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ISET

CLIMATE ACTION PLAN FOR HUE CITY

Responding to Climate Change From 2014–2020

VIETNAM
September 2014

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LIST OF ACRONYMS

M-BRACE	Mekong-Building Climate Resilient Asian Cities
USAID	United States Agency for International Development
ISET	Institute for Social and Environmental Transition
NTP-RCC	National Target Program to Respond to Climate Change
SP-RCC	Support Program to Respond to Climate Change
UNISDR	United Nations International Strategy for Disaster Reduction
LGSAT	Local Government Self-Assessment Tool
JICA	Japanese International Cooperation Agency
KOICA	Korean International Cooperation Agency
MPI	Ministry of Planning and Investment
MONRE	Ministry of Natural Resources and Environment
DONRE	Department of Natural Resources and Environment
DOC	Department of Construction
DOLISA	Department of Labors, War Invalids and Social Affairs
CFSC	Committee for Flood and Storm Control
NGO	Non-governmental organization

Photo credit: Richard Friend, ISET-International

SECTION 1
INTRODUCTION

Hue City is the economic, cultural and political center of Thua Thien Hue province, and is also one of the areas most sensitive to climate change in the central region of Vietnam. The city often suffers from the severe impacts of floods, droughts and storms. In recent years, the intensity and frequency of these extreme events has increased and become more unpredictable. An extreme one-day rain event in 1999, when nearly 1,000mm of precipitation fell (2 November 1999), equal to almost 30 percent of the average annual precipitation, led to a historic flood that claimed 352 lives, injured 305 people and caused approximately VND 1,700 billion (> USD 950,000)[1] in damage. Current climate change projections suggest natural disasters will increase in complexity and severity in the future. At the local level, according to the 2011 Vietnam Climate Change Scenarios, sea level in Thua Thien Hue could rise by up to 94cm by 2100. All of these factors will continue to seriously affect the lives, income and health of local people, as well as the ecosystems and infrastructure systems of Hue City as they have done in the past.

The Mekong-Building Climate Resilient Asian Cities (M-BRACE) project officially started in Hue City in March 2012 to build climate change resilience. The United States Agency for International Development (USAID) funds this project, with technical support from the Institute for Social and Environmental Transition-International (ISET-International), under the direction of Thua Thien Hue province and the leadership of Hue City. One of the most significant products of this project is the Action Plan to Respond to Climate Change in Hue City (Action Plan).

This Action Plan was developed in accordance with the goals of the Vietnam National Target Program to Respond to Climate Change (NTP-RCC) and the Action Plan to Respond to Climate Change of Thua Thien Hue province. M-BRACE's core technical group developed the Action Plan with technical support from ISET-International.

THE HISTORIC FLOOD IN 1999 IN HUE

Photo Credit: Sai Gon Giai Phong Newspaper

1. LEGAL BASIS

The Action Plan was developed under the national and provincial framework policies on responding to climate change. The legal framework incorporates the following legislations:

- Decision no. 172/2007/QD-TTg dated 16 November 2007 by the Prime Minister of Vietnam approving the National Strategy for natural disaster prevention, response, and mitigation until 2020;
- Decision no. 158/2008/QD/TTg dated 2 December 2008 by the Prime Minister approving the National Target Program to Respond to Climate Change;
- Decision no. 2139/QD-TTg dated 5 December 2011 on the National Strategy on Climate Change;
- Decision no. 1474/QD-TTg dated 5 October 2012 by the Prime Minister issuing the National Action Plan on Climate Change period 2012-2020;
- Instruction no. 35/2005/CT-TTg dated 17 October 2005 by the Prime Minister on Implementation of the Kyoto Protocol under the United Nations Framework Convention on Climate Change;
- Document no. 3815/BTNMT-KTTVBDKH dated 13 October 2009 by the Ministry of Natural Resources and Environment on Guidance Framework for the Development of the Action Plan to Respond to Climate Change;
- Decision no. 313/QD-UBND dated 5 February 2013 approving the Action Plan to Respond to Climate Change of Thua Thien Hue Province until 2020;
- United Nations Framework Convention on Climate Change and Decision no. 47/2007/QD-TTg dated 6 April 2007 by the Prime Minister approving the Plan to Implement the Kyoto Protocol period 2007–2010;
- Law no. 52/2005/QH11 on Environment Protection, 2005;
- Decision no. 256/2003/QD-TTg dated 2 December 2003 by the Prime Minster approving the National Strategy for Environment Protection until 2010 and orientation until 2020;
- Decision no. 153/2004/QD/TTg by the Prime Minister issuing the Strategy for Sustainable Development of Vietnam; and
- Decision no. 79/2006/QD-TTg dated 14 April 2006 by the Prime Minister approving the National Target Program on Economical and Effective Use of Energy.

2. RATIONALE

Hue City, located in Thua Thien Hue province, is situated next to the Huong River close to the ocean, making it highly susceptible to severe climate events. The city is prone to the serious impacts of natural disasters such as storms, floods, droughts and saline intrusion. According to statistics, from 1990 to 2011, floods alone cost up to VND 8,319.5 billion in damage and caused 594 deaths.[2]

This situation is expected to become more serious in the future due to the impacts of global climate change, including higher temperatures, changes in precipitation (decreasing dry season precipitation and increasing rainy season precipitation), sea-level rise and more extreme weather events. According to the 2011 Vietnam Climate Change Scenarios, average daily summer temperature in Hue City may increase by as much as 1.4°C by 2050 and 3.1°C by 2100; sea levels could rise by up to 94cm by the end of the century. This will exacerbate existing problems facing the city and will lead to severe impacts on local people's health and living standards, and on the city's economic development objectives.

For these reasons, it is critical to reduce the city's vulnerability to climate change and build resilience. This was confirmed by the major national and provincial policies, such as the National Target Program, the National Strategy to Respond to Climate Change and the Action Plan to Respond to Climate Change of Thua Thien Hue province.

The Action Plan will help Hue sketch out a direction for addressing major issues related to its vulnerabilities, including:

- Identifying priority measures or sets of measures to adapt to climate change suitable for the short, medium and long term.
- Assigning roles and responsibilities for stakeholders and working out mechanisms for coordination across sectors and levels.
- Identifying the budget needed for implementation and developing a plan for mobilization of this budget.

3. GOAL AND OBJECTIVES

Goal

The goal of the Action Plan is to strengthen the resilience of Hue City to climate-related disaster risks, in order to secure people's lives and socio-economic development objectives.

Objectives

- Identify priority issues related to the vulnerability of agents and systems, and identify priority interventions for the short, medium and long term;
- Improve the awareness and capacity of related organizations, departments, agencies and civil society organizations and the community on climate change impacts, and assist them in developing and implementing Action Plans to respond to climate change;
- Prepare guidelines and promote the integration of climate resilience into policies and plans, such as sectoral development plans, urban development plans and city socio-economic development plans;
- Reinforce institutional structures and regulations related to climate change; and
- Establish mechanisms for sharing information across levels and sectors, and develop a systematic climate change database.

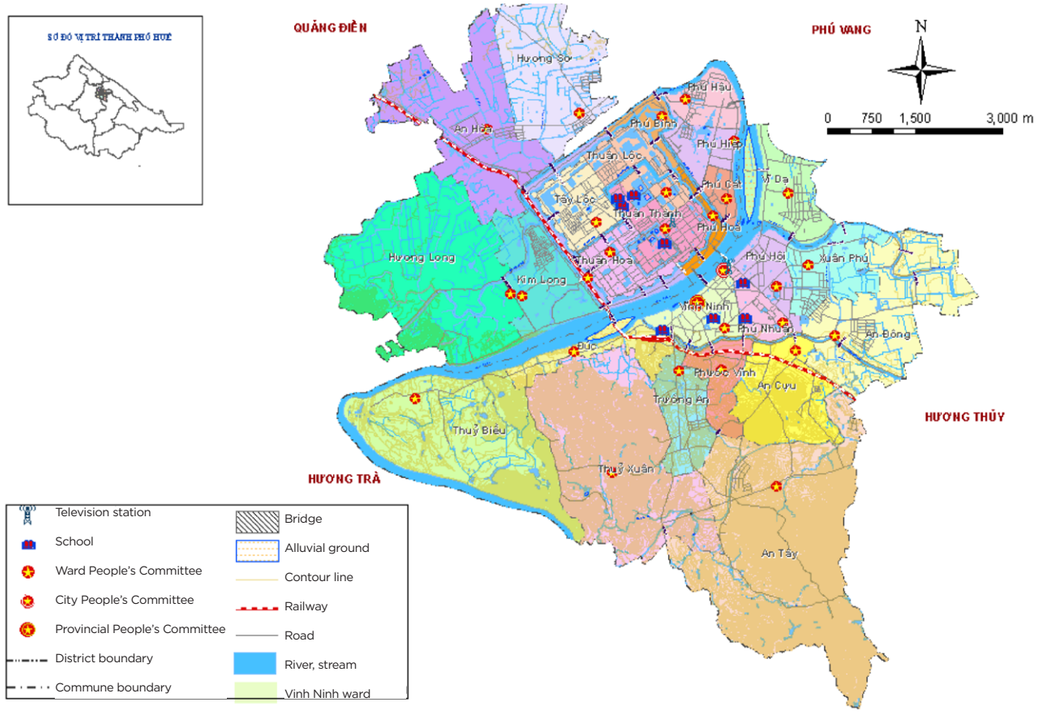
4. BACKGROUND OF HUE CITY

4.1. Geography and climate

Location

Hue City is the central city of Thua Thien Hue province. It has an area of 7,099 hectares, accounting for 1.4% of the province's area. The city is located at longitude of 107°31'45''–107°38' east and latitude 16°30'45''–16°24' north. It borders Huong Tra town, Quang Dien district to the north; Huong Thuy town to the west and south; and Phu Vang district to the east (Figure 1).

FIGURE 1
ADMINISTRATIVE MAP OF HUE CITY (2012)

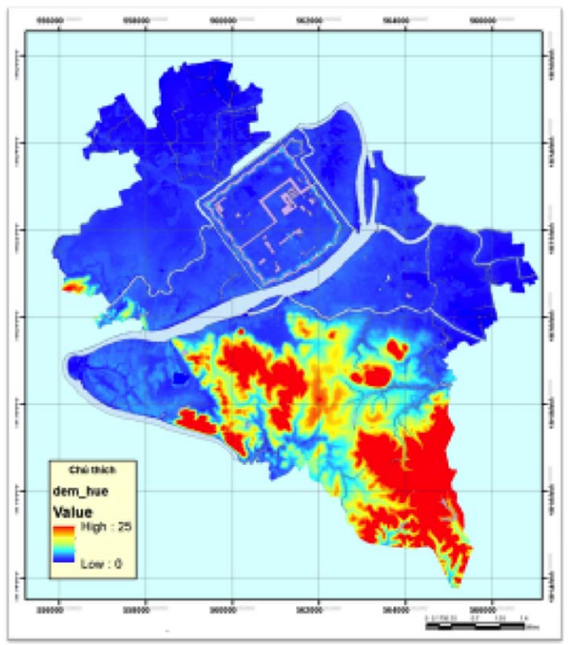


Topography[3]

Hue is located on a narrow plain sloping steeply from the west to the east. The central area of the city was built on a narrow strip of flood plain, on the downstream section of the Huong River. There are two types of terrain (Figure 2):

- Low eroded hills on deeply weathered sedimentary rocks, concentrated in Thuy Xuan and An Tay wards to the west of Hue City.
- Depositional plains concentrated to the north and east of the city. There are two main areas: the northern and southern areas of the Huong River.
  - The northern area of Huong River is flat. The Citadel area has an elevation of +1.8m to +3.5m. Phu Hiep and Phu Cat wards have an elevation of 2.7m to 3.5m. Areas with elevation of less than + 2.0m are frequently flooded.
  - The southern area of the Huong River has a fairly broad elevation range of +2.5m to +7.5m. There are flat hills with elevation of +12.0m to +18.0m, in contrast to rice fields and lakes with elevation of <+1.5m.

FIGURE 2
DIGITAL ELEVATION MAP OF HUE CITY–2009 (HUE GIS DATABASE)



Climate

Hue City is located in the transitional climate zone between the north and the south of Vietnam. The climate has a range of weather patterns with the typical characteristics of a tropical humid monsoon climate. The city is considered to be one of the most severely-affected areas in Vietnam climate-wise. In summer or the dry season (from May to September) the temperature remains fairly high with southwest winds that make the air very dry. The average temperature in summer months is 27–29°C, with the temperature in the hottest months (May and June) reaching 38–41°C. In winter or the rainy season (from October to April) the city is often influenced by northeast monsoons, which generate considerable rainfall and significantly decrease the temperature. The average temperature in the winter months ranges between 20°C and 22°C.

Hue experiences one of the highest precipitation rates in Vietnam. The average annual precipitation fluctuates around 2,800mm. However, precipitation distribution is unequal across the months and is mainly concentrated in the rainy season, especially October and November (with over 30 percent of annual precipitation). In some years, total precipitation during this period can be remarkably high. For instance, in November 1999 precipitation was 2,452mm out of the total average annual precipitation of 3,093mm.[4]

Hue also has fairly high humidity with an average annual level of 85–86 percent. Two types of monsoons influence the city: the southwest monsoon (from April to July, causing hot and dry weather with high evaporation and prolonged drought), and the northeast monsoon (from September to March, accompanied by rain causing cold and wet weather and floods).

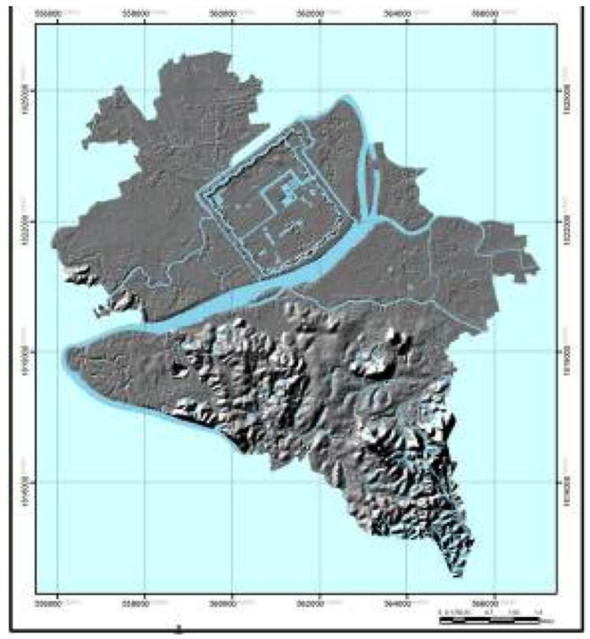
These climate characteristics are making droughts and floods in Hue increasingly more severe.

Hydrology

Hue City is directly affected by the hydrological regime of the Huong River system, the largest river system in Thua Thien Hue province. The Huong River has three tributaries—the Bo, Ta Trach and Huu Trach—originating from the slopes of the Truong Son range (Figure 3), and running through the center of Hue City. Its basin covers an area of 2,830km^2, about 56 percent of the area of the province. Its main course is 104km long, with average elevation of 330m, and an average gradient of 2.85 percent. Its basin length is 63.5km, average basin width is 44.6km and drainage density is 0.6km/km^2.

South of the Huong River, there are interconnected branches of the An Cuu and Nhu Y rivers as well as the Phat Lat Canal, which create a complete natural drainage network. North of the Huong River are the Bach Yen and An Hoa river branches and the Ngu Ha and Ho Thanh Hao rivers as well as a series of interconnected lakes that function as natural flood mitigators for the Citadel area.

FIGURE 3
HYDROLOGICAL NETWORK OF HUE CITY 2009 (BASED ON GIS DATA OF HUE CITY)

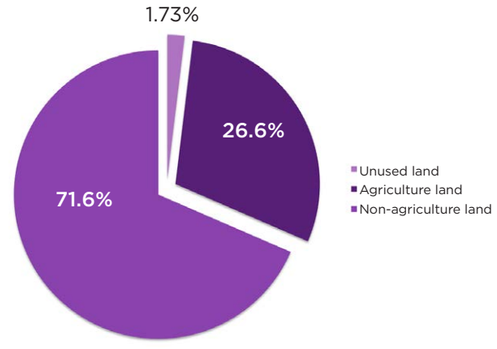


Land resources

According to the 2012 land inventory report, Hue City had an area of 7,099ha, comprising 1,908.7ha of agricultural land (26.6 percent of the total city area); 5,135.6ha of non-agricultural land (71.6 percent); and 24.2ha of unused land (1.73 percent).

DIAGRAM 1

LAND USE STRUCTURE OF HUE CITY IN 2012



From 2011 to 2012, the agricultural land area in Hue City decreased by 40.94ha. This included rice land, which decreased by 39.64ha due to urban development (housing and public facilities) under the An Van Duong urban area project (in An Dong ward). According to the inventory report, non-agricultural land increased by 5.78ha after the conversion of 5.04ha of rice land, 0.03ha of annual crop cultivation land and 0.66ha of perennial crop cultivation land. At the same time, 2.4ha of residential land were converted for transportation to make way for new roads by the Ngu Ha River and for the expansion of Dien Bien Phu Road. Another 0.06ha of residential land were also converted for commercial and industrial purposes.

Water resources

Hue City's main surface water supply is the Huong River, its branches, and 48 lakes of various sizes, including some important lakes in Thuan Loc, Thuan Hoa, Tay Loc and Thuan Thanh wards. In Thuan Loc ward there are Tinh Tam, Hoc Hai and Sen (Cay Mung) lakes; in Thuan Hoa ward there are Vo Sanh and Tan Mieu lakes; and in Tay Loc ward there are Moc Duc and Huu Bao lakes. In addition, surrounding the Citadel, there are the inner and outer Kim Nguu lakes. In terms of groundwater, underground aquifers are distributed throughout the city, with thickness varying from 12m to 22m. The amount of water in each aquifer ranges from poor to average, depending on its source. The water is fresh, with static water levels very shallow, varying from 0.1m to 5.5m.[5]

Regarding domestic water supply capacity, according to documents released in 2008 by the National Centre for Rural Water Supply and Sanitation, the rate of water supply in Hue City was quite high sitting at 95 percent. Raw water is taken from the Huong River for the Van Nien, Quang Te 1, Quang Te 2 and Da Vien water plants.

4.2. Socio-Economic conditions

Population

According to statistics, the population of Hue City in 2011 was 342,550 people, accounting for 31.01 percent of the provincial population. Population density in the city was 4,778.9 people/km^2, 21.8 times higher than the average level of the whole province. Phuoc Vinh ward had the highest density at 20,705 people/km^2 and Huong Long ward had the lowest density at 1,411 people/km^2. Population distribution was uneven. An Cuu was the most populous ward with 22,620 people, while Phu Hoa ward had only 5,792 people[6]. The urban population increased by about 100,000 people in the ten-year period from 2001 to 2011, while the rural population decreased from about 60,000 people in 2001 to about 32,000 people in 2008.[7]

According to a 2009 survey assessing poor and near-poor households in Hue City (new poverty line for 2011–2015), the city had 3,333 poor households (or 4.84 percent of households) and 3,344 near-poor households (or 4.85 percent of households). The wards with the highest poverty rates included An Hoa, An Tay, Huong So, Phu Binh, Phu Hau, Phu Hiep, Huong Long, Thuan Loc, Thuy Bieu, Thuy Xuan and Vy Da.

Economic and labor structures

Hue City has a fairly abundant labor force. In 2011, the number of employees in the economic sectors was about 198,480 people, representing 57.9 percent of the population (Table 1). Over the past several years, the economic and labor structures have been changing rapidly with an increase in tourism and services and a decrease in industry, handicrafts and agriculture. Employment in the service sector increased from 55.05 percent in 2005 to 72.23 percent in 2011, while the agriculture sector decreased rapidly from 17.3 percent in 2005 to 12.43 percent in 2011. At the same time, employment in the industrial and construction sectors also decreased from 27.64 to 15.34 percent. These figures confirm the current significance of the service sector and the importance of its role in the future economic development of Hue City.

TABLE 1

EMPLOYMENT AND CHANGES IN LABOR STRUCTURE IN HUE

Sector	2005		2011	
	Total (people)	Proportion (%)	Total (people)	Proportion (%)
Total	**112,413**	**100**	**125,714**	**100**
Agriculture, forestry and fishery	19,464	17,31	15,635	12,43
Industry and construction	31,070	27,64	19,188	15,34
Services	61,879	55,05	90,891	72,23

Education, Health, and Culture

Education

Hue City is one of the major training centers of Vietnam—Hue University is one of Vietnam's regional universities. Over 95,000 students attend each year. The city also offers a range of other tertiary education institutions, including Hue Academy of Music, Phu Xuan University, central-level institutes and academies, three colleges, three technical schools and dozens of vocational training schools and training institutions on information technology and foreign languages.

Healthcare

Hue is one of three specialized health centers of Vietnam. Hue Central Hospital and Hue College of Medicine and Pharmacy have a total of 2,600 beds. In addition, 44 clinics (including three private hospitals) have a total of 3,306 beds. The ratio of hospital beds to population in Hue is relatively high at 10.3 beds/1,000 persons.

Culture

Hue is one of the major cultural centers of the country with a massive network of cultural venues, including the old capital city of Hue (which was recognized as a world cultural heritage site in 1997), historical and war sites (33 national- and three provincial-level sites), dozens of large pagodas with strong architectural and artistic values built over 300 years ago, four museums, three specialized cultural houses and 25 ward-level cultural and information establishments.

4.3. Water supply infrastructure

The water supply system consists of Da Vien and Quang Te water plants, Van Nien pumping station and more than 200km of main pipelines and conduits. Water is extracted from the Huong River and distributed at an average capacity of 100 liters/person/day. The future demand of the city's residents is expected to be met by the continuing use of Quang Te plants 1 and 2, as well as the construction of the Quang Te 3 plant. (The city aims to supply 150–200 liters/person for 95 percent of the population by 2020, and 220 liters/person for 99 percent of the population by 2030.)[8]

The drainage system has 123.8km of main sewer pipes (65.5km in the northern area and 60.33km in the southern area of the Huong River). The current sewerage system has a capacity of about

45,000–50,000m³/day, of which 80 percent is urban wastewater and 20 percent is industrial wastewater. The rate of wastewater collected and treated is only 30–40 percent (only at 50 percent of the 80 percent standard set for a grade I city). The city does not have a separate drainage system for rainwater, domestic sewage and industrial wastewater. Only 13 percent of wastewater is discharged into the sewage drains, and most of the remaining wastewater is discharged directly into the Kim Long, Bach Yen, Ngu Ha, An Cuu and Huong rivers before entering the sea, thereby polluting ecosystems, especially the water source of the Huong River.[9]

Over the past several years, the city had invested in building and dredging the canals, sewers and riverbeds in the city, thus gradually improving the drainage system (see the list of the city's drainage projects in Appendix 3). However the flood problem has not been completely solved and some places in the city, such as Thuan Thanh, Thuan Loc, Phu Cat-Phu Hiep-Phu Hau, and Xuan Phu still flood during prolonged periods of heavy rain. The school system (including 11 kindergartens, 28 primary schools, and 22 secondary and high schools) and health centers have also received investment to build more floors, and to meet required standards. The transport system has also been improved, with an upgrade of roads in the west of the city and Tu Duc-Thuy Duong Road[9].

The city has also built new resettlement areas for the 1,069 households in the floating community on the Huong River. Plans for new urban areas have been developed and implementation has commenced. The new urban areas include the Tay An Hoa at 260ha, Con Da Vien area at 11ha, Thuy Bieu at 500ha, and an urban area in the north of the city (Huong So and An Hoa wards) at 700ha.

4.4. Socio-economic and spatial development plans by 2020[10]

Development objectives

- Preserve and promote the heritage values of the old capital city of Hue; build a city with appropriate spatial organization; develop urban architecture that harmonizes with nature; and implement modern technical infrastructure suited to the roles and functions of a city with unique ecological, natural and cultural heritage characteristics.
- Upgrade Hue City and its surrounding areas to make it one of the six central-level cities of Vietnam.

Socio-economic targets

- **Population**: 615,500 people by 2020, with an urban population of 521,200 and an urbanization rate of 84.7 percent.
- **Population of each region:**
  - 211,900 people (urban population: 192,500) in the north of Hue;
  - 246,200 people (urban population: 213,200) in the south of Hue;
  - 59,800 people (urban population: 47,000) in Huong Thuy;
  - 36,700 people (urban population: 20,000) in Thuan An;
  - 53,700 people (urban population: 42,500) in Tu Ha; and
  - 7,300 people (urban population: 5,900) in Binh Dien.
- **Working population**: By 2020, the working age population and the number of employed are expected to be 340,632 and 274,010 respectively; the unemployment rate is predicted to decrease from 5.3 percent in 2011 to 4.9 percent in 2020.

Orientations for technical infrastructure development

The targets for technical infrastructure development are listed below:

Urban transportation: By 2020, street density will be 3.0–3.5km/km², an increase of 1.5 times compared to 2009; roadway infrastructure usage rate will be 20–25 percent (compared with 5–10 percent in 2009) and the rate of public means of transport will be 25–30 percent (no statistics are available for 2009).

Disaster prevention facilities: By 2020, the city will have upgraded drainage works, dredged and re-enforced the Huong, Nhu Y and An Cuu rivers, installed a new rainwater drainage system and built new pumping stations and floodwater retention lakes.

Water supply: By 2020, 100 percent of the urban area will have access to potable water supply.

*Drainage***:** By 2020, drainage capacity in urban areas will be 85 percent and 100 percent by 2030.

Waste treatment: By 2020, the waste collection rate is expected to be 100 percent while the waste treatment rate will be 90 percent.

Spatial development plan

According to the urban development plan, the expanded Hue City will cover an area of approximately 348.5km² and will comprise the existing Hue City (70.99km²), the development areas in Huong Thuy and Huong Tra towns and part of Phu Vang district (Thuan An town and neighboring communes).

Functions of the city

Hue City will become a political, economic, cultural, scientific and technical center for Thua Thien Hue province, which is currently striving to become a central-level city. The city will serve as a large and unique central Vietnamese city in terms of culture; tourism; science and technology; specialized healthcare; a high quality multisector education venue for Vietnam and the Southeast Asia region; and an interactive economic hub for the region.

Orientations for urban development

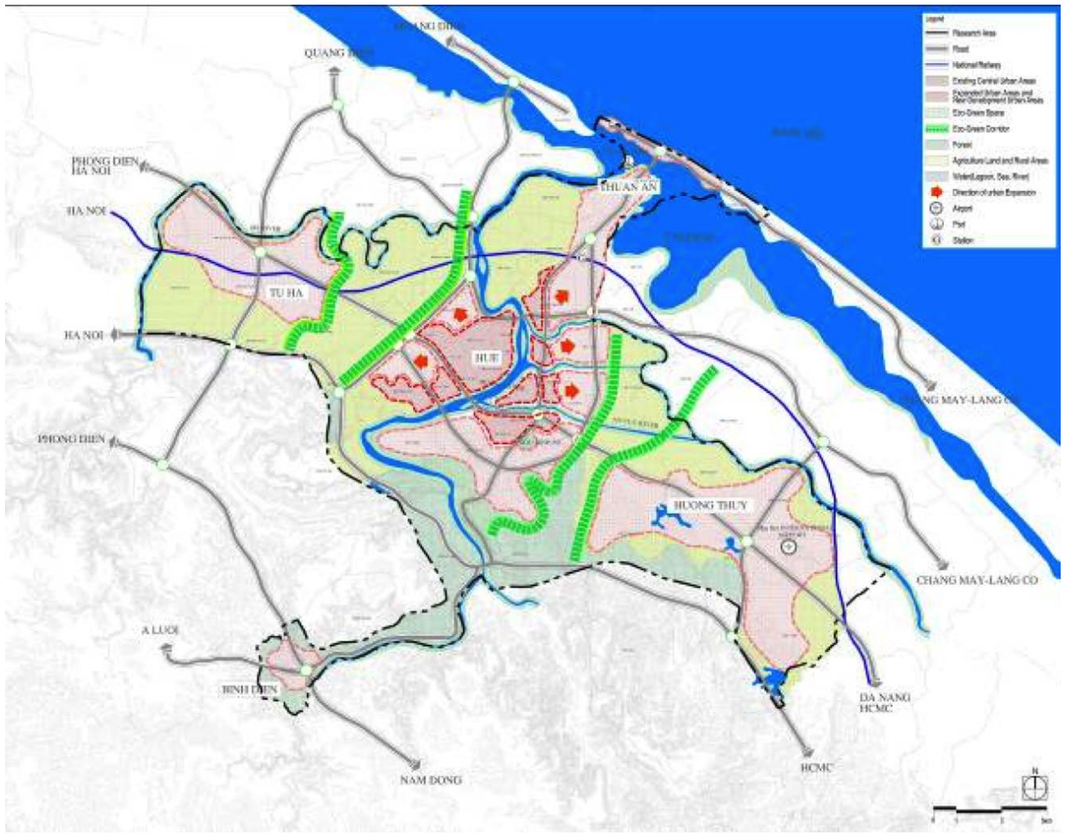
- The existing functions of the city as a service, tourism, healthcare and administrative center will be further strengthened. The expanded urban area will also be strengthened to provide services for the city as a whole, including educational facilities, intellectual industry, ecotourism and healthcare.

Hue City and its environs have historic and natural resources that need protection, including historical sites, lagoons and agricultural land. Priority will be given to preserving ecological reserves and historical conservation areas; the development of new areas will take place on or near agricultural land. Further study on the urban spatial structure of the city will be conducted to ensure an effective urban plan is developed.

The Action Plan will focus on developing the North-South axis, where construction has already been approved in the City Master Plan. It will also prioritize renovating the existing urban residential areas in Hue City.

- Functional urban areas:
  - Huong Thuy, functional city 1: to provide the multiple services of an industrial center, to be the southern gateway of Hue City, to provide public services to Hue City and the Huong Thuy area, to develop residential, industrial, tourism and service sectors.
  - Thuan An, functional city 2: to be a tourist center and a maritime trading gateway for the City, to provide public services to Phu Vang area and other specific functions such as developing sea and lagoon ecotourism as well as buffering the development of high-density residential areas. Further investigation on urban development in low-lying areas such as An Van Duong should be conducted.
  - Huong Tra, functional city 3: to provide basic industrial functions such as manufacturing and production, with Tu Ha industrial zone as a hub; provide public services for Huong Tra area.
  - Binh Dien, functional city 4: to connect Hue City to the western area of Thua Thien Hue province, and to serve as a center in the future western area of Thua Thien Hue City. The hilly terrain will be taken full advantage of in developing mountain tourism. Binh Dien area will be gradually urbanized, and the city will also provide public services to surrounding areas.

FIGURE 4
SPATIAL DEVELOPMENT ORIENTATIONS



Endnotes

1. Oanda exchange rate on 2 November 2009: VND17,835/USD1.00, see: http://www.oanda.com/currency/converter/.
2. Office of the Steering Committee for Flood and Storm Control of Thua Thien Hue province.
3. Hue City Climate Vulnerability Assessment Report under project "Mekong-Building Climate Resilience Asian Cities (M-BRACE) in Hue City".
4. Nguyen Viet & Phan Van Hoa, 2000. Climate change during the last 100 years and projections for flood season of 2000. Science and Technology Journal of Thua Thien Hue (27).
5. Nguyen Dinh Tien & Hoang Ngo Tu Do, 2009. Assessing sensitivity of groundwater contamination in Hue City and the surrounding areas.
6. Hue City statistical yearbook, 2011.
7. Synthesized from statistical yearbooks of Hue City.
8. Adjustments to the Plan of the Thua Thien Hue provincial region, 2012.
9. According to data from the Hue Environment and Urban Works Company
10. According to the project "Adjustment of Hue City master plan until 2030, with vision to 2050"

SECTION 2

THE VULNERABILITY TO CLIMATE CHANGE OF HUE CITY

1. CLIMATE CHANGE

1.1. Temperature[1]

Temperature variation through time

Changes in temperature have been evaluated based on monitoring data from 1931 to the present. Analysis of this period shows that the average yearly and monthly temperatures in Hue have experienced variable changes, but show no clear trends. Basically, average annual temperature increased slightly from the 1931–1940 period to the 1971–1980 period (about 0.1–0.2°C), however, it decreased by 0.2–0.3°C in the period from 1981 to today.

Future temperature scenarios

Information about climate change scenarios used in the vulnerability assessment and this Action Plan is taken from the Vietnam climate change scenarios, issued in 2011 by the Ministry of Natural Resources and Environment. As there are no detailed data for Hue City, the information was taken from the scenario of Thua Thien Hue province or from the forecast data of the region[2].

DIAGRAM 2
AVERAGE JULY TEMPERATURE (1986–2006)

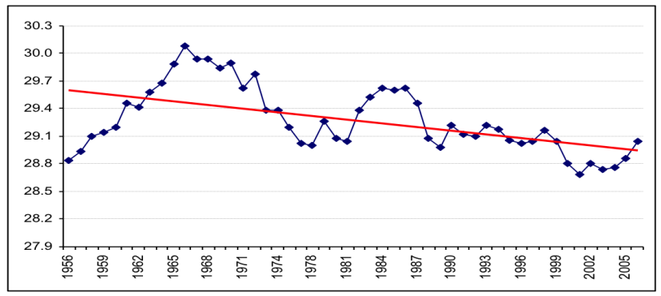
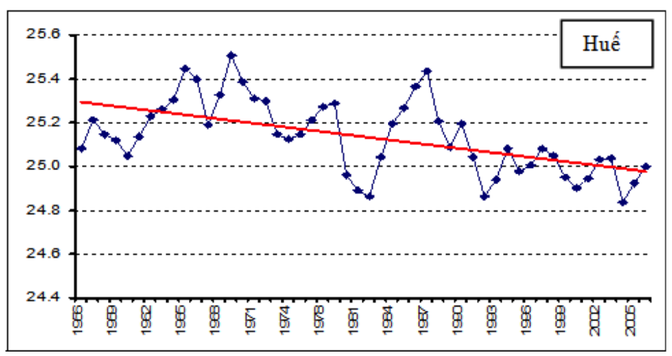


DIAGRAM 3
AVERAGE ANNUAL TEMPERATURE IN THE 1986–2006 PERIOD



The overall tendency is that average seasonal and annual temperatures are likely to increase in the future with the lowest increase of 1°C, which will occur during summer in 2050 (corresponding to the low emission scenario B1). The highest increase in average seasonal and annual temperatures could be up to 3.7°C in 2100 (corresponding to the high emission scenario A1FI). Thus, average temperature tends to increase more in spring and winter and increase least in summer.

In terms of extreme values, the lowest temperature in winter (corresponding to the scenario B2[2]) could increase by a maximum of 1.2°C by 2050 and 2.2°C by 2100, while the highest temperature could increase by about 2.2°C by 2050 and 3.2°C by 2100. In summer, maximum temperature could increase by about 1.2°C by 2050 and 3.2°C by 2100. According to forecasts, the number of days with highest temperature of above 35°C could increase by 10-20 days/year by 2100 (corresponding to the average emission scenario B2).

TABLE 2

CHANGES OF AVERAGE TEMPERATURE IN RECENT DECADES (°C)

Decade	Average temperature in Hue		
	Average January temperature	Average July temperature	Average annual temperature
1931–1940	19.8	29.0	25.1
1941–1950	20.8	29.3	25.3
1951–1960	20.1	29.3	25.2
1961–1970	19.9	29.8	25.3
1971–1980	20.0	29.4	25.3
1981–1990	19.8	29.3	25.1
1991–2000	20.2	29.1	25.0
2001–2010	19.9	28.9	25.0

TABLE 3

FUTURE TEMPERATURE CHANGE SCENARIOS OF HUE CITY[2]

Season	2050	2100	2050	2100
	Seasonal average		Extreme temperature (B2)	
Winter (Dec–Feb)	1.4–1.8°C11	1.6–3.7°C	Lowest: 1.0–1.2°C Highest: 1.2–2.2°C	2.0–2.2°C 2.2–3.2°C
Spring (Mar–May)	1.2–1.6°C	1.6–3.7°C		
Summer (Jun–Aug)	1.0–1.4°C	1.0–3.1°C	Lowest: 1.7–2°C Highest: 1.0–1.2°C	2.7–3.2°C 2.2–3.2°C
Autumn (Sep–Nov)	1.0–1.6°C	1.3–3.7°C		
Yearly average	1.2–1.6°C	1.6–3.7°C	Lowest: 1.0–1.7°C Highest: 1.0–1.7°C	2.2–3.0°C 2.0–3.2°C

1.2. Precipitation

Changes in precipitation from past to present[1]

Monitoring data show that annual precipitation in Hue has been relatively high compared to other localities, with average yearly precipitation ranging from 2,700–2,800mm/year. In some particular years, total annual precipitation was remarkably high (e.g. precipitation in 1999 was up to 3,093mm), and might be 600–800mm higher than the average yearly levels. In assessing rainfall distribution over time, rainfall has been concentrated mainly in the months of October and November. In some years, precipitation in one of these two months accounted for 60–80 percent of yearly precipitation (e.g. rainfall in November 1999 was 2,452mm out of the total annual amount of 3,093mm).

According to statistics, precipitation in Hue has fluctuated greatly over the decades without a clear trend. Average yearly precipitation decreased from 2,842mm/year in the 1961–1970 period to 2,575mm/year in the 1981–1990 period, but increased gradually in the two decades after that, with the most significant increase being over 500mm in the 1991–2000 period compared to the previous decade. Notably, although average annual precipitation increased, precipitation in July (dry season) of the 1991–2000–2010 period decreased drastically, while precipitation from September to November (rainy season) increased compared to the previous two decades. Compared to the 1961–1970 period, the average July precipitation decreased by 23 percent during the 2001–2010 period, while the average November precipitation increased by 27 percent.

In terms of daily rainfall intensity, in the past few decades, the number of rain events with extreme intensity has been on the rise and has always taken place in October and November. Some days had particularly heavy rain. For instance, rainfall on 2 November 1999 was up to 978mm, almost 20 percent of the total annual precipitation of the year.

In short, the average annual precipitation of the 2001–2010 period was actually higher than the previous decades from 1961–2000, but there is no confirmation of increase or decrease of the average yearly value. It is certain that precipitation in October and November is always at extreme levels, with intense to extremely intense rain events, which tend to continue to intensify. Meanwhile, July precipitation (dry season) is likely to decrease. These periods need special attention in analysing future precipitation scenarios as a basis for building climate resilience for Hue City.

DIAGRAM 4

AVERAGE SEPTEMBER TO NOVEMBER PRECIPITATION

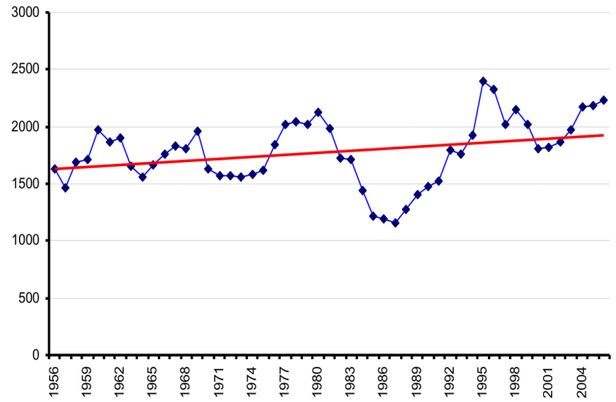


DIAGRAM 5

AVERAGE JULY PRECIPITATION

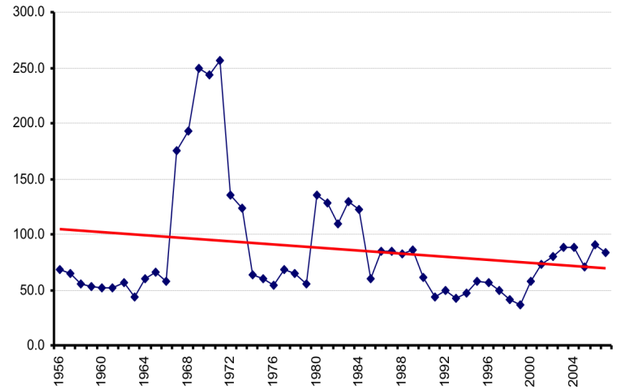


DIAGRAM 6

DAILY HIGH PRECIPITATION LEVELS IN HUE IN THE LAST TEN DECADES

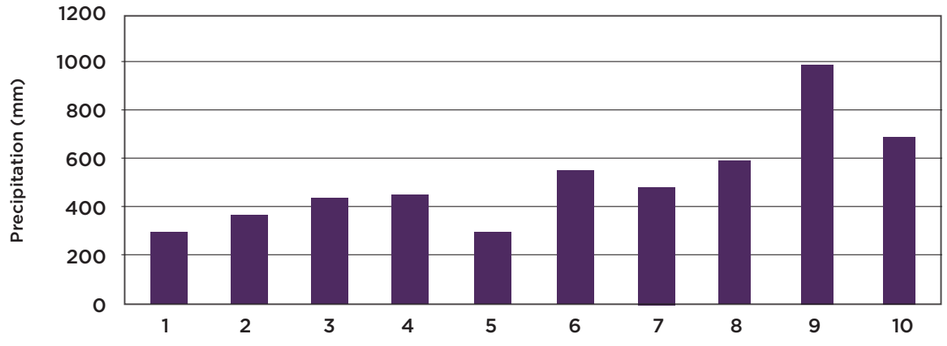


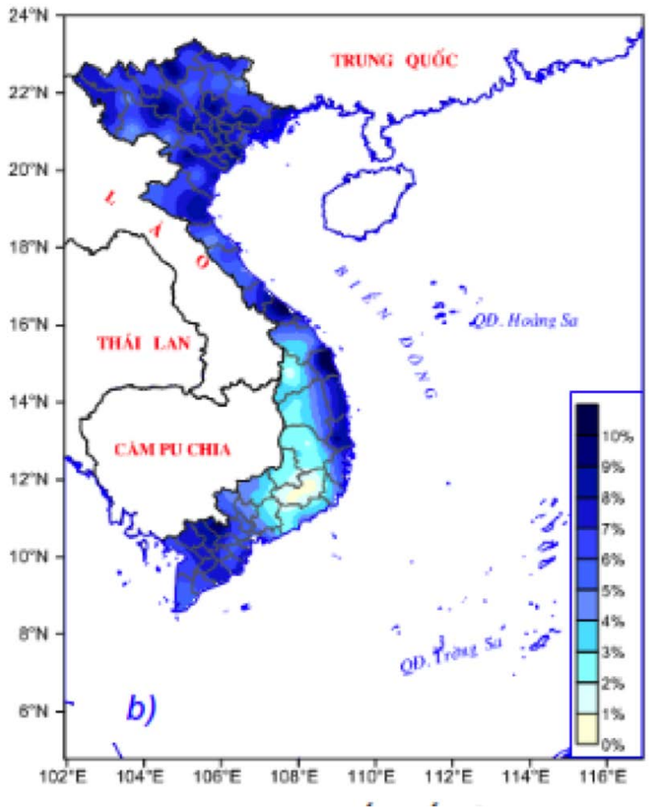
TABLE 4

SCENARIO OF PRECIPITATION CHANGES IN HUE CITY IN THE FUTURE

Season	Change in average rainfall	
	2050	2100
Winter (Dec–Feb)	2–4% increase	0–6% increase
Spring (Mar–May)	2–6% decrease	4–10% decrease
Summer (Jun–Aug)	4–6% increase	4–14% increase
Autumn (Sep–Nov)	4–10% increase	4–16% increase
Yearly average	3–5% increase	6–10% increase

FIGURE 5

CHANGES IN ANNUAL RAINFALL AT THE END OF THE 21ST CENTURY ACCORDING TO A1FI



Future precipitation scenarios[2]

According to projections, average yearly precipitation in Hue could increase at the rate of 3–4 percent by 2050 and 6–10 percent by 2100. Average precipitation will increase in spring, summer and autumn, and decrease in winter.

Notably, decreases in precipitation might occur in the dry season by a rate of as much as 6 percent by the middle of the century, and 10 percent by the end of the century. Precipitation in autumn—from October to December, the period with the largest rainfall in the year—is likely to increase most significantly at the maximum rate of 16 percent in 2100. Thus, the problems of droughts and floods in Hue are likely to become extremely serious in the future.

In addition, daily high rainfall in Hue might increase by about 20 percent over the 1980–1999 period, possibly with abnormally heavy rainfall twice as much as the current record.

1.3. Sea level rise scenarios

Sea-level rise scenarios for Hue are developed based on the forecast data for the area from Ngang Pass to Hai Van Pass. Changes in sea levels in the future are compared to the average sea level in the 1980–1999 period.

According to Table 5, sea level is expected to increase in the future. By 2020, 2050 and 2100 sea level may rise—at the highest level—by 9, 28 and 94cm respectively. In addition, the difference between the low and the high scenario values tends to broaden over time. This means the uncertainty of future forecasts is increasing, which is a major challenge for planning.

TABLE 5

FUTURE SEA LEVEL RISE SCENARIOS OF HUE CITY (CM)

Emission scenario	Timeframes								
	2020	2030	2040	2050	2060	2070	2080	2090	2100
Scenario B1	7–8	11–12	16–18	22–24	28–31	34–39	41–47	46–55	52–62
Scenario B2	8–9	12–13	17–19	23–25	30–33	37–42	45–51	52–61	60–71
Scenario A1FI	8–9	13–14	19–20	26–28	36–39	46–51	58–64	70–79	82–94
Extreme level range	7–9	11–14	16–20	22–28	28–39	34–51	41–64	46–79	52–94

1.4. Climate change related disasters and their impacts on Hue City

Major types of natural disasters in Hue include floods, storms, droughts and heat waves, of which flooding is considered the most dangerous and causes the most damage. In recent years, changes in temperature and rainfall have made these disasters more severe, complicated and unpredictable.

Floods often occur in the rainy season, mostly from September to December. Flood season flow accounts for about 65 percent of total annual flow. According to monitoring data, there are on average 3.5 floods of Level 2 Warning or greater occurring every year on the Huong River, with the greatest number being up to eight floods a year. Among them 36 percent are potentially disastrous floods[3].

The average duration of a flood is about three to five days, with the longest being six to seven days. The average time taken for a flood to travel a distance of 51km—from the upstream area (Thuong Nhat) to the downstream area (Kim Long)—is five to six hours. Flood severity (duration and depth) depends on multiple factors, such as rainfall in the upstream area, rainfall in Hue City, the tidal situation and rising sea level (caused by storm surges and/or global warming). Therefore, climate change in recent decades has made floods in Hue more complicated, dangerous and less predictable.

1. **The flood from October 28 to January 1, 1983 left 252 people dead, 115 people injured, 2,100 houses collapsed, 1,511 houses washed away and 2,566 buffalos and 20,000 pigs washed away.**
2. **The historic flood in early November 1999 with flood level ranging from 3.2 m to 4.9 m left 352 people dead, 305 people injured, 25,015 houses washed away, 1,027 schools collapsed, and 160,537 cattle and 879,776 poultry heads dead. Total loss was over VND 1,700 billion.**
3. **The flood from November 25–27, 2004 left 10 people dead and caused loss of over VND 208 billion.**

Source: Office of the Committee for Flood and Storm Control of Thua Thien Hue Province

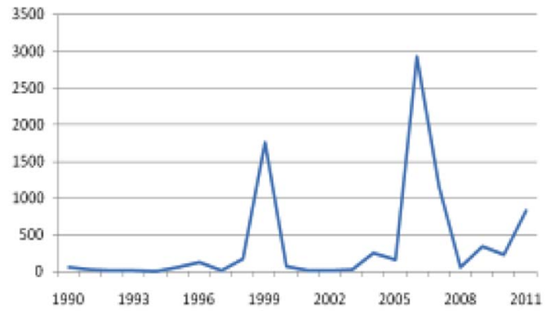
In the 19th Century, from 1801 to 1888, the citadel and neighboring areas suffered 40 big floods, the most notable ones are listed below:

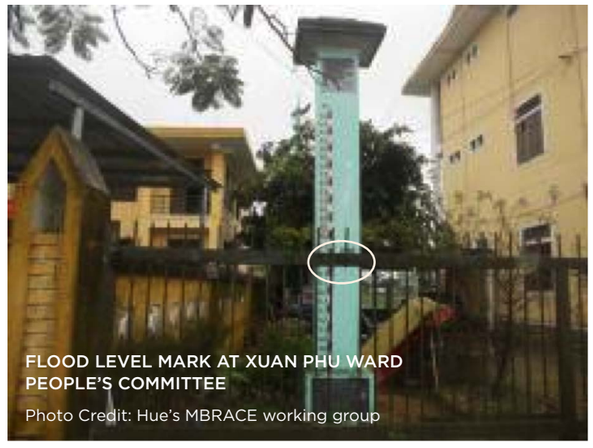
- The 1811 flood inundated the Royal Palace under 3.36m of flood, and broke the Tu Dung (Tu Hien) gate.
- The 1818 flood inundated the citadel with flood depth of 4.2m.
- The floods in 1841 and 1842 left more than 700 houses collapsed, Minh Mang Tomb heavily damaged, and caused a large number of deaths.
- The October 1844 flood left more than 1,000 people killed, 2,000 houses completely destroyed, and the citadel inundated at the depth of 4.2m.
- Many subsequent floods in 1848 and 1856 destroyed over 1,000 houses in Hue and two thirds of the Noon Gate (Ngo Mon).

Source: "Natural disasters in Thua Thien Hue and comprehensive preventive measures", Nguyen Viet, Thua Thien Hue Provincial Hydro-Meteorological Forecasting Center.

DIAGRAM 7

ECONOMIC LOSSES CAUSED BY FLOODS FROM 1990 TO 2011[1]





FLOOD LEVEL MARK AT XUAN PHU WARD PEOPLE'S COMMITTEE

Photo Credit: Hue's MBRACE working group

According to statistics, flood damage in the city is enormous in terms of mortality, economic, cultural and social aspects. In the 1990–2011 period, floods in Hue caused 596 deaths (an average of 27 deaths/year), and approximately VND 8,320 billion of material loss (an average of VND 378 billion/year).

Storms

Situated only about 20km away from the coast, Hue City is easily affected by storms. The storm season is from May to November, with the highest frequency occurring in September and October. According to statistics from 1884 to 2000, there were on average 0.684 storms and tropical depressions directly affecting Hue City every year, the highest number being up to three to four storms a year (1971).[4]

Direct impacts of storms include destruction of and damage to houses; public and cultural works; trees; transportation; communication infrastructure; power lines; and crops. Storms also directly impact community livelihoods and other economic activities, especially tourism.

Examples of damage caused by major storms

1. Typhoon Cecil on 16 October 1985 in Quang Tri and Thua Thien Hue: the collapse of 214,000 houses, 2,000 classrooms and 200 health facilities; 600 broken high-voltage electricity pylons; thousands of ships sunk; 840 people killed; 100 people missing; and 200 people injured.

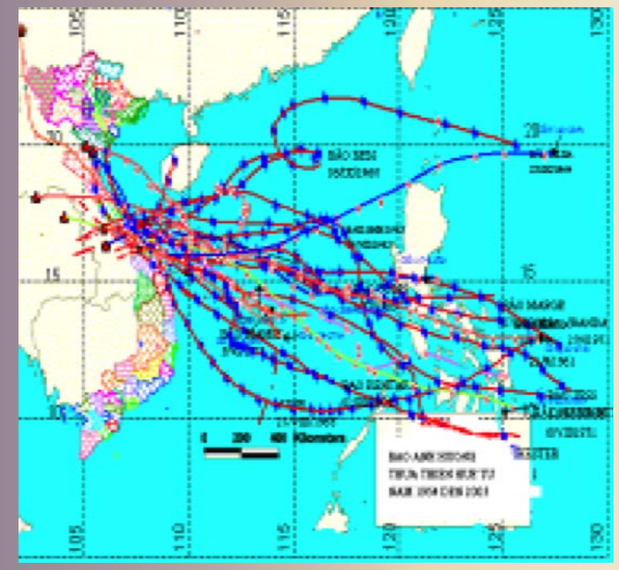
2. Typhoon Ed on 18 October 1990: 18 deaths and property loss of VND56,540 billion.

3. Typhoon Xangsane on 1 October 2006: flooding across the province with ten deaths and VND 2,910 billion in damage.

Source: Natural disasters in Thua Thien Hue and comprehensive preventive measures, Nguyen Viet

FIGURE 6

PATHS OF STORMS THAT AFFECTED HUE CITY FROM 1954 TO 2005[4]



Droughts, water shortage and saline intrusion

Droughts and saline intrusion occur every year, especially during the El Niño years. They do not cause loss of life but can lead to severe impacts on agriculture, industry, environment and health. According to monitoring data, the farthest point inland that salt water has reached was about 30km on the Huong River. Approximately 2,000–2,500ha of agricultural land—mainly in low-lying areas along the Huong and Bo rivers—was affected.

Droughts often occur from May to August and directly affect agriculture and water supply. In addition, they are also the indirect cause of more severe saline intrusion. In the past three to five years, droughts have been occurring less frequently, but have increased in severity and uncertainty.[5] In the past, the city experienced serious droughts in 1977, 1993–1994, 1997–1998 and 2002. The 1993–1994 drought dried up rivers and streams and killed many trees and crops (including perennials). It also caused salt water to intrude into the Huong River, destroying 12,710ha of the summer-autumn rice crop, equivalent to about 20,000 tons of paddy.[6] During the 2002 drought, salt water penetrated deep into the Tuan ferry, forcing many plants and factories to close, and significantly affecting the local economy. So far, Thao Long dam has partially controlled saline intrusion.

Tornadoes and whirlwinds

Tornadoes and whirlwinds often occur in Hue City. While they do not cause the same extensive impacts as storms, their strong winds, sometimes accompanied by hail, can cause considerable damage. In recent years, the number of tornadoes and whirlwinds occurring in Thua Thien Hue has increased, especially in the El Niño years, such as 1993, 1997 and 2002. Since 1993, on average, there have been approximately four tornadoes a year.[4]

2. VULNERABILITIES TO CLIMATE CHANGE

A climate vulnerability assessment was conducted by a local interdepartmental expert group. The survey and detailed assessment focused primarily on floods, given that floods are the most dangerous types of disaster for the city. The assessment focused on both current and future vulnerabilities.

The vulnerability assessment focused on three major areas: communities and organizations; infrastructure system; and analysis of the institutional system and government management at the local level related to urban development and climate change. Vulnerability was assessed through analysis of the following factors: exposure to disaster risks; sensitivity to disaster risks; and ability to adapt to climate change. The analysis looked at different aspects including financial capacity, awareness and knowledge, effectiveness of management policies and social support, and ability to learn.

Current vulnerability was assessed using information and data from historical disasters, tools such as synthesis and analysis of secondary data, surveys, interviews and group discussions with local people and other stakeholders. Future vulnerability was assessed based on hydrological-hydraulic models, data overlay and data analysis. Results from related projects –especially the Japanese International Cooperation Agency (JICA) project on Building Capacity to Respond to Natural Disasters in Central Vietnam—are important inputs to this assessment. The time frames for future vulnerability assessment are 2020 and 2050.

2.1. Current vulnerability

a. Exposure

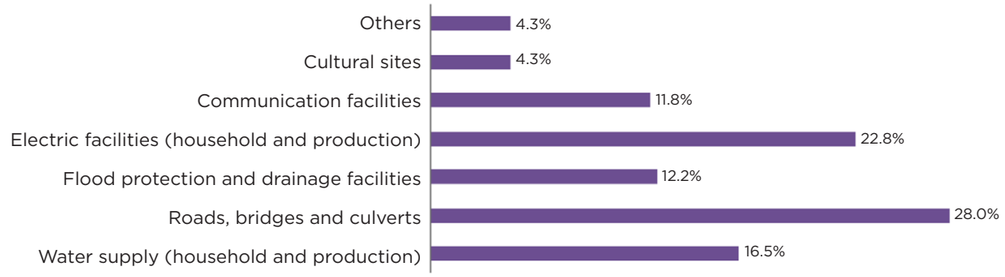
The systems and sectors investigated included urban infrastructure (roads, railroads, public facilities such as schools, hospitals and clinics, and housing systems); water supply and drainage; electricity supply; communication; tourism and services (including tourist facilities and cultural structures); agriculture; and industries. An assessment of the vulnerability of each sector included the infrastructure and facilities of each sector and the population groups involved in the sector.

The urban infrastructure system is affected by floods, storms and tropical depressions, of which floods cause the greatest damage. The highest-risk period is from September to November, when heavy rainfall and storms prevail. Regarding forms of impacts, climate-related disaster risks often cause damage to urban infrastructure such as flooding, siltation of irrigation works, erosion of roads and destruction of houses, power supply and communication systems.

TABLE 6
SUMMARY OF CLIMATE CHANGE IMPACTS ON URBAN INFRASTRUCTURE

Urban infrastructure	Form of impact	Most vulnerable areas
Roads	• Road inundation leading to traffic congestion • Road surface cracking, subsidence, erosion	Tay Linh area (Thuan Loc ward); Kiem Hue a Tay Linh area (Thuan Loc ward); Kiem Hue area (Xuan Phu ward); Phu Hau, Xuan Phu, Phu Cat, Thuy Bieu wards rea (Xuan Phu ward); Phu Hau, Xuan Phu, Phu Cat, Thuy Bieu wards
Railroads	Inundation and erosion	An Hoa area
Public facilities, houses	Destruction of houses and public facilities	Suburban wards
Electricity and communication systems	Broken pylons and wiring, damage to electrical substations and transmitter stations	All areas
Irrigation works	Siltation, erosion and damage to bridges and culverts	Nhu Y, Ngu Ha, An Cuu and Dao rivers, and Tich Dien channel
Cultural sites	Subsidence, destruction and damage	Walls of the Ancient Citadel and recreation areas

DIAGRAM 8
LOCAL PEOPLE'S ASSESSMENT OF INFRASTRUCTURE EXPOSURE TO DAMAGE



According to assessment results, the most vulnerable system under the urban infrastructure category is the transportation system, followed by power and the water supply and drainage systems. Cultural and historical heritage sites, schools, hospitals and residences are also highly vulnerable.

Tourism, services and culture: Hue City is nationally and internationally recognized for its historical and cultural heritage, and has always been a top tourist destination in Vietnam. This has been and remains an advantage for the ongoing development of the city as a key economic area of the province. However, during the past few years, this sector has often been affected by climate-related natural disasters, especially flooding. Natural disasters lead to the disruption of tourism and service activities; generate threats such as degradation and destruction of tangible heritage (temples, pagodas and royal tombs); and can damage tourism facilities such as hotels, hostels and quays.

The level of impact that climate change imposes on historical and cultural heritage is fairly high. Given their historical age, these buildings are very sensitive to the impacts of storms, rainfall, floods and prolonged periods of inundation. They are often situated in flood-prone areas. This situation is getting worse not only because of more severe climate events, but also due to the negative aftermath of the rapid and in many cases inappropriate urbanization process.

Major historical heritage in Hue Ancient City

- The Flag Tower, Long An Palace, Phu Xuan Communal House, Xa Tac Esplanade, Nine Holy Cannons, Hue Ancient Citadel, Noon Gate (Ngo Mon), Thai Hoa Palace, Dai Trieu Nghi yard, Trieu To Temple, Hung To Temple, The To Temple, Dien Ngo Palace, Truong Sanh Palace, Hien Lam Pavilion, Nine Dynastic Urns, Phung Tien Palace, etc.
- **Royal tombs:** Gia Long Tomb, Minh Mang Tomb, Thieu Tri Tomb, Tu Duc Tomb, Dong Khanh Tomb, Duc Duc Tomb and Khai Dinh Tomb
- **Pagodas/churches:** Thien Mu Pagoda, Tu Dam Pagoda, Tu Hieu Pagoda, Redemptorist Church, Phu Cam Main Cathedral

INUNDATED HERITAGE SITES IN A FLOOD EVENT IN 2011 FLOOD
*Source: laodong.com.vn

Impacts on industries

Agriculture: The agriculture sector is diminishing in terms of its economic contribution to Hue City. In 2011, the contribution of all agricultural, forestry and aquaculture activities together accounted for only 11 percent of the city's GDP. During the last period, the proportion of agricultural labor compared to the total labor force declined considerably, from 17.3 percent in 2005 to 12.43 percent in 2011. In addition, the total area of agricultural land has also decreased rapidly, from 1 870.7ha in 2005 to 1 591.81ha in 2011 (a decrease of 278.9ha). Among agricultural activities, cropping accounts for the highest proportion at 29.5 percent. The major threats to this sector include storms, floods, droughts, extreme heat waves and cold snaps; floods and droughts constitute the greatest threat. The highest risk usually occurs from September to November, and from May to August.

TABLE 7
DAMAGE TO THE AGRICULTURE SECTOR FROM 2006–2013[7]

Year	Natural disasters and extreme weather events	Impacts on agriculture
2006	Typhoon Xangsane	About 50ha of forest and trees in cities destroyed
2007	Floods in October and November	Ten tons of rice and 20ha of vegetable fields inundated, 100 livestock and 2,000 poultry killed or washed away
2008	The 38-day cold snap	70ha of rice and 5ha of peanut crops destroyed
2009	• Inundation caused by heavy rain from 3–8 September 2009 • Typhoon No. 9 from 28–30 September, with heavy rain and serious flooding	130ha of transplanted rice seedlings inundated, 2 tons of rice seeds spoiled
2010	Typhoon No. 3 (23–24 August) together with serious inundation	200ha of rice inundated
2011	Prolonged and stronger cold snap with rain	• 120ha of rice damaged • 2 tons of rice seeds spoiled
2012	• Heavy rain events from December 2011 • Prolonged heat waves combined with southwestern monsoon late July early August	• Pollination of rice affected, leading to high rate of empty grains • About 80ha of rice affected
2013	• Two cold spells from 23–27 December and from 30–31 December • Cold snaps combined with tornadoes on 6 April	• 10ha of transplanted rice seedlings destroyed and replaced • 100ha of rice affected

In terms of sensitivity (susceptibility) and intensity of exposure to natural disasters, rice growing and aquaculture are the two livelihood areas facing the highest risk. They both rely upon low-lying riverine or coastal areas and depend largely on weather conditions. To date, former low-lying rice-growing areas such as Thuy Bieu, Thuy Xuan, Huong Long, Xuan Phu and An Tay wards, especially An Dong and Huong have been the most severely affected.

Industry: Industrial production is not a core economic sector of Hue City. However, because industrial zones such as Bac Huong So, Bac An Hoa were mostly built on former agricultural land, typically low lying, they usually suffer heavy damage from floods.

TABLE 8
OVERVIEW OF AGRICULTURAL PRODUCTION AND IMPACTS OF CLIMATE CHANGE

Production area	Area (ha) %	Key natural disasters (in order of severity)	Most vulnerable areas
Rice growing	1,751.70 (88.87%)	Flooding, extreme cold spells, droughts, storms, heat waves	Huong So, An Dong, Huong Long, Thuy Bieu, Thuy Xuan, Kim Long, Xuan Phu
Vegetables and flowers	455 (22.82%)	Flooding, extreme cold spells, droughts, storms, heat waves	An Dong, An Hoa, Thuy Bieu, Huong Long, Kim Long
Fruit trees and industrial trees	249 (12.49%)	Flooding, extreme cold spells, droughts, storms, heat waves	Huong Long, Thuy Bieu
Forestry	387.85 (19.46%)	Storms, droughts	Thuy Bieu, Thuy Xuan, An Tay
Aquaculture land	13.65 (0.68%)	Flooding, storms, extreme cold spells and heat waves, saline intrusion	Huong So, An Dong, Huong Long, Thuy Bieu, Thuy Xuan
Animal husbandry	73 water buffalo, 747 cows, 12,467 pigs	Flooding, extreme cold spells and heat waves, storms	Thuy Bieu, Thuy Xuan, An Tay

Impacts of climate change on community groups

Communities in Hue suffer from varying degrees of damage and impact from natural disasters, depending on their location, livelihood and level of adaptive capacity. These impacts range from injuries and deaths caused by floods and storms; health impacts and susceptibility to diseases caused by prolonged and extreme heat or cold spells; and destruction of houses and livelihood facilities. Livelihood facilities can include boats, livestock cables, fishponds and crops, which can lead to a loss of productivity and income.

Communities also suffer from indirect impacts, such as damage to public infrastructure and facilities, which makes them more vulnerable. According to assessment results, the most vulnerable groups include farmers (especially in Huong So, Huong Long, Thuy Bieu and Phu Hau); people living close to high risk and poor neighborhoods; farmers who lose their arable land due to resettlement related to urban and industrial development (especially in An Dong and Huong So); households owning small businesses that depend on tourism and services (such as in Phu Cat and Phu Hoa); and a small group of informal labor.

IMPACTS OF FLOODING ON PEOPLE'S LIVES
*Source: laodong.com.vn

b. Adaptive capacity

Adaptive capacity includes internal factors (such as income, community awareness and knowledge), and external factors (for example, the adaptive capacity of the transport system depends on the quality of policies, planning and management). The adaptive capacity of a community depends on the quality of the infrastructure and the supporting policies of local government. Adaptive capacity can be assessed from multiple aspects including technical capacity; management capacity; stakeholder awareness of climate change and urban development; stakeholder/community understanding and awareness about adaptive measures; financial capacity (income, budget allocation for climate change, system development and upgrade); institutions and policies; the management system for responding to climate change; the level of climate change integration in policies; strategies and the development and implementation of urban infrastructure development and community support plans; capacity to manage and share information; ability to learn; and flexibility and redundancy in construction and management of infrastructure, production and business.

Knowledge and capacity: The transport, construction, water supply and drainage sectors all have experience in disaster prevention and control. However their knowledge and capacity relating to climate change adaptation remain limited, particularly in the areas of vulnerability assessments, prioritization of adaptive measures, analysis and use of information to support decision-making, development and implementation of adaptation plans, integration of climate change into sectoral plans and socio-economic development plans. There are currently no existing agencies in Thua Thien Hue province and Hue City that have experience in these areas. The awareness level of the community, civil society organizations and the private sector is even lower. Several training events have been conducted with a focus on various population groups in the city. However, these events were mostly small scale, separate and reactive (due to dependence on external technical and financial support). According to analysis based on the United Nations International Strategy for Disaster Reduction (UNISDR)'s Local Government Self-Assessment Tool (LGSAT), the level of awareness and capacity for disaster reduction of Hue City is assessed to be four out of a five-level scale (with five for best performance), while for climate change adaptation it is only two out of five.

Government management systems to support climate change adaptation: A management system for flood and storm control for all levels of government was established many years ago, to respond to annual disasters. Associated legal documents, policies, regulations and plans have also been developed and implemented in a fairly systematic manner. The roles and responsibilities of different stakeholders have also been well defined.

For climate change adaptation, a Steering Committee and interdepartmental working group was established at the provincial level, however, there is currently no mechanism or structure at the city level. The coordination between related departments and agencies is still limited due to a number of reasons, including lack of an agency that specializes in climate change; no full-time staff at agencies across all levels of government; and disaster management and climate change adaptation are managed separately by two independent departments (Department of Agriculture and Rural Development, and Department of Natural Resources and Environment).

According to the results of the LGSAT assessment, the criteria related to the integration of climate change into sectoral plans scored very low points. For example:

- The level of support and complementariness between risk assessments in the city with risk assessments in neighboring areas or national/provincial risk management plan: 2 out of 5
- Existing regulations (such as land-use plans and construction standards) that effectively support disaster risk reduction in the city: 2 out of 5
- Adequate risk assessment for all types of hazards for schools, hospitals and clinics: 1 out of 5
- Local hospitals and schools safe enough to maintain operation in emergency situations: 2 out of 5
- Effectiveness of measures to protect public facilities from disaster damage: 2 out of 5
- Important public facilities in high-risk areas are assessed for their overall risks related to all types of hazards: 3 out of 5

The development and implementation of related policies and plans: At present, the provincial Action Plan has been developed, although implementation is still in the early phases. There are currently no guidelines available for developing adaptation plans for each sector, or for integrating climate change into development plans and policies. Existing sector development plans and socio-economic development plans are still mostly based on historical statistics and/or one single scenario. These scenarios are considered to be the most suitable for the local area and fail to take into account other circumstances, such as extreme climatic and natural disaster scenarios. Conflicting views still exist among different policies and different fields and sectors.

The implementation of policies and plans for urban development and climate change adaptation still faces many problems. The most typical example of this is uncoordinated planning and development, leading to flooding, especially in new urban areas and resettlement areas such as in An Dong ward and An Van Duong. According to the LGSAT assessment, most new urban development plans fail to properly consider the impacts of climate change. Since 1999, a series of new urban areas and public facilities have been built on low-lying areas and old and new infrastructure systems are still not properly connected. This can lead to consequences such as obstruction and contraction of drainage channels, reduction of natural retention capacity and localized flooding in new urban areas and construction projects.

According to results from interviews carried out with local people under the vulnerability assessment, almost 70 percent of interview respondents believe that new urban areas will make flooding more frequent and severe.

DIAGRAM 9

PEOPLE'S ASSESSMENT OF CAUSES OF WORSENING FLOODS*

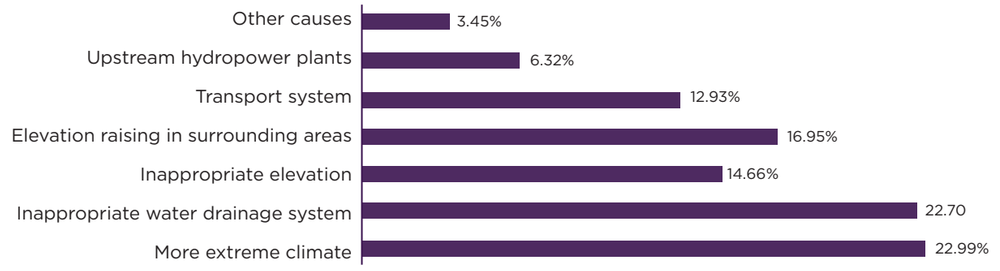
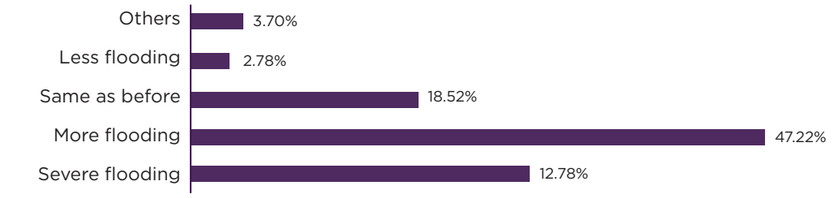


DIAGRAM 10

LOCAL PEOPLE'S OPINIONS ABOUT IMPACTS OF URBAN DEVELOPMENT ON FLOODING*



*Source: Vulnerability Assessment Report by M-BRACE project in Hue

Examples of impacts of urban development on flooding in Hue City

The development of the An Van Duong new urban area led to the blockage of major drainage channels in the area and caused severe flooding in residential groups 13, 13A, 14 and 15. The elevation of major roads is lower than standard and as such they suffer higher levels of floods.

Phu Hau ward: Following the upgrade of Nguyen Gia Thieu road, flooding at the wholesale market area worsened. As there is no drainage system in the area, the water cannot drain to Huong River.

Phu Thuong commune: Transport infrastructure in the commune has recently been upgraded, including the construction of Nguyen Sinh Cung road and National Highway 49. This created barriers that prevented water drainage from higher villages such as Tay Thuong and Ngoc Anh.

Source: Vulnerability Assessment Report, M-BRACE project in Hue

The ineffective implementation of urban development plans and policies can partially be explained by the limited involvement of stakeholders in the decision-making process of policies and plans on climate change and development. Under the LGSAT assessment, this area was given a below-average mark of two out of five.

The financial resources for climate change adaptation are still limited. The city is receiving very little official and regular support from the national budget for climate change adaptation. Most of the resources received by the city come from international support. Flood and storm control in the city is supported mostly by the national and provincial budget and several donors. The difference between what is financially acquired and what is needed is quite large. Most of the resources are put towards the regular operation of the Committee for Flood and Storm Control, and for post-disaster recovery activities. There is very limited budget available for capacity building, awareness raising, systematic risk assessment, development of proactive disaster prevention and long-term adaptation plans, and integration of climate change into development plans. In addition, there are limited funds and policies to support poor households and communities in high-risk areas (such as credit services, small savings, livelihood improvement or livelihood change, and post-disaster recovery). According to the LGSAT assessment, criteria related to this area only had a rank of two out of five.

For community groups, according to statistics, the wards and communes with the lowest financial capacity and highest poverty rates in Hue are An Hoa, An Tay, Huong So, Phu Binh, Phu Hau, Phu Hiep, Huong Long, Thuan Loc, Thuy Bieu, Thuy Xuan and Vy Da. Households that have been resettled from their livelihood source (agriculture or aquaculture production) for urban development are also considered vulnerable as many face significant difficulties in finding new livelihoods. Social policies for these groups are also ineffective and inappropriate.

Early warning capacity, quality of database and information-sharing mechanisms: There are several hydrometeorological monitoring stations and flood gauges in Thua Thien Hue province. These systems play a key role in delivering warnings, especially flood warning in the province and in Hue City. Before and during a natural disaster event, warnings are delivered to local people through multiple means of communication such as television, newspaper, official letters and text messages. The Central Committee for Floods and Storms Control (CFSC) system at different levels plays a large role in this process. Currently, the city does not have an effective system for the collection and management of a unified database. While there are many sources of information available such as hydrometeorological statistics, research results, related projects and programs (e.g. disaster risk assessment reports and flood maps), it is often located throughout many different agencies and departments. There are also limitations in the mechanism for two-way, cross-level and interdepartmental information sharing (between city government, departments, wards/communes and communities) related to urban development, natural disaster and climate change.

Ability to learn: Each year the city conducts a review of the previous year's flood and storm control activity and draws lessons of experience that can be used to assist future management strategies. Community knowledge and experience are partly promoted through the application of the four on-the-spot principles.[8] However, in general, the learning process, especially shared learning among sectors from other localities and access to updated scientific knowledge is not organized and systematic enough. One of the limitations is the lack of experience and ability to effectively develop and implement comprehensive plans, and to develop policies and strategies for responding to different likely scenarios and future risks. Local communities are those with the most limited access to scientific information and knowledge. Poor communities in wards with high poverty rates and low education levels such as An Hoa, An Tay, Huong So, Phu Binh, Phu Hau, Phu Hiep, Huong Long, Thuan Loc, Thuy Bieu, Thuy Xuan and Vy Da are assessed as the most vulnerable considering their limited ability to learn.

Flexibility, redundancy and safe failure of the infrastructure system in Hue City is still limited. This can be explained by the traditional approach of infrastructure design, which relies mostly on historical disaster information and/or reliance on only one scenario. This is especially dangerous in the context of climate change because the intensity, frequency and uncertainty of events are higher and less predictable. Moreover, the overlap and silo-sector perspective in the construction of urban infrastructure also limits the ability of responding flexibly to different circumstances. An area of concern is that according to the LGSAT assessment, most local schools and hospitals are not safe enough to remain in operation in an emergency situation (a rank of two out of five).

SUMMARY OF CURRENT VULNERABILITY

It is agreed that climate change has been the reason for many serious issues in Hue City, affecting most systems, sectors and communities. Results of the Vulnerability Assessment show that the following sectors, systems and population groups are highly vulnerable and need special consideration in the process of building climate resilience for Hue City: transport infrastructure, heritage sites, schools, major hospitals, power supply, water supply, water drainage, agricultural production (rice, vegetables and fruit), tourism and services, poor farmers and fishers in peri-urban areas, poor resettlement households (who lost their agricultural land to industrial and urban development) and households existing on tourism services.

These groups and systems are also vulnerable to internal factors such as limited capacity and awareness, lack of effective coordination mechanisms, lack of specialized and capable staff, lack of well-coordinated and systematic plans, ineffective implementation of urban development plans and policies, limited financial resources (from provincial to city and community levels), unorganized databases, lack of effective information-sharing mechanisms and lack of flexible and safe-failure planning. It is important that all of these gaps are considered in building resilience for the city.

FIGURE 7

MAP OF RESEARCH AREA, INCLUDING EXISTING AND EXPANDED AREAS OF HUE CITY

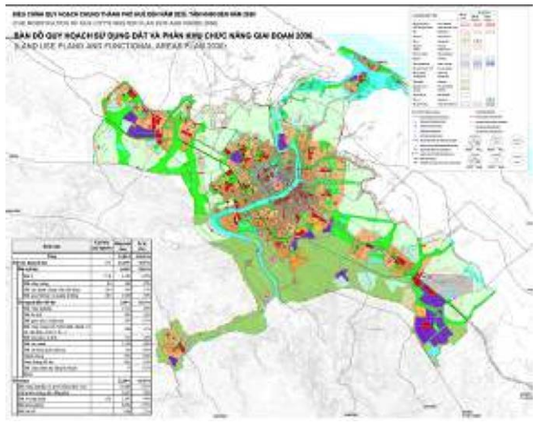
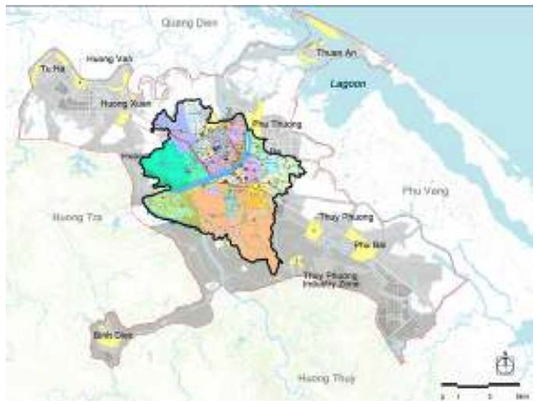


FIGURE 8

LAND-USE PLAN AND ZONING MAP 2030



2.2. Future vulnerability

The future vulnerability of the city was analysed based on future socio-economic and climate change scenarios. The two time horizons selected were 2020 and 2050. Due to limitations in resources, time and data, detailed assessment of future vulnerability only focused on floods, considered the greatest threat to Hue City.

Development scenarios were developed based on the Socio-Economic Development Plan of Thua Thien Hue Province period 2006–2020, the report on Adjustment of Hue City Master Plan and the Land Use Plan for Expansion of Hue Urban Areas, supported by the Korea International Cooperation Agency (KOICA). Future climate parameters (presented in Part 1, Section 2) are precipitation and sea-level rise under scenario B2 from the Climate Change Scenarios for Vietnam, version 2011.

Because input scenarios are not sufficiently detailed, the future vulnerability assessment only sketched tendency. This assessment will be regularly updated when more data become available.

Future impacts of floods on the city were assessed based on a combination of scenarios for sea-level rise, changes in precipitation, reservoir operation (Ta Trach, Binh Dien and Huong Dien reservoirs), and urbanization (see Table 9).

Key tools applied in the assessment were Mike 11, Mike 21 and Mike Flood models. The assessment also used results from previous related projects, particularly the component on flood mapping under the project Strengthening Capacity to Respond to Natural Disaster in Central Vietnam funded by JICA. Assessment results presented in this report are also based on the in-depth analysis of flooding and flood drainage capacity of Hue City under the impacts of urban development and climate change.

TABLE 9

COMBINATION OF SCENARIOS USED IN ASSESSING FUTURE VULNERABILITY[9]

PERIOD	Scenario	Code	Flood simulation scenarios
2009	1	2009QHCC	New urban planning scenario with urbanization, with reservoir regulation and with consideration of climate change
	2	2009HTCC	Status quo scenario without urbanization, with reservoir regulation and with consideration of climate change
	3	2009QHCK	New urban planning scenario with urbanization, with reservoir regulation and without consideration of climate change
	4	2009HTCK	Status quo scenario without urbanization, with reservoir regulation and without consideration of climate change
	5	2009QHKC	New urban planning scenario with urbanization, without reservoir regulation and with consideration of climate change
	6	2009HTKC	Status quo scenario without urbanization, without reservoir regulation and with consideration of climate change
	7	2009QHKK	New urban planning scenario with urbanization, without reservoir regulation and without consideration of climate change
	8	2009HTKK	Status quo scenario without urbanization, without reservoir regulation and without consideration of climate change
2020	9	2020QHCC	New urban planning scenario with urbanization, with reservoir regulation and with consideration of climate change
	10	2020HTCC	Status quo scenario without urbanization, with reservoir regulation and with consideration of climate change
	11	2020QHCK	New urban planning scenario with urbanization, with reservoir regulation and without consideration of climate change
	12	2020HTCK	Status quo scenario without urbanization, with reservoir regulation and without consideration of climate change
	13	2020QHKC	New urban planning scenario with urbanization, without reservoir regulation and with consideration of climate change
	14	2020HTKC	Status quo scenario without urbanization, without reservoir regulation and with consideration of climate change
	15	2020QHKK	New urban planning scenario with urbanization, without reservoir regulation and without consideration of climate change
	16	2020HTKK	Status quo scenario without urbanization, without reservoir regulation and without consideration of climate change
2050	17	2050QHCC	New urban planning scenario with urbanization, with reservoir regulation and with consideration of climate change
	18	2050HTCC	Status quo scenario without urbanization, with reservoir regulation and with consideration of climate change
	19	2050QHCK	New urban planning scenario with urbanization, with reservoir regulation and without consideration of climate change
	20	2050HTCK	Status quo scenario without urbanization, with reservoir regulation and without consideration of climate change
	21	2050QHKC	New urban planning scenario with urbanization, without reservoir regulation and with consideration of climate change
	22	2050HTKC	Status quo scenario without urbanization, without reservoir regulation and with consideration of climate change
	23	2050QHKK	New urban planning scenario with urbanization, without reservoir regulation and without consideration of climate change
	24	2050HTKK	Status quo scenario without urbanization, without reservoir regulation and without consideration of climate change

a. Level of impacts

Despite improvement in infrastructure systems, sectors and local communities will still be affected by similar types of impacts; it is expected that these impacts will become more severe and unpredictable.

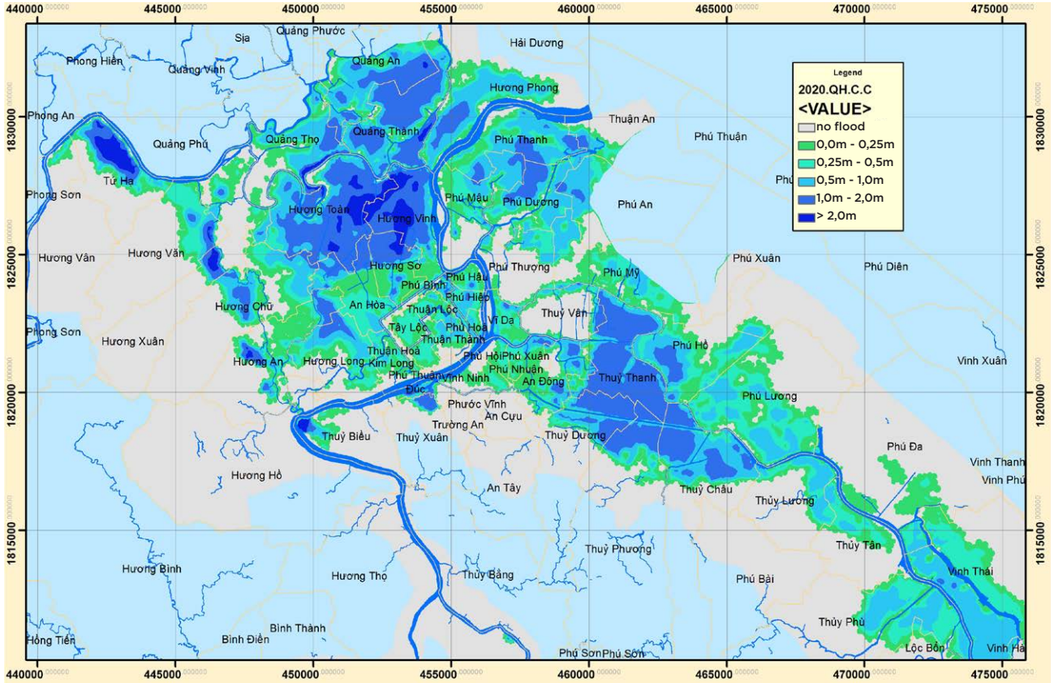
According to assessment results on future urban development and regulation of reservoirs, areas expected to suffer from the most serious floods are Huong Toan, Huong Vinh, Tu Ha, Thuy Thanh, Phu Thanh, Quang An and Quang Thanh. The total flooded area is also expected to increase from 24.84 percent in 2020 to 28.67 percent in 2050. Both these figures are lower than the total flooded area in the 2009 historic flood (32.17 percent). However, input data for future assessment are average and not extreme values; the total area with mild flooding (0–0.5m) is expected to increase most considerably, from 22.73 to 26.22 percent

If there are no reservoir regulations (or when the reservoirs fail), deep flooding will increase in many areas such as Thuy Bieu, Huong An, Huong Ho, Phu Mau, Phu Duong and especially inner-city areas such as Tay Loc, Thuan Loc and Thuan Thanh. Flooded area also expected to increase to 37.96 percent in 2020 and 42.68 percent in 2050, both worse than the catastrophic flood in 2009.

Flood depth in some areas is expected to decrease (compared with the 2009 flood), especially the inner Citadel, Huong Ho, Huong An, Huong So, Phu Thuong and Huong Van, while extended areas such as Thuy Luong, Thuy Van, Thuy Phu, Vinh Thai, Quang An, Quang Thanh and Huong Phong will suffer from more serious flooding. This can be explained by elevation raising and improvement of the infrastructure systems. For example, the water drainage infrastructure is being improved in new urban areas while the quality and standard of infrastructure in newly annexed wards is still very limited.

FIGURE 9

FLOOD MAP OF HUE IN 2020 (SCENARIO WITHOUT RESERVOIR REGULATION)[9]



In general, urban infrastructure will be more exposed to extreme climate conditions, and the vulnerability of other sector systems will also change. In future, the infrastructure networks in Huong Toan, Huong Vinh, Huong Phong, Tu Ha, Quang Thanh, Quang An, Thuy Thanh and Phu Duong will be affected more heavily by floods, while the level of impact on the infrastructure system in the inner city area is expected to decrease. In addition, the transportation system, especially roadway routes, will continue to be highly exposed to climate risks in general and to flooding in particular. This is partly because it is a large network, accounting for over 60 percent area of urban infrastructure. It is notable that according to flood analysis, infrastructure works of urban areas in North and West Huong So will be significantly affected when floods occur.

According to the **land-use plan** of Hue City until 2030, agriculture and aquaculture land will encompass 11,587ha, an increase of 5.8 times from the current amount. There are currently five suburban communes that will be developed according to the specialized-trade village model, which will focus on handicraft and fine art products, sculpture and services, while farming activities will be carried out in low-lying areas such as Huong Phong, Huong Vinh, Huong Toan, Phu Thanh, Phu Mau, Phu Thuong, Quang Thanh, Thuy Thanh, Phu Ho and Thuy Chau. In the development and analysis of flood maps, these communes will all be located in high-risk areas. Therefore, unless suitable solutions are identified, their vulnerability will be very high. In terms of importance, agriculture will only hold a moderate position in the city's economy (about 0.82 percent by 2020[10]). However, the city still needs to pay proper attention to labor in the agriculture sector, as it is one of the sectors most affected by weather and climate.

Employment in **services and tourism** still rates the highest, as they are the leading economic sectors of Hue City. However, as climate change becomes more severe and unpredictable they will experience further problems. Analysis shows that central city wards and wards on the southern bank of Huong River (the main tourist area), where many major historical and cultural heritage sites are situated, will be less affected than today compared to other areas in the future. However, other tourist clusters in Con Hen, An Van Duong, Phu Binh through Bao Vinh and Tam Giang lagoon towards Thuan An Sea all lie in areas with relatively high flood impact exposure (although they are still not the most severely affected). On a positive note, most of these clusters are planned for ecotourism/garden-house tourism development, so their sensitivity to flooding is expected to be lower.

Industries: Hue City gives priority to developing clean industries and high-tech industries such as information technology, telecommunication, electronic engineering, medicinal chemistry, textiles, footwear and specialty food processing for export. There will also be development of traditional craft villages such as embroidery, lacquer painting, pottery, woodcarving, bronze casting, cone hat making and Hue traditional specialties. In terms of spatial distribution, the city has been developing industrial zones in the north including Huong So, Nam Thuy An (Thuy Duong commune) and the southeast area of Hue.

Community groups: Although small in number, farmers will continue to be a group greatly affected by climate change because their production activities depend largely on weather conditions and take place mostly in low-lying areas (such as Quang Thanh, Huong Phong, Huong Vinh, Huong Toan, Phu Thanh, Phu Ho, Phu Thuong, Phu Mau, Thuy Thanh and Thuy Chau) or areas affected by urban development. Among them, resettled households, small business households, and informal labor from surrounding provinces, districts or towns are likely to be the most vulnerable when natural disasters occur. Labor in the industry sector is the group least likely to be vulnerable to the impacts of climate change because the future industry of the city will focus mainly on hi-tech areas.

Impacts of other natural disaster risks: Besides flooding, other extreme climate events such as droughts, extreme hot and cold spells, and riverbank erosion are expected to be more severe and frequent. Though not analysed in much detail, it is likely that the level of impacts (on economic development, livelihood, health and human life) on sectors and community groups in Hue City will be much more severe and profound than today.

b. Ability to adapt in the future

Assessment of future ability to adapt only has relative value because it is based on the assumption that the city's development plans and objectives will be achieved.

Capacity and awareness: It is almost certain that the general basis of climate change knowledge and awareness of various stakeholders, including local communities and government agencies will improve significantly. According to the current objective statement, Hue City will become a center for high quality education and training of various disciplines, and 100 percent of high schools in Hue will satisfy national standard by 2020. The level of awareness and technical capacity for development and implementation of climate adaptive solutions will depend on how effective measures under the Climate Action Plan of Thua Thien Hue province and Hue City (Action Plan) are implemented. There are two key issues to be noted for this component: the city needs to focus on strengthening awareness for vulnerable groups and also build the knowledge, tools and skills for planning and decision-making to respond to abnormal situations.

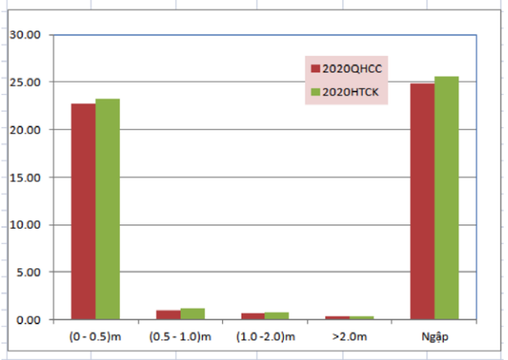
Institutions, policies and management systems for climate change adaptation: From 2015–2020, while measures under the provincial and city Action Plans are being implemented, it is expected that existing gaps in institutions (such as unclear responsibilities, lack of effective cross-sector and cross-level coordination, and lack of a capable focal point agency specializing in climate change) will be resolved. However, it is necessary to have strong and deep commitments from the provincial and city-level leadership.

Moreover, formulation of policies and development objectives for each sector will also help to strengthen the city's climate resilience. Examples of the city's objectives include: improving health service quality (100 percent of wards satisfy national healthcare standards), strengthening the education sector, improving sanitation and the environment, developing clean industries, reducing poverty (to 0 percent by 2020), reducing unemployment (the unemployment rate will be below 5 percent by 2020) and upgrading the urban infrastructure system. However, some existing policies and plans do not adequately address the issue of climate change, are not systematic and comprehensive, and fail to assess the negative impacts of climate change on flooding in the city. *According to the research Assessing Flood Drainage Capacity of Hue City under Impacts of Urban Development and Climate Change*, future urban development might lead to more severe flooding in the city. Specifically,

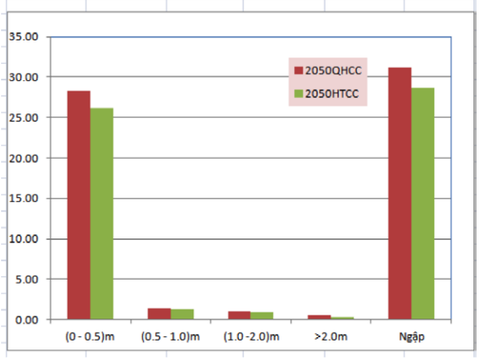
DIAGRAM 11

IMPACTS OF URBAN DEVELOPMENT ON FLOODING[9]

KB	(0 - 0.5)m	(0.5 - 1.0)m	(1.0 -2.0)m	>2.0m	Total
2020QHCC	22.73	1.02	0.73	0.37	24.84
2020HTCK	23.28	1.17	0.80	0.38	25.63



Scenerios	(0 - 0.5)m	(0.5 - 1.0)m	(1.0 -2.0)m	>2.0m	Total
2050QHCC	28.27	1.39	0.99	0.57	31.22
2050HTCC	26.11	1.29	0.90	0.38	28.67



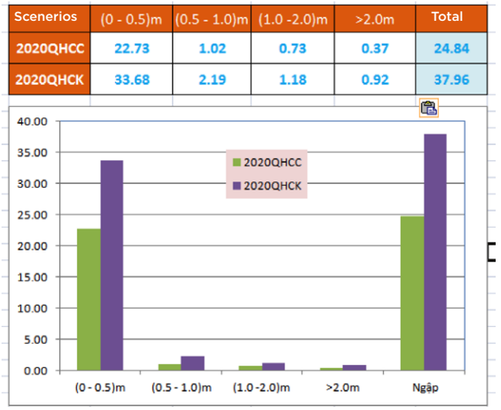
under the current climate and reservoir regulations, if the city urban development plan is fully implemented, 22.97 percent of the city will experience less severe flooding by 2020 (mostly thanks to raising of elevation in new urban areas and industrial zones), while 13.45 percent of the city will experience more severe flooding. Notably, inundation situations will be improved in only 15.84 percent of the city area, and are expected to become worse in 27.79 percent of the city area by 2050. Therefore the city needs to carefully reconsider its urban development plan so it can achieve its stated objectives (related to both flood management and socio-economic development).

The aforesaid research noted also pointed out the critical role of the operation of Binh Dien, Huong Dien and Ta Trach reservoirs on flooding, by proving that flooded areas will increase by more than 10 percent if these reservoirs are not regulated. However, there are currently no plans to implement any policies or plans to ensure the effective operation of these reservoirs.

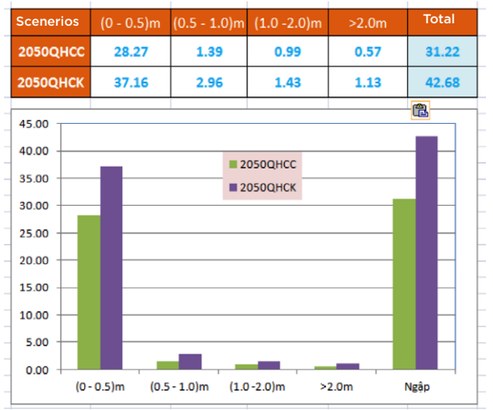
DIAGRAM 12

COMPARING FLOOD LEVELS WITH AND WITHOUT RESERVOIR REGULATION[9]

Scenerios	(0 - 0.5)m	(0.5 - 1.0)m	(1.0 -2.0)m	>2.0m	Total
2020QHCC	22.73	1.02	0.73	0.37	24.84
2020QHCK	33.68	2.19	1.18	0.92	37.96



Scenerios	(0 - 0.5)m	(0.5 - 1.0)m	(1.0 -2.0)m	>2.0m	Total
2050QHCC	28.27	1.39	0.99	0.57	31.22
2050QHCK	37.16	2.96	1.43	1.13	42.68



Financial resources for climate adaptation: According to the city's socio-economic development plan, the overall financial capacity of Hue City and residents will improve significantly by 2020 and will continue to improve in the subsequent decades. This statement is based on development objectives such as: per capita GDP of USD 5,000 by 2020; local government budget income growing by an average of 12–15 percent/year during the period from 2011–2020; an employment rate of over 97 percent; and poverty eradication by 2020.[11] However, there are a number of issues related to these objectives. First the above-mentioned figures are only targets; whether they can be reached is another issue. In the context of global economic recession, these objectives are quite ambitious. Secondly, there have been no policies or documents pointing to the funding or measures to acquire financial resources to support climate adaptation activities, especially to resolve current problems (as presented in the section on Vulnerability Assessment). If the financing issue is not clarified, the implementation of this plan will hardly be practical.

Flexibility, redundancy and safe failure in infrastructure systems: According to the report on adjustment of Hue City Master Plan until 2030 with vision to 2050, almost all infrastructures in Hue will be improved and upgraded, and new infrastructure will be built. For example, there will be investment in construction of major multipurpose irrigation works in upstream areas such as Ta Trach, Binh Dien (Huu Trach river), Huong Dien and Be Luong (Bo River); protection and construction of dykes to prevent erosion at critical sections of rivers, channels and lakes; encroachment prevention for rivers and annual dredging to accelerate drainage to the sea; new flood retention lakes and drainage canals; surface water sewers in 100 percent of the urban road systems by 2020; completion of almost all

modern urban infrastructures for the city up to regional standards; upgrading and strengthening of the early warning system; collection of 95–100 percent of solid waste with standard treatment by 2020; upgrading of all health and education facilities to national standards; and restoration and conservation of historical and cultural heritage sites. The issue with these plans is that all of the aforesaid objectives only provide a direction, without detailed technical analysis of their practicality. They also fail to consider climate change and climate resilience aspects such as flexibility, redundancy and safe failures. Furthermore, very few non-structural measures are mentioned, and only a few projects mentioned 'no-regret' solutions in flood management such as afforestation, protection of headwater vegetation and proper land-use plans for upstream areas of watersheds to control floodwater accumulation and prevent erosion.

Information-sharing mechanisms and capacity to learn: Based on the current information available, there are no specific measures identified to improve these areas, despite the critical importance of building resilience for the city.

SUMMARY OF FUTURE VULNERABILITY

In the future, flooding will remain the most serious risk to the city. It is important to note that the actual flood vulnerability level of Hue City may be significantly higher than assessment results for the following reasons: climate change might happen more quickly and have more severe impacts than projected under the moderate B2 scenario (which was used in this assessment); compound impacts of other extreme natural disasters; development objectives might not be achieved; and urban plans may not be adjusted; and reservoirs may not be regulated effectively.

The types of impacts caused by floods will continue to be similar in nature, however the magnitude and severity of impacts on each population group, and time distribution of risk will be different. The urban transportation system, especially roadway systems, and the agriculture sector will continue to be vulnerable. Meanwhile, historical structures and the tourism/service sector, and major public facilities such as schools, hospitals will become more vulnerable. Community groups, farmers, urban development resettled households, manual labor and immigrant workers are those who will require the most attention. In terms of location vulnerability, flooding will most likely decrease in inner-city areas, but become worse in outer-city areas and areas surrounding new urban development sites. Highest risk areas include Huong Vinh, Huong Toan, Huong Phong, Tu Ha, Quang Thanh, Quang An, Thuy Thanh, Phu Thanh, Phu Mau, Phu Duong and Thuy Bieu.

Areas of focus (based on assessment) to build resilience for the city:

- Review and update plans, policies and development objectives to incorporate aspects related to future climate change;
- Review and update future urban development plans to be systematic and comprehensive, and to minimize negative impacts on flooding in the city;
- Introduce innovative solutions and regulations for the management and operation of hydropower reservoirs;
- Create response plans and build the capacity of the community to respond to unexpected and extreme events. Flexibility, redundancy and safe failure criteria will be used to assess this work.
- Develop clear mechanisms and measures to mobilize finance for building climate resilience; and
- Promote strong commitment in provincial and city governments to be decisive in their response to climate change; resolve the overlaps and confusion in the roles and responsibilities of stakeholders; resolve the ineffectiveness of cross-sector coordination and the absence of a capable well-staffed focal agency for climate change resilience.

Endnotes

1. Nguyen Viet & Phan Van Hoa. 2000. Climate change during the last 100 years and projections for flood season of 2000. Science and Technology Journal of Thua Thien Hue (27).
2. Climate change scenarios for Vietnam, 2011.
3. Level 2 Warning: Dangerous flooding condition, with inundation in low areas, except for towns and cities protected from flooding. In-channel flows at high velocity endanger riverbanks, erode dykes and lead to high erosion risks of bridge abutments. Level 3 Warning: Very dangerous flooding conditions, with inundation in all low-lying areas, including areas inside cities. Protective dyke systems are threatened, with initial infrastructure damage. Above Level 3 Warning: Emergency flooding condition—floods are uncontrollable on a large scale, dyke failures are difficult to avoid and maybe out of control, with serious infrastructure damage (Central Committee for Flood and Storm Control).
4. According to the Geography Book of Thua Thien Hue province.
5. http://www.husta.org/tin-khoa-hoc-cong-nghe/bien-doi-khi-hau-va-van-de-san-xuat-nong-nghiep-o-thua-thien-hue.html
6. Ministry of Science and Technology. Synthesis report of the project "Investigating recovery and adaptation plans for Thuan An and Tu Hien coastal estuaries and Tam Giang-Cau Hai lagoon". Hanoi, July 2001.
7. Synthesized from the report on agriculture production by the Department of Agriculture and Rural Development
8. The four on-the-spot principles: command on the spot, supplies on the spot, human resources on the spot and logistics on the spot.
9. Assessment of Flooding and Flood Drainage Capacity of Urban Areas of Hue City under the Impacts of Climate Change, 2014.
10. According to the Socio-Economic Development Plan of Hue City until 2020.
11. According to the report on Adjustment of Hue City Urban Master Plan until 2030, with vision to 2050.

SECTION 3
BUILDING RESILIENCE TO CLIMATE CHANGE

1. IDENTIFYING ADAPTIVE MEASURES

1.1. Key issues

The purpose of identifying adaptive measures is to address the underlying causes for increased vulnerability of systems and agents, and to help the city actively respond to potential extreme and abnormal climate events in the future. Key issues to be addressed can be summarized from the M-BRACE vulnerability assessment as follows:

- Limited awareness among local people, departments, agencies, mass organizations and the private sector about climate change and its impacts, the compounding impacts of natural disasters and uncertainty about extreme climate events.
    - Poor communities such as farmers, informal laborers and resettled households tend to have lower levels of awareness than other population groups.
    - An in-depth understanding among responsible government agencies, especially planning agencies related to climate change, is critical to building climate resilience for the city.
- Limited capacity across sectors, levels and communities to assess future vulnerabilities, develop plans, implement climate adaptive measures and integrate climate uncertainties and climate resilience into development plans and urban plans.
    - There is a strong need for capacity building in the planning and investment, construction, transport, tourism and service sectors.
    - There is a lack of technical staff with sound expertise in this area. Without this, the city will always be reactive when responding to climate change, and will be dependent upon external expertise.
    - Capacity building for local communities is crucial because local communities are the people directly and most severely affected.
- The roles of departments, agencies and organizations in building climate change resilience are not clearly defined and regulations and guidelines are not enforced.
- Urban planning and urban infrastructure planning in particular is of great importance to building climate resilience. However, currently and most likely into the future these planning processes may exacerbate flooding in Hue. The reasons are:
    - In most cases, plans are developed based mostly on historical disaster data without consideration of climate change impacts, especially extreme and abnormal conditions, and they do not provide measures to respond to these type of events.
    - Plans are not systematic or well coordinated (measures to reduce floods in one area can increase floods in another area).
    - Plans of different sectors still overlap.
- The reservoir system plays an important role in responding to floods in Hue. However, there have been no innovative solutions to effectively manage the operation of these reservoirs, especially in major flood events. Thua Thien Hue province and Hue City do not have preventive measures and intervention plans in place for reservoir failure events.
- The integration of climate change resilience into current and future plans has not been done or has not been done appropriately. The provincial and city governments do not have any legal documents addressing this issue. There are no guidelines or technical support available for departments, agencies or the community.
    - The integration of climate change into land-use plans, urban construction and infrastructure development plans (especially transportation, public facilities such as schools, hospitals, health clinics), tourism sector plans and socio-economic development plans is essential.
    - Regarding communities, it is necessary to integrate climate change into policies to support farmers, resettlement groups, informal workers and immigrant labor.
- Local people, especially poor communities in peri-urban areas of An Hoa, An Tay, Huong So, Phu Binh, Phu Hau, Phu Hiep, Huong Long, Thuan Loc, Thuy Bieu, Thuy Xuan and Vy Da wards face many difficulties in accessing information about development plans and climate change. Communities, especially in peri-urban areas, are often not consulted properly, and are not involved in decision-making processes related to the development of plans that directly affect their lives and livelihoods. Several examples identified were related to resettlement in new urban areas such as An Van Duong, Huong So and Vy Da.
- Financial resources allocated to climate resilience are minimal and rely mostly on external sources. The city does not have any innovative measures to explore and allocate funds for these activities.
- A synchronized, reliable and regularly updated database on natural disasters and climate change that enables the city, departments and communities to make informed decisions about climate adaptation is still absent. Cross-sector and cross-level information sharing and learning are also limited. The city does not currently have plans for developing a database like this in the future.
- Infrastructure most vulnerable to the impact of floods:
    - The road transportation system;
    - Historical and cultural heritage sites;
    - Essential public facilities such as schools, hospital and health clinics. These are not examined thoroughly in risk assessments, and there are no measures in place for the operation of these facilities in emergency or extreme natural disaster events.
- Lack of detailed assessment and solutions for other potential climate impacts such as droughts, heat waves, prolonged extreme cold weather and the cumulative impacts of multiple disasters. These issues need to be addressed thoroughly when this Action Plan is updated.
- Community groups that need special attention are: farmers (in Thuy Bieu, Thuy Xuan, Huong Long, Xuan Phu, An Tay and especially An Dong and Huong So wards for the current period, and in Huong Phong, Huong Vinh, Huong Toan, Quang Thanh, Phu Thanh, Phu Mau, Phu Thuong, Phu Hoa, Thuy Thanh, Thuy Chau for the future); urban development-related resettlement households, resettlement households who used to live on Tam Giang lagoon; and the unskilled workers' group.

1.2. Methods to identify adaptive measures

Principles in identifying adaptive measures include:

- Focus should be on measures that directly affect the city, but consider interactions with surrounding areas and interventions outside the administrative boundary but important to the city.
- Priority is given to the most vulnerable people and systems and to the most urgent issues.
- Measures need to be specific, innovative and feasible.
- Measures should be diverse (addressing needs for capacity, awareness and finance, from technical and institutional aspects, consider structural and non-structural approaches, and should be 'no-regret').
- Measures should be consistent with the provincial and city strategies, policies and plans.
- Consultation with related stakeholders must occur, especially beneficiaries, if necessary.

Adaptive measures must also consider the innovation (are there any differences and breakthroughs compared to conventional approaches), lessons learned (from past experience, other cities, applying new knowledge) and coordination (measures to support a group or area should not be at the expense of other groups or areas); they must be diverse and flexible, to allow a system or a community to adapt to different climate conditions over time.

METHODS TO IDENTIFY ADAPTIVE MEASURES

Measures were identified and analysed by the core technical group of M-BRACE in Thua Thien Hue during group discussions with support from ISET-International. For each issue raised in the previous section, one or several solutions were identified based on the above principles. The team then analysed each solution using the following procedural order:

1. Title
2. Objectives and expected results
3. Duration
4. Scale and priority groups and areas
5. Potential source of funds
6. Linkage to other programs/ projects
7. Roles of key stakeholders

2. SUGGESTED ADAPTIVE MEASURES

After identifying and analysing suggested measures, the technical team agreed on the following measures (see Table 10 and Appendix 2). Measures are listed in the order of time and categorized into three groups: Infrastructure, Capacity and Institution.

TABLE 10
LIST OF SUGGESTED ADAPTIVE MEASURES

NO.	SUGGESTED SOLUTIONS	PERIOD	GROUP		
			Infra-structure	Capacity	Institution
I. Awareness and capacity building					
1	Develop and implement plans to build awareness on climate change and its impacts on vulnerable communities	2014-2015		x	
2	Adapt technical information on urban planning and climate change for public communication	2014–2015		x	x
3	Develop a systematic database on climate change and information-sharing mechanisms	2014–2015		x	x
4	Build capacity in development and implementation of climate change adaptation action plans, and integration of climate change into socio-economic development plans for ward/commune level staff	2014–2016		x	x
5	Build capacity in development and implementation of the Climate Action Plan, and integration of climate change into socio-economic development plans for provincial-level department staff and the People's Committee of Hue City	2014–2016		x	x
6	Study the impacts of droughts and prolonged heat and cold spells on Hue City and identify adaptive measures	2016–2018		x	x
7	Review and update the annual Climate Action Plan, and review and update overall plans in 2015 and 2020	2014–2020			x
8	Review and assess the resilience of hospitals and schools to extreme and unusual natural events plus maintenance and reinforcement	2014–2020	x		x
II. Institutions and Management					
9	Allocate annual budget for climate change in the city	2014			x
10	Establish synchronized mechanisms for planning, and develop transportation and water supply systems	2014–2015			x
11	Establish a provincial-level climate change coordination office	2014–2015		x	x
12	Review and develop measures to respond to arising problems in reservoir management and operation, and organize annual drills	2014–2015		x	x
13	Review and adjust the new urban plan with consideration of climate change and its impacts on flooding in the city	2014–2015	x	x	x
14	Establish a city-level climate change working group	2014		x	x

NO.	SUGGESTED SOLUTIONS	PERIOD	GROUP		
			Infra-structure	Capacity	Institution
15	Develop a mechanism for monitoring community consultation in development and implementation of the urban development plan	2014–2015			x
16	Institutionalize climate change integration into the process of construction planning, sector development planning and local development planning	2014–2016			x
17	Conduct pilot integration for several sectors: urban planning and tourism	2014–2016		x	x
18	Integrate climate change into social security programs (elimination of temporary housing, resettlement, livelihood support to poor households)	2014–2020		x	x
19	Promote mobilization of investment and financial support to climate change	2014–2020		x	x
III. Technology and Infrastructure					
20	Apply new material and technologies in transportation infrastructure development to increase durability and tolerance to flood impacts	2014–2016	x		
21	Develop a floodway plan for the city and update the drainage plan with consideration of climate change	2014–2016	x	x	x
22	Upgrade and dredge the drainage system and balance lake distribution in the Citadel area	2015–2020	x		
23	Develop flood control infrastructure for the city	2015–2020	x		
24	Establish an early flood warning system	2014–2020	x		x

SECTION 4
IMPLEMENTATION

DEVELOPING SYSTEMS AND MECHANISMS FOR COORDINATION

It is critical for the successful implementation of the Action Plan that the People's Committee of Hue City establishes a Steering Committee and a Working Group to implement the Action Plan.

The Steering Committee should include:

- A Vice-Chairman of the City People's Committee as Head of the Steering Committee;
- A leader from the technical department under the City People's Committee as Deputy Head; and
- Leaders from divisions, subdepartments, agencies, mass organizations and ward-level People's Committees.

The role of the **Working Group** is to provide advice and supervision of the implementation process.

RESPONSIBILITIES OF THE STEERING COMMITTEE AND CORE WORKING GROUP

- Support the City People's Committee and the Chairman of the City People's Committee in directing the implementation of the climate adaptation measures for the city;
- Organize the implementation of the Action Plan, with priority given to the most urgent activities;
- Review and evaluate the implementation of the Climate Action Plan annually; and
- Provide advice to the City People's Committee in revising and supplementing the Action Plan corresponding to changes in the development of the city.

ROLES AND RESPONSIBILITIES OF HUE CITY PEOPLE'S COMMITTEE

- Establish a Steering Committee and working group responsible for adaptation to climate change in Hue City;
- Develop a mechanism for effective implementation and monitoring of the Climate Action Plan;
- Annually review of budget allocation for the project to reduce impacts of climate change in the city;
- Develop policies to attract investment on climate change adaptation for the city; and
- Integrate contents of the Action Plan into socio-economic development plans, programs and projects of the city.

ROLES AND RESPONSIBILITIES OF DEPARTMENTS AND AGENCIES

- Work with Hue City People's Committee to develop and implement the annual Action Plan;
- Suggest and integrate contents of the Action Plan into plans, programs and projects of their sectors; and
- Participate in general coordination activities as assigned by the province.

ROLES AND RESPONSIBILITIES OF WARD PEOPLE'S COMMITTEES

- Lead the implementation of the Climate Action Plan as approved by the City People's Committee; and
- Work together with related stakeholders to implement the plan in their wards.

ROLES AND RESPONSIBILITIES OF CIVIL SOCIETY ORGANIZATIONS AND THE PRIVATE SECTOR

Political-social and social-professional organizations, mass associations, non-governmental organizations and businesses actively participate in climate adaptation activities relevant to their fields, especially related to education and communication; mobilizing community participation; sharing experiences and good practices; and implementing or participating in climate change-related projects in the city.

IMPLEMENTATION PERIOD

This is based on a time frame approved by the City People's Committee.

FINANCIAL MECHANISM

The Provincial and City People's Committee will allocate an annual budget for implementation, mobilize funds from the National Target Program to Respond to Climate Change (NTP-RCC), and assign this to projects in the city.

MONITORING AND EVALUATION

The Steering Committee is responsible for monitoring the implementation of projects, conducting annual evaluation and preparing reports.

Photo credit: Tho Nguyen, ISET-Vietnam

APPENDIX 1
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APPENDIX 2
DESCRIPTION OF ADAPTATION MEASURES

TITLE: DEVELOP AND IMPLEMENT PLANS TO BUILD AWARENESS ON CLIMATE CHANGE AND ITS IMPACTS ON VULNERABLE COMMUNITIES	
Duration	**2015**
Priority groups and areas	• Thuy Bieu, Huong So, Phu Hau, Phu Hiep, Phu Cat, Huong Long, An Hoa, An Dong, Xuan Phu and Vy Da wards • Poor communities, informal labor
Objectives and expected results	100% of vulnerable groups have access to information related to climate change, its impacts and adaptive measures
Notes for project development	• This should be linked closely to other related programs (such as Decision No. 1002/QD-TTg dated 13 July 2009 by the Prime Minister, and resettlement programs) • Focus should be on vulnerable groups. • Information needs to be two-way. • Details of activities should be consistent with existing needs and livelihoods.
Sources of funds	• NTP-RCC • Decision No. 1002/QĐ-TTg dated 13 July 2009 by the Prime Minister • Natural disaster prevention plan and strategies of the province and the city
Roles and responsibilities	The city to lead; organizations, agencies, NGOs and other stakeholders to implement

TITLE: ADAPT TECHNICAL INFORMATION ON URBAN PLANNING AND CLIMATE CHANGE FOR PUBLIC COMMUNICATION	
Duration	**2014-2015**
Priority groups and areas	New urban areas such as An Van Duong, Huong So, Vy Da; vulnerable groups
Objectives and expected results	Disseminate, demonstrate and explain about details of the urban development plan to communities and its impacts on their lives
Notes for project development	Linkages to related programs such as urban development plan, new urban development and resettlement plans
Sources of funds	City budget and budget from urban development projects
Linkage to other programs/projects	New urban area development plans
Roles and responsibilities	The city to lead; Department of Construction (DOC) to take technical responsibility

TITLE: DEVELOP SYSTEMATIC DATABASE ON CLIMATE CHANGE AND INFORMATION-SHARING MECHANISM	
Duration	**2014-2015**
Priority groups and areas	Thua Thien Hue province, and pilot in Hue City
Objectives and expected results	Database is established and managed

TITLE: DEVELOP SYSTEMATIC DATABASE ON CLIMATE CHANGE AND INFORMATION-SHARING MECHANISM	
Duration	**2014-2015**
Notes for project development	• This proposal should be suggested as a component under the provincial project on database development • Synthesize and process available data and information for the database • Complete the database on flood monitoring and the CIMPAC tool (Cascadia) • Learn from the experience of Da Nang and Can Tho cities
Sources of funds	• Provincial budget/budget of the science and technology sector • External resources
Linkage to other programs/projects	• NTP-RCC • Combine with the website of Thua Thien Hue province • DOC program on plan alignment for the city
Roles and responsibilities	• Provincial People's Committee to lead • Technical responsibilities: Department of Natural Resources and Environment (DONRE), Department of Information and Communication (DOIC), Hue City People's Committee

TITLE: BUILD CAPACITY IN DEVELOPMENT AND IMPLEMENTATION OF CLIMATE ACTION PLAN, AND INTEGRATION OF CLIMATE CHANGE INTO SOCIO-ECONOMIC DEVELOPMENT PLANS FOR WARD-/ COMMUNE- LEVEL STAFF	
Duration	**2014-2016**
Priority groups and areas	• Technical staff in agriculture, transportation and urban management, tourism and services, natural resources and environment, flood and storm control, chair and vice-chair of ward-level People's Committees responsible for flood and storm control • Pilot areas: An Dong, Xuan Phu, Phu Hau, Thuan Loc and Huong So wards
Objectives and expected results	100% of vulnerable groups have access to information related to climate change, its impacts and adaptive measures
Notes for project development	• This should be linked closely to other related programs (such as Decision No. 1002/ QD-TTg dated 13 July 2009 by the Prime Minister, and resettlement programs) • Focus on vulnerable groups • Information needs to be two-way • Details of activities should be consistent with existing needs and livelihoods of people
Sources of funds	• City budget: Priority is given to specific focus areas; • External budget (provincial budget, national budget, NGOs): other activities
Linkage to other programs/projects	• NTP-RCC • Decision No. 1002/QĐ-TTg dated 13 July/2009 by the Prime Minister; • Natural disaster prevention plan and strategy of the province and the city
Roles and responsibilities	The city to lead, organizations, agencies, NGOs and other stakeholders to implement

TITLE: BUILD CAPACITY IN DEVELOPMENT AND IMPLEMENTATION OF THE CLIMATE ACTION PLAN, AND INTEGRATION OF CLIMATE CHANGE INTO SOCIO-ECONOMIC DEVELOPMENT PLANS FOR PROVINCIAL-LEVEL DEPARTMENT STAFF AND PEOPLE'S COMMITTEE OF HUE CITY	
Duration	**2014-2016**
Priority groups and areas	Focal staff from the departments of construction, transport, agriculture and rural development, natural resources and environment, and investment and planning, and Hue City People's Committee
Objectives and expected results	100% of focal staff from the departments and Hue City People's Committee are trained and can develop the Climate Action Plan for their sectors/areas

TITLE: BUILD CAPACITY IN DEVELOPMENT AND IMPLEMENTATION OF THE CLIMATE ACTION PLAN, AND INTEGRATION OF CLIMATE CHANGE INTO SOCIO-ECONOMIC DEVELOPMENT PLANS FOR PROVINCIAL-LEVEL DEPARTMENT STAFF AND PEOPLE'S COMMITTEE OF HUE CITY	
Duration	**2014-2016**
Notes for project development	• Build capacity first for the key technical experts, and then for the other groups • Organize training combined with pilot Action Plan development and integration for some sectors and areas
Sources of funds	• Provincial budget for pilot activities • External resources (national budget, NTP-RCC, international donors) for replication
Linkage to other programs/projects	NTP-RCC
Roles and responsibilities	• The Provincial People's Committee to lead • Department of Natural Resource and Environment to be the focal point

TITLE: STUDY IMPACTS OF DROUGHTS AND PROLONGED HOT AND COLD SPELLS ON HUE CITY, AND IDENTIFY ADAPTIVE MEASURES	
Duration	**2016–2018**
Priority groups and areas	Droughts and prolonged hot and cold spells in Hue City
Objectives and expected results	Identify vulnerabilities of the city to droughts and hot and cold spells and adaptive measures
Notes for project development	Consider issues related to forest fires, water shortage and urban green solutions
Sources of funds	Provincial and city budget, external resources
Linkage to other programs/projects	NTP-RCC
Roles and responsibilities	• The city to lead • DONRE to coordinate with the technical support of other departments, agencies, colleges under Hue University, institutes, and research centers in the province

TITLE: REVIEW AND UPDATE ANNUAL CLIMATE ACTION PLANS, AND REVIEW AND UPDATE OVERALL PLANS IN 2015 AND 2020	
Duration	**2014–2020**
Priority groups and areas	Information related to weather, socio-economic conditions and climate adaptation activities of Hue City
Objectives and expected results	The plan is updated annually and reviewed overall in 2015 and 2020
Notes for project development	Need to update with results of related projects/activities. The review in 2015 and 2020 might need to include re-assessment of the city's vulnerabilities
Sources of funds	Provincial/city budget
Linkage to other programs/projects	NTP-RCC
Roles and responsibilities	• The city to lead • DONRE to provide advice • Local technical team and the working group to implement

TITLE: REVIEW AND ASSESS RESILIENCE OF HOSPITALS AND SCHOOLS TO EXTREME AND UNUSUAL NATURAL EVENTS PLUS MAINTENANCE AND REINFORCEMENT	
Duration	**2014–2020**
Priority groups and areas	Schools and hospitals/clinics in the city
Objectives and expected results	100% of schools and hospitals/clinics are upgraded for resistance to level-12 storms, and have plans to respond to unusual and extreme events
Notes for project development	Learn from the experience of Da Nang
Sources of funds	Provincial budget and external sources
Linkage to other programs/projects	NTP-RCC, flood and storm control plans, programs for education and health sectors
Roles and responsibilities	DOC, Steering Committee of the CFSC, Department of Education and Training, Department of Health

TITLE: ALLOCATE ANNUAL BUDGET FOR CLIMATE CHANGE IN THE CITY	
Duration	**2014–2020**
Priority groups and areas	Hue City
Objectives and expected results	Have an annual budget for climate change adaptation in Hue City
Notes for project development	Seek additional funding from other sources: other related projects of the province, international support
Sources of funds	• Regular budget of the province and city • Additional budget from external sources
Linkage to other programs/projects	NTP-RCC
Roles and responsibilities	City People's Committee, Department of Finance

TITLE: ESTABLISH SYNCHRONIZED MECHANISMS FOR PLANNING AND DEVELOP TRANSPORTATION AND WATER SUPPLY SYSTEMS	
Duration	**2014–2015**
Priority groups and areas	Pilot synchronized mechanisms for development and management related to building climate resilience for Kiem Hue, Phu Hau and Phu Hiep wards
Objectives and expected results	• Development and implementation of the mechanisms in several wards • Mechanisms developed for the entire city/province
Notes for project development	• In the short term, we can conduct pilot research in several areas. After that, the city/province mechanism can be developed. • Work with local people on the issues of sewage dumping on roads, solid waste disposal into the drainage system and construction of a drainage system
Sources of funds	Provincial/city budget
Linkage to other programs/projects	Combine with the city's water environment improvement and urban upgrade projects
Roles and responsibilities	• Provincial and City People's Committees • Department of Transport, Department of Construction, City People's Committee, Sanitation and Urban Infrastructure Company

TITLE: ESTABLISH A PROVINCIAL-LEVEL CLIMATE CHANGE COORDINATION OFFICE	
Duration	**2014–2015**
Priority groups and areas	Establish a provincial-level climate change coordination office
Objectives and expected results	The climate change coordination office is established, with a clear operation mechanism, functions and responsibilities, full-time staff and regular budget allocation.
Notes for project development	Learn from experience of Ben Tre, Ho Chi Minh City, Can Tho, Da Nang and Binh Dinh
Sources of funds	Provincial budget and NTP-RCC
Linkage to other programs/projects	NTP-RCC
Roles and responsibilities	• The province to lead • DONRE and the Provincial Steering Committee to Respond to Climate Chnge to be focal points

TITLE: REVIEW AND DEVELOP MEASURES TO RESPOND TO ARISING PROBLEMS IN RESERVOIR MANAGEMENT AND OPERATION, AND ANNUAL DRILLS	
Duration	**2014–2020**
Priority groups and areas	Hue City
Objectives and expected results	• Detailed plans for responding to emergency events • Conduct drills in all high-risk wards
Notes for project development	Emphasize the role of local people in the drills and other activities
Sources of funds	Provincial budget, provincial CFSC, city CFSC, Reservoir Management Board
Linkage to other programs/projects	Annual flood and storm control plan of Thua Thien Hue province and Hue City
Roles and responsibilities	Provincial CFSC to lead and coordinate with city CFSC and Reservoir Management Board

TITLE: REVIEW AND ADJUST NEW URBAN PLANS WITH CONSIDERATION OF CLIMATE CHANGE AND ITS IMPACTS ON FLOODING IN THE CITY	
Duration	**2014–2015**
Priority groups and areas	An Van Duong, Huong So, and Kiem Hue wards
Objectives and expected results	New urban areas plans and plan revisions are updated with consideration of climate change impacts.
Notes for project development	Study existing guidelines on integrating climate change into plans issued by the Ministry of Natural Resources and Environment (MONRE), and Ministry of Planning and Investment (MPI), and into urban development plan by the Institute for Architecture and Rural and Urban Planning (Ministry of Construction)
Sources of funds	Provincial/City People's Committees
Linkage to other programs/projects	NTP-RCC and the project on urban development in Vietnam to respond to climate change period 2013–2020
Roles and responsibilities	• Depending on specific cases, roles and responsibilities for management, coordination or implementation can be assigned to relevant departments, agencies and local governments (Department of Construction, Department of Transport, DONRE, Hue City People's Committee)

TITLE: ESTABLISH A CITY-LEVEL CLIMATE CHANGE WORKING GROUP	
Duration	**2014**
Priority groups and areas	Hue City
Objectives and expected results	• The City's People Committee issues the decision to establish a climate change working group to provide support and advice to the City People's Committee on capacity building to respond to climate change in the city. • Clear operation mechanism, functions and responsibilities, and budget for the working group
Notes for project development	• Need capacity building for members of the working group • Link to the province/city activities • Need regular budget for operation
Sources of funds	City budget and external funds
Linkage to other programs/projects	NTP-RCC
Roles and responsibilities	• The city to lead • DONRE to provide guidance

TITLE: DEVELOP MONITORING MECHANISMS FOR COMMUNITY CONSULTATION IN DEVELOPMENT AND IMPLEMENTATION OF URBAN DEVELOPMENT PLANS	
Duration	**2014–2015**
Priority groups and areas	New urban area development projects
Objectives and expected results	Mechanisms are issued and implemented.
Notes for project development	Pilot implementation in several areas before finalizing the mechanisms for city/provincial levels
Sources of funds	Provincial/city budget
Linkage to other programs/projects	Urban development program
Roles and responsibilities	• Provincial People's Committee • Department of Construction to provide guidance

TITLE: INSTITUTIONALIZE CLIMATE CHANGE INTEGRATION INTO CONSTRUCTION PLANNING, SECTOR DEVELOPMENT PLANS AND LOCAL DEVELOPMENT PLANS	
Duration	**2014–2016**
Priority groups and areas	Issues related to planning in Hue City
Objectives and expected results	• Thua Thien Hue Provincial People's Committee issues decision requiring sectors and local governments to integrate climate change into urban and development plans • Guidelines on integration are developed
Notes for project development	Learn from experience of other provinces/cities (Binh Dinh, Da Nang), MONRE, MPI
Sources of funds	Provincial budget
Linkage to other programs/projects	NTP-RCC
Roles and responsibilities	• The province to lead • DONRE and the Steering Committee of the NTP-RCC to act as focal points

TITLE: CONDUCT PILOT INTEGRATION FOR SEVERAL SECTORS: URBAN PLANNING AND TOURISM	
Duration	**2014–2016**
Priority groups and areas	Urban management and tourism sectors of Hue City
Objectives and expected results	Climate change is integrated into the sectors' development plans.
Notes for project development	Learn from experience of Binh Dinh, Da Nang and the tourism project funded by Spanish (I)NGO in Hue
Sources of funds	Provincial/city budget
Linkage to other programs/projects	NTP-RCC, project on urban development to respond to climate change in Vietnam period 2013–2020
Roles and responsibilities	• The province to lead • Department of Construction and Department of Culture, Sports and Tourism to be focal points

TITLE: INTEGRATE CLIMATE CHANGE INTO SOCIAL SECURITY PROGRAMS (ELIMINATION OF TEMPORARY HOUSING, RESETTLEMENT, AND LIVELIHOOD SUPPORT TO POOR HOUSEHOLDS)	
Duration	**2014–2020**
Priority groups and areas	Pilots in An Hoa, Huong So and Phu Hau wards, and Thuong Thanh-Eo Bau
Objectives and expected results	Apply flood- and storm-resistant techniques for construction in resettlement programs and elimination of the temporary housing program
Notes for project development	• Collaborate with the DOC program • Learn from the models and experience of Da Nang City
Sources of funds	Provincial/city budget
Linkage to other programs/projects	• NTP-RCC • Program on designing storm-resistant houses (led by the DOC)
Roles and responsibilities	• City People's Committee to lead • DOC to lead or coordinate • Department of Labor, War Invalids and Social Affairs (DOLISA) to be the focal point

TITLE: PROMOTE MOBILIZATION OF INVESTMENT AND FINANCIAL SUPPORT TO CLIMATE CHANGE	
Duration	**2014–2020**
Priority groups and areas	Hue City
Objectives and expected results	Increasing annual budget for climate change activities from international sources
Notes for project development	• Work together with the Center for International Cooperation and Center for Investment Promotion of the province • Have a proper incentive mechanism for potential organizations and individual investors • Strengthen the network and mobilize support from MONRE
Sources of funds	Provincial and city budget
Linkage to other programs/projects	NTP-RCC, National Support Program to Respond to Climate change (SP-RCC)
Roles and responsibilities	DONRE to be the focal point and collaborate with the Center for International Cooperation and Center for Investment Promotion of the province

TITLE: APPLY NEW MATERIAL AND TECHNOLOGIES IN TRANSPORTATION INFRASTRUCTURE DEVELOPMENT TO INCREASE DURABILITY AND TOLERANCE TO FLOOD IMPACTS	
Duration	**2014–2015**
Priority groups and areas	Pilot in Kiem Hue, Phu Hau and Phu Hiep areas
Objectives and expected results	• New road construction; use new materials and technologies • Quality monitoring and evaluation reports
Notes for project development	• There should be a method for monitoring, evaluation and comparison of quality between roads using new and old types of materials. • Mechanism to encourage use of new materials
Sources of funds	Provincial/city budget
Linkage to other programs/projects	City urban upgrading project
Roles and responsibilities	• The province and city to allocate funds for pilot implementation • Department of Transport to lead implementation in collaboration with other stakeholders

TITLE: DEVELOP FLOODWAY PLAN FOR THE CITY AND UPDATE THE DRAINAGE PLAN WITH CONSIDERATION OF CLIMATE CHANGE	
Duration	**2014–2016**
Priority groups and areas	Huong River Basin
Objectives and expected results	• Improve flood drainage capacity, reduce flood depth and flood duration in Hue City • Develop a master plan for floodways and update floodways
Notes for project development	Development of the floodway plan should consider all related sectoral plans
Sources of funds	Provincial/city budget
Linkage to other programs/projects	Flood and storm control plan, NTP-RCC
Roles and responsibilities	• The province to lead • CFSC and DONRE to collaborate in implementation

TITLE: UPGRADE AND DREDGE THE DRAINAGE SYSTEM AND RETENTION LAKES IN THE CITADEL AREA	
Duration	**2015-2020**
Priority groups and areas	Areas surrounding the Citadel, Ngu Ha River, Tinh Tam Lake
Objectives and expected results	• Restore flood drainage and flood retention capacity of infrastructure • Contribute to protection and stability of heritage structures
Notes for project development	Ensure close collaboration between the management board, Ancient Hue Heritage Preservation Center, Hue City People's Committee and Hue Sanitation and Urban Infrastructure Company
Sources of funds	Province/city budget and other sources
Linkage to other programs/projects	City urban upgrade project, heritage preservation and restoration projects
Roles and responsibilities	• The province/city to lead • Ancient Hue Heritage Preservation Center and Hue Sanitation and Urban Infrastructure Company to implement

TITLE: DEVELOP FLOOD CONTROL INFRASTRUCTURE FOR THE CITY	
Duration	**2015-2020**
Priority groups and areas	
Objectives and expected results	• Resettle all households living in floodway zones in Hue • Develop a system of dykes and roads along rivers: Ke Van River, Lap River, An Cuu River (from An Cuu bridge to Hoang Quoc Viet road), Nhu Y River embankment • Restore lake water retention function (Bau Va, Au and Mung lakes)
Notes for project development	Focus on compensation policy when clearing the sites for timely implementation
Sources of funds	Provincial/city budget
Linkage to other programs/projects	Resettlement and flood and storm control programs
Roles and responsibilities	Hue City People's Committee (Project Management Board, Hue Sanitation and Urban Infrastructure) to lead and coordinate with other agencies for implementation

TITLE: ESTABLISH AN EARLY WARNING SYSTEM FOR FLOODING	
Duration	**2014-2020**
Priority groups and areas	Huong River Basin, with priority for the city area
Objectives and expected results	Early warning system installed and functional
Notes for project development	Establish water level and river flow monitoring stations for locations in front of reservoir floodgates
Sources of funds	Provincial budget and external sources
Linkage to other programs/projects	Flood and storm control plan, NTP-RCC
Roles and responsibilities	• The province to lead • The provincial CFSC to be the focal point • The city CFSC to participate • Consult with the Hydrometeorology Forecasting Center and other related agencies

APPENDIX 3
DRAINAGE PROJECTS IN THE CITY

- Drainage project (phase 1) funded by Nord-Pas-de-Calais Region (France), implemented from 1995-1996 for roads in Phu Hiep, Thuan Hoa, Phu Hoi and Vinh Ninh wards
- Drainage project (phase 2) funded by Nord-Pas-de-Calais Region (France), implemented in 1997-1998 for roads in Thuan Loc and Thuan Thanh wards
- Drainage project (phase 3) funded by Nord-Pas-de-Calais Region (France), implemented in 1995-1996 for roads in Tay Loc, Thuan Hoa and Thuan Thanh wards
- Project on wastewater drainage system for Hue City, with loans from the Belgium Government. However, during the implementation of this project, many issues arose, and the project was canceled when only 10 percent of the work was completed
- National- and provincial-funded drainage projects in Hue City [refer to website of Hue City People's Committee]:
- Project for developing new settlement areas in An Van Duong, Kiem Hue, Southeast Thuy An, Vy Da, Phu Hau, Huong So, Kim Long, Thuy An, An Cuu, Thuy Xuan and Thuy Bieu which includes drainage infrastructure
- Project for dredging of rivers and riverbank erosion
- Improvement of leachate treatment at Thuy Phuong landfill
- Improvement of lakes in the old capital area and drainage of roads in Thuan Thanh ward
- Dredging of Ngu Ha and Ke Van rivers
- Improving pavements, dredging drains and providing lighting for Chu Van An, Vo Thi Sau, Pham Ngu Lao and other major streets
- Improving pavements and drainage of roads in the old capital city area
- Drainage improvement for major flooding sites

In general, all local projects are small (below VND30 billion), and only aim to resolve immediate issues related to drainage in Hue City.

In the coming period, the project Improving Water Environment in Hue City will be implemented. This large project aims to thoroughly improve the drainage system of Hue City (firstly the area south of Huong River) via the following components:

- Dredging and dyke construction for Phat Lat, Ho Thanh Hao, Dong Ba and Ngu Ha channels, An Cuu rivers and lakes.
- Construction of new drainage channel systems, with about 180 000m of drains; construction of drains connecting lakes and ponds to regulate rainwater flow
- Application of a semi-centralized sewerage system: investments in interceptor sewers, collection sewers, pumping stations and sewerage treatment stations

Source: Improving Water Environment in Hue City project

It is expected that this project will help to resolve the flooding problems caused by rain and reduce inundation in the old capital area, contributing to the socio-economic development of Hue City.

Photo credit: Tho Nguyen, ISET-Vietnam

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