	Sea level rise and spring tide	Drought	Salinization
1	<b>Ca Mau</b>	++	+	+++	+++	++	+++
2	<b>Rach Gia</b>	++	+	+++	+++	++	++

Notes: +++ Strong impact; ++ Medium impact; + Light impact

### **1.3. Current situation of management of urban road network in urban centers of southwestern coastal provinces in key economic regions of Mekong river delta adapting to climate change**

Assessment of urban road network management in urban centers of the southwestern coastal provinces in the Mekong River Delta based on the following main aspects:

- Promulgating and implementing documents on urban road network planning management
  - Road network design adapting to climate change
  - Managing land fund for construction of road network according to field planning
  - Manage the synchronization and articulation of technical infrastructure works
    - Planning for construction, maintenance and operation of road network
    - Organizational apparatus for managing the urban road network
    - Community participation in urban road management

### **1.4. Literature review**

#### **1.4.1. Foreignliterature**

Some of the research topics and dissertations published are mostly urban planning and urban management, but road network management related to this thesis topic is only presented with 4 topics and 2 works.

#### **1.4.2. Domestic literature**

\* There have been a number of important publications published on climate change for urban areas in Vietnam such as: "Climate Change Adaptation in Vietnam" - Monographs - National Assembly

XIV- Commission Department of Science, Technology and Environment, etc.

\* Some research projects of Research Institutes and Universities: Including 4 subjects and 2 research projects. However, the topics have not mentioned the management of road-map adapting to climate change of urban centers in the western coastal provinces of the Mekong Delta.

### **1.5. The issues raised in the thesis research**

From the limitations of the two cities in the management of road network management, the characteristics of the natural conditions and the climate change situation of each city, the task of the thesis is to clarify some contents of urban road network management adapting to climate change for urban centers in the southwestern coastal region of the Mekong Delta is:

1. Clearly identify the factors of climate change impacts on the urban road network of urban centers in the southwestern coastal provinces of the Mekong river delta so as to have suitable solutions in climate change adaptation.

2. Determine criteria for managing urban road network in urban centers of southwestern coastal provinces in the Mekong river delta to adapt to climate change. Based on the criteria to the city government has strategic directions in the management and development of road network.

3. Based on the actual conditions of the 2 cities to determine the specific urban area zoning in the management of climate change adaptations to climate change. This is associated with the planning work such as: Land use issues in urban planning and urban transport planning integrated with climate change. Upgrading and improving urban road networks to raise the density of km/km<sup>2</sup> to meet the standards for managing urban road networks to adapt to climate change.

4. Propose a number of structural and non-structural solutions suitable to 3 areas of the two urban centers of the southwest coastal province in the Mekong Delta region in managing urban road adaptations to climate change.

5. Propose the organizational structure and supplementing the regulations on mechanisms and policies in managing the network of

climate change adaptive urban roads for the two urban centers in the southwestern coastal province of the Mekong river delta.

6. Mobilize community participation in the management of urban road adaptation to climate change

## **CHAPTER 2. SCIENTIFIC BASIS FOR MANAGING URBAN ROAD NETWORKS IN URBAN CENTERS IN THE SOUTHWESTERN COASTAL REGION OF THE MEKONG RIVER DELTA TO ADAPT TO CLIMATE CHANGE**

### **2.1. Legal basis for the management of urban road networks in urban centers of southwestern coastal provinces in the Mekong river delta**

#### ***2.1.1. Law System***

The legal basis of the thesis is the law system: Road Traffic Law, Urban Planning Law, Environmental Protection Law, Land Law, Construction Law, and Law on Natural Disaster Prevention.

#### ***2.1.2. System of legal documents***

The thesis bases on the by-law documents including: National target program to respond to climate change, Climate change scenarios and related legal documents and Documents of the Ministry of Transport on road network management; Decree 10/2013 / ND-CP dated 11/1/2013 of the Government on management, use and exploitation of road transport infrastructure assets.

#### ***2.1.3. Orientations for urban development planning in the Mekong Delta***

- Development orientations for the transport network in the Mekong river delta region till 2015, orientation to 2020.

- Transport development planning in key economic region of Mekong Delta to 2020 and orientation to 2030.

#### ***2.1.4. Climate change scenarios for the West coastal region of the Mekong Delta***

The detailed climate change scenario in 2016 was built on the basis of Vietnam's meteorological and sea level data updated to 2014; Topographic data is updated to March 2016; the latest method in the Fifth Intergovernmental Climate Assessment Board Report on Climate Change. Climate change scenarios are formulated for the West coastal provinces of Ca Mau and Kien Giang.

## 2.2 Rationale for managing urban road to adapt to climate change.

### 2.2.1. Content of state management of road network management

Management of urban roadway planning is a part of urban planning management. Currently, the management of urban road network planning is implemented according to Circular No. 04/2008 / TT-BXD, February 20, 2008 and Circular No. 16/2009 / TT-BXD, June 30, 2009 of the Ministry of Construction. For the content of urban urban road network management, the thesis would like to mention some key contents of the Circular related to MLM management to adapt to climate change.

### 2.2.2. Some criteria of road network capable of adapting to climate change.

Researching urban criteria to adapt to climate change is currently a new problem in the world, so the study of criteria for urban adaptation to climate change is a newer and more in-depth problem. Based on reference of the criteria of urban adaptation to climate change, the thesis will conclude to consider for urban road network.

#### 2.2.2.1. Criteria of urban centers adapting to climate change

Network of Asian cities and cities with adaptive capacity including 3 criteria or 3 characteristics: Persistence- Adaptability - Convertibility.

#### 2.2.2.2. The index of adapting to the hazards of climate change

##### a. According to the Organization for Economic Co-operation and Development OECD

A comprehensive set of adaptation indicators covers the following issues: (see Figure 2.5)



Figure 2.5- Description of the adaptation index

## **b. According to ARUP (USA)**

The set of urban resilience index (CRI) that ARUP (USA) has instructed countries, CRI is built on broad research. The indexes are broad: Health and well-being, Economy and Society, Infrastructure and Environment, Leadership and Strategy

### ***2.2.3. Factors affecting climate change adaptability in urban road management***

Urban road network management is the field affected by many factors. If climate change is taken into consideration, the factors that are more likely to impact are: Topographical - natural conditions, Socio-economic factors and construction, Climate change factors of the region, Coordination among stakeholders.

### ***2.2.4. Some requirements in urban road network management adapting to climate change***

- Require integration of climate change adaptation research into urban transport planning.
- Solutions to integrate in the management of urban road networks to adapt to climate change
- Require integration land use planning with transport planning
- Requirements on the capacity of organizing urban traffic management.

## **2.3. Experience in managing urban road networks adapting to climate change of some cities in the world and Vietnam**

### ***2.3.1 Experience of some foreign cities***

In Southeast Asia, there are a number of cities that are also strongly affected by climate change such as Cebu City, Manila, and Bangkok, Thailand. Understanding the management situation of urban areas in road network management adapting to climate change adaptation cities of these cities are also lessons learned for cities in the West coastal region of the Mekong Delta.

### ***2.3.2 Experiences of domestic cities***

With the experience of domestic cities in the thesis, the cities refer to: Can Tho, Da Nang, etc. in order to choose to study the achieved results, the difficult aspects to do lessons for 2 cities in the southwestern coastal town.



## **CHAPTER 3. PROPOSING A NUMBER OF SOLUTIONS TO MANAGE URBAN ROAD NETWORKS IN URBAN CENTERS IN THE SOUTHWESTERN COASTAL REGION OF THE MEKONG DELTA ADAPTING TO CLIMATE CHANGE**

### **3.1. Viewpoints, principles and criteria for managing climate change urban road networks.**

#### ***3.1.1. Viewpoints.***

The thesis proposes the management of road network for urban centers in the southwestern coastal region of the Mekong Delta based on 7 points of view.

#### ***3.1.2. Principles of road network management adapting to climate change***

In order to improve the efficiency of urban road network management in the southwest coastal provinces in the Mekong Delta adapting to climate change, the author proposes management principles based on four bases.

With 4 bases on the 7 points of view mentioned above, the thesis proposes 7 general principles in managing the urban road network adapting to climate change of Ca Mau and Rach Gia cities as follows:

1. Conform with the general planning of urban centers in the region till 2030 with a vision to 2050

2. Comply with the planning for development of urban road networks in the region, ensuring multimodal transportation.

3. Building management models must be flexible and open for integration

4. Based on the specific situation affected by climate change to zoning in urban road management on the basis of which determine the urban road management method for each area. Link land use planning with road network planning, paying particular attention to areas prone to sea level rise and storm surge.

5. The construction of a system of operating centers, information and traffic management must be synchronized and uniform for the whole city. At the same time, promoting community participation is an important element in managing climate change adaptation.

6. In order to reduce greenhouse gas emissions urban areas need to promote the development of public transport systems in the

direction of green transport combined with the organization of walking streets and car routes to reduce greenhouse gas emissions.

7. Select the principle of sustainable development as the basis for the proposal in the management of urban road networks to adapt to climate change.

### ***3.1.3 Criteria for managing urban road network to adapt to climate change***

#### ***3.1.3.1 Basis for proposing criteria***

To propose criteria for managing urban climate change adaptive climate change for urban centers in the southwest coastal region of the Mekong Delta, the author presented in chapter II

#### ***3.1.3.2 The criteria for managing urban road network to adapt to climate change***

From the 4 bases mentioned above, the author proposes the system of urban road network management to adapt to climate change with the following 5 criteria:

- Having long-term GT planning strategy to adapt to climate change
- Consistent with natural terrain conditions and climate change characteristics of the region
- Consistent with local socio-economic conditions.
- Consistent with the characteristics and resilience of the telecom infrastructure
- Consistent with the mechanism and responsibilities of the stakeholders.

### **3.2. Some solutions to manage the urban road network in the southwestern coastal provinces and towns in the Mekong River Delta to adapt to climate change**

The thesis proposes 3 groups of solutions including: Group of zoning solutions, Group of solutions to improve organizational structure, Solutions of policies and mechanisms

#### ***3.2.1. Group of zoning solutions***

##### ***3.2.1.1. Regional zoning for managing urban road networks adapting to climate change***

###### **a. Zoning basis**

Basis of zoning based on: current road network, geology, topography and climate change situation.

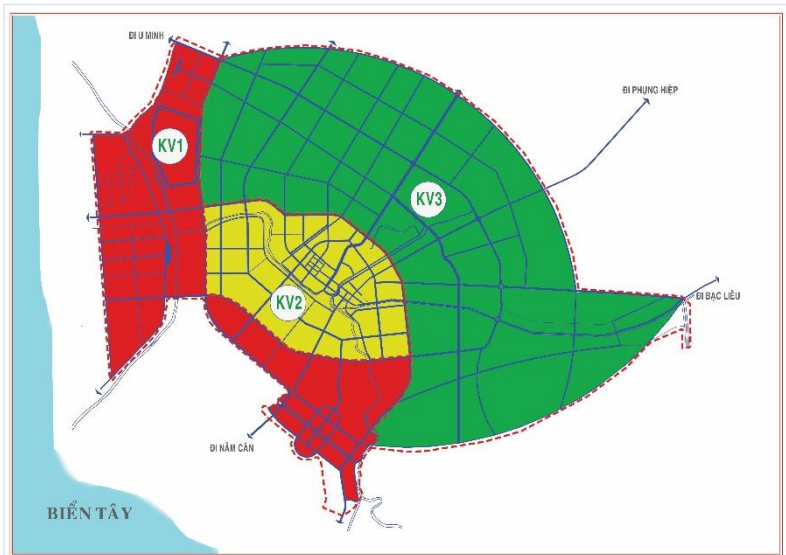
### b. Proposing zoning by region for 2 cities

Proposing solutions to zone into 3 areas:

- Zone 1: The zone near the sea and the zone close to the sea
- Zone 2: The urban center zone
- Zone 3: Peripheral and bordering zone (offshore area)

#### • Regional zoning for Ca Mau city

In order to manage urban road network adapting to climate change, the thesis proposes dividing Ca Mau City into 3 zones (see Figure 3.2).



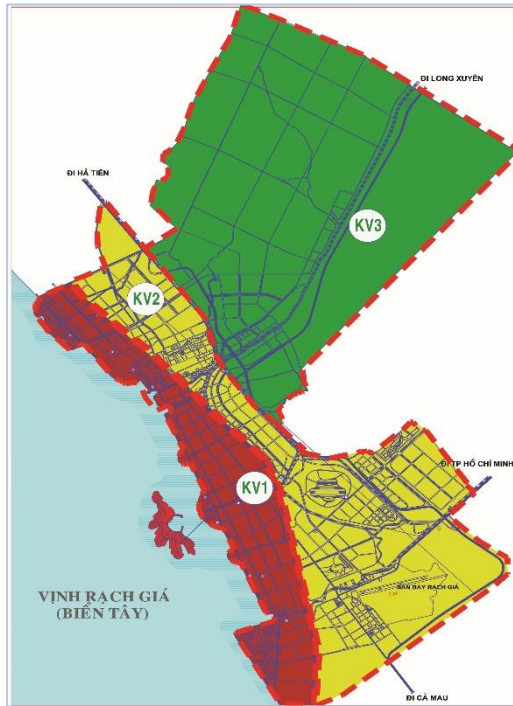
*Figure 3.2. Diagram of zoning for Ca Mau City*

- Zone 1 in red: zone near the sea
- Zone 2 in yellow: Central urban zone
- Zone 3 in green: Peripheral zone (offshore area)

#### • Regional zoning for Rach Gia city

The author of the thesis proposes to divide Rach Gia city into 3 zones (see Figure 3.3).

- Zone 1 in red (Coastal area)
- Zone 2 in yellow (Central urban area)
- Zone 3 in green (outskirts of city and border)



*Figure 3.3- Diagram of the Rach Gia city zoning*

### *3.2.1.2 Solutions to manage urban road adaptation to climate change for each area of Ca Mau city and Rach Gia*

#### **a. Management solutions in 3 zones of Ca Mau city**

##### **• Zone 1 - zone near the sea**

Zone 1 is a new urban area close to the sea, a new urban area along the center of the city. However, Ca Mau has not paid much attention to climate change, especially without climate change integration in urban planning and construction, but it is especially near the sea, which is highly affected by climate change compared to other areas in the municipality of the region. Therefore, for this zone 1, the thesis proposes solutions: Solutions to organize traffic and complete the road network, Solutions to develop protection forests to prevent landslides.

- **Zone 2-central area**

It is the central urban area of the city which is the home of administrative agencies built during the French period, high population density, narrow roads, low road surface elevations, storm water drainage and general sewerage systems, old drainage systems often inundated locally, planning and construction of urban roads only for cars and motorbikes, no roads dedicated to public transport and bike lanes, using sidewalks as walkways. In this condition, the thesis proposed solutions for the central area (zone 2) are: *Technical solutions and improving the road network; Organizing transport links between public transport and non-motorized traffic; Restoring the order of urban roads that ensure pedestrian sidewalks*

- **Zone 3 - the periphery of the city and its borders**

The thesis proposes to organize the management of road network of Zone 3 as follows:

- Connect the road traffic network with waterway traffic due to the characteristics of the Mekong River Delta
- Organize bus routes to suburban commune / ward centers.
- Connect bus stations with ferry stations across and across waterways.
- Construction of river / canal embankments to protect the roads since most of the roads are parallel to canals.
- Mobilize people to plant trees, following the routes in order to reduce landslides and reduce the temperature of direct contact with the road surface.

## **b. Solution to manage 3 zones of Rach Gia city**

- **Zone 1-area close to the sea**

This is an area with many new urban areas, mostly sea encroachment, located in the West of the city (**close to the sea**), the areas mostly affected by the climate change due to its location along the coast and two large estuaries flowing directly into the sea, the connection of traffic infrastructure between new urban areas and the old urban areas due to the difference in elevation on average of over 50cm. Although it is a new urban area, road network has not paid much attention to climate change factors. Therefore, the thesis proposes: *Solution of planning and improving the road network; Solutions of breakwaters along the West coast of Rach Gia city to*

*adapt to climate change, Building 3 sluice gates to prevent saline intrusion into the southwestern sea.*

• **Zone 2- old urban area of the city**

This is an area with quite dense road and high population density, narrow road system, an area with many administrative agencies, and relics Nguyen Trung Truc communal house, commercial centers, so the traffic is often congested. Traffic jam in this area happens during the festive seasons. Roads and drainage systems are seriously degraded. In this area, the thesis proposes: *Planning and renovating roads, planting new trees, improving drainage systems and restoring urban traffic order.*

• **Zone 3 - periphery of the city (offshore). The thesis proposes:**

- Build more salt sluice gates along the city at river mouths directly to the sea

- The network planning to adjust the road network in the region must ensure adaptation to climate change in association with the network of road and canal network.

- Constructing the rural road network system according to the new rural standards and using new material technologies so that the roads are capable of adapting during high tide and floods.

-There is a solution to connect personal vehicles when participating in traffic with the bus network with horizontal and vertical ferry routes of waterway transport.

*3.2.1.3. Urban road network planning associated with land use planning integrated with climate change adaptation.*

Traffic planning is associated with land use planning in relation to the process of controlling urban land use density, reducing the traffic land use density along canals, ditches and coastal areas at risk landslides, mangroves, and tides change to create green patches and buffer zones along rivers and canals.

*3.2.1.4. A number of other proposals in the road network adaptation planning solution.*

a. Solution of planning and managing the road network in the direction of green traffic adapting to climate change

b. Review technical standards for planning and engineering in road design taking into account the climate-specific factors of the region.

### 3.2.2. Group of solutions of organizational structure improvement

Management of urban road network planning of Ca Mau City and Rach Gia City is shown as the diagram in Figure 3.12

- In fact, there are many limitations: Maintenance, investment capital for the road network, not integrating the road network planning to adapt to climate change, the road network management personnel adapting to the climate change are not trained thoroughly in road network management to adapt to climate change.

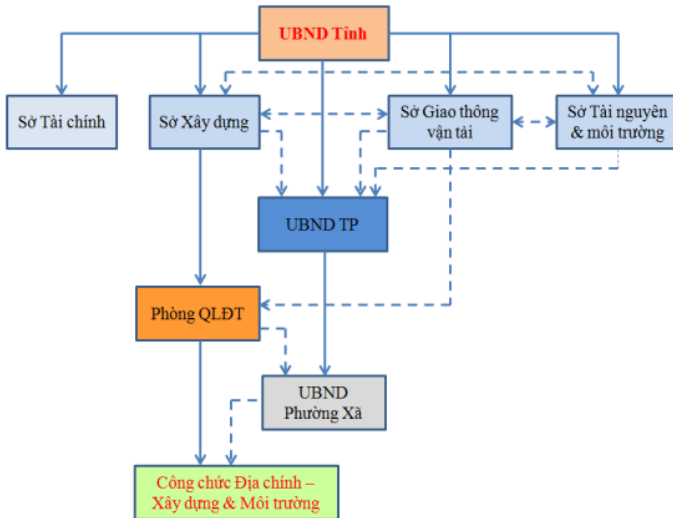


Figure 3.12 - Organizational chart of urban road management agency in the southwest coastal town

The Urban Management Division is the advisory unit for the City People's Committee on urban road management, but the duties and powers are very limited, depending mostly on the Department of Transport in allocating maintenance funds and plans.

3.2.2.1. Solution of decentralization to manage urban road networks in southwestern coastal provinces and towns in the Mekong Delta region to adapt to climate change

According to Circular No. 04/2008 / TT-BXD dated February 20, 2008 on Urban Road Management issued by the Ministry of Construction, which has been applied and implemented.

*3.2.2.2. Solutions to improve the function of the Urban Management Division in the urban centers of the southwest coastal provinces in the Mekong Delta region to adapt to climate change*

a. General solutions for urban management division

The thesis proposed general solutions for urban management office of 2 cities of Ca Mau and Rach Gia to form specialized groups suitable to the functions and duties of the room based on the coordination of experts in teams and strengthening professional training of managers involved in managing climate change adaptation to climate change.

b. Specific solution for urban management division

As the two cities have similarities in nature, planning, institutions, policies, and organizational structures, there is a clearer division of responsibilities and the responsibilities of each specialist are clearer and more affected of climate change. The thesis proposes an organization chart and functions and duties of the Urban Management Division of 2 cities including 15 staff members with organizational structure:

+ Leaders include: 1 manager, 3 deputy heads

+ Technical staff: 3 specialized groups, 1 Computer Center, 1 Urban Order Team.

This is a good structure for two cities in the southwestern coastal region of the Mekong Delta that the provincial towns in the Mekong Delta should refer to.

c. Enhancing the capacity of the officials of the Department of Construction, Department of Transport, Department of Natural Resources and Environment, and the Office of Investment and Management of the 2 cities in managing climate change adaptation.

In training and retraining programs for leaders and experts of the Department of Transport, the Department of Construction, the Department of Natural Resources and Environment, the City Urban Management Department shall be equipped with management knowledge in urban road network adapted to climate change.

***3.2.3. Proposal to supplement regulations on mechanisms and policies***



### *3.2.3.1. Proposal to supplement regulations on mechanisms*

- a. Coordination between the parties has a focal point of primary responsibility
- b. Strengthen monitoring and evaluation of traffic environment in urban areas

### *3.2.3.2. Proposal to supplement the policy regulations*

Management policy is a core and important step, it determines the management efficiency of the city, affecting the whole region. The thesis proposes specific policies to implement related tasks.

### ***3.2.4. Mobilize community participation in the management of climate change urban road networks***

In order to build and manage an urban road network, community participation is important. Therefore, the thesis proposes:

- a. Close coordination between the government and the people
- b) Increasing the awareness of the community in obeying traffic rules and adapting to climate change

### **3.3. Discussion the findings**

From the research findings, the thesis discusses in the following 5 issues:

1. Discussing criteria for managing urban road adaptation to climate change.
2. Discussing urban road network planning in association with climate change adaptive land use planning for the southwestern coastal towns of the Mekong Delta.
3. Discussing urban zoning by region to manage the urban road network to adapt to climate change.
4. Discussing the organization of urban road management apparatus in urban centers in the southwestern coastal region of the Mekong Delta adapting to climate change.
5. Discussing the improvement of the organization of urban management division in Ca Mau and Rach Gia cities.

## CONCLUSION AND RECOMMENDATION

### • CONCLUSION.

The Mekong River Delta plays an important role in socio-economic development, environmental protection, security and national defense, but it is also an area heavily affected by climate change, including 2 southwest coastal cities. The research of the topic "Urban road network management in the southwestern coastal provinces in the Mekong Delta to adapt to climate change" is very necessary. Findings of the thesis include:

\* Systematically identify the characteristics of the southwestern Mekong Delta provincial urban centers that are the factors affecting the management of urban road adaptation to climate change. On that basis, build a scientific basis in managing urban road adaptation to climate change

\* With the current condition of managing urban road network adapting to climate change, the thesis has proposed 5 criteria suitable to the direction of sustainable urban development and climate change adaptation.

\* Based on the specific characteristics of urban centers in the southwestern coastal region of the Mekong Delta, the thesis has proposed the division into 3 zones to have solutions to manage urban road adaptations to climate change for each zone including area close to the sea, central area and offshore area.

\* The thesis has studied the proposal of more decentralization for cities in the southwestern coastal region of the Mekong Delta in the management of road network, namely: The roads inside the urban areas are managed by the urban authorities to overcome the issue in which too many different regulatory bodies participate in the management, leading to overlap and failure to clarify responsibilities. At the same time, propose the organizational structure and policy mechanism in managing urban road adaptation to climate change for two cities in the southwestern coastal province of the Mekong Delta, namely Ca Mau and Rach Gia cities.

\* Awareness raising with the participation of the community in the management of urban road adaptation to climate change for the two provinces.

- **RECOMMENDATION**

1). Recommendations to the Ministry of Construction and the Ministry of Transport

- Urban road network planning should be included in the road network research work. Therefore, it should be considered in the strategic directions of the Ministry of Construction when linking transport planning work with land use planning integrated with climate change. It should be included in standards and regulations for implementation and management.

- There should be a plan in training to improve the capacity of the officials and specialists in the field of transport and new knowledge about the management of urban road network adapting to climate change. Strengthen facilities, equipment and update possible modern equipment to better serve the urban road network management system at all levels to adapt to climate change.

2). Recommendations to municipal governments in the Mekong Delta region

- It is necessary to reorganize the Urban Management Division under the City People's Committee with the professional division according to the functional tasks assigned to the division. It must allocate full-time staff, this helps to make the administration clear and the responsibilities of each specialist are more specific. Especially in the functions and duties of the department, it is necessary to pay attention to climate change work.

- In many solutions to adapt to climate change for coastal cities of Ca Mau and Rach Gia, for coastal protection forest development and the city greening program to adapt to climate change, cities can mobilize people to participate in planting and protecting protection forests, planting new street trees. It is a very effective solution. This will make the city greener, more beautiful and also a solution to climate change. Planting many trees and developing coastal protection forests with the participation of the community needs the determination of the whole political system.