Climate-inclusive Hazard Assessment: A key to Risk-informed Urban Planning

Case Study

July 2024

Climate change's impact on cities

Climate change is intensifying at an unexpected rate than predicted by the Scientific Community. As a result, climate-induced hazards triggered by extreme weather and climate events are becoming more frequent and more intense when compared to the nature of hazards that occurred in the past. This highlights the very importance of incorporating climate change projections in hazard assessments and understand the risks from anticipated climate emergencies in the future.

Cities in Southeast Asia that are located in hazard prone areas such as low elevation and deltaic/costal zones will suffer substantial disaster losses and damages as a consequence of these increasing climate-changed induced extreme weather events. The major reason for this would be the increased migration of people towards cities that makes exposure and vulnerabilities escalate.

Capital and Maga Cities, in majority of the occasions, are supported by countries to build their capacity and resources in order to enhance the resilience to climate extreme events. The secondary/ medium-sized cities where the major economic growth is predicted to take place in the coming decade too experiences the same hazards and are prone to suffer sever disaster losses and damages due to lack of capacity and sufficient resources to be resilient against these extreme hazards. If these cities are not supported enough, the hard-earned development gains would be lost putting more and more urban dwellers at disadvantaged conditions.

My Tho and Nam Dinh, two secondary/medium-sized cities in Viet Nam

Asian Disaster Preparedness Center (ADPC) with financial assistance from the Norwegian Agency for Development Cooperation (Norad) implemented the "Urban Resilience to Climate Extremes in Southeast Asia (URCE)" regional program in two secondary (medium-sized) cities (My Tho and Nam Dinh) that aimed at building the resilience to climate extreme events.

My Tho City, located in the Mekong Delta in southern Viet Nam is home to around 228,109 people spanning an area of 81.54 km2. The city is 70 km to the south-west of Ho Chi Minh City, the major city in southern Viet Nam. My Tho City enjoys a strategic geographical location on the northern bank of the Tien River, acting as a hub for both road and water transportation. The City is well-positioned for achieving further economic development. Riverine/tidal flooding, heavy rain and typhoons are some of the major hazards present in the city.

My Tho City, Tien Giang Province, Viet Nam

Nam Dinh is a City in the Red River Delta in northern Viet Nam. Around 249,267 people live in the city in an area of 46.41 km2. Nam Dinh City is located in an important intersection of waterways and a key location for future development. The major climate-induced hazards threatening the city are typhoons and floods

Nam Dinh City, Nam Dinh Province, Viet Nam

Climate-inclusive Hazard Assessment

The Need

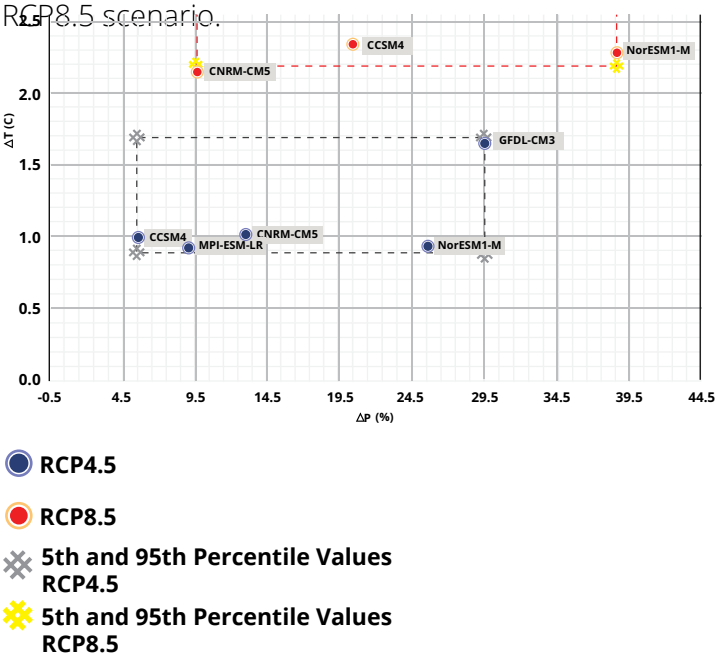
Nam Dinh and My Tho cities both happened to have hazard maps developed based on the historical data. However, the cities lack the understanding of the potential impact of future extreme events on the urban systems and communities with climate change.

ADPC assisted the city level authorities in carrying out a climate-inclusive hazard assessment to analyze the potential impact from climate extreme events. The hazards assessed were floods, typhoons and heat & cold waves. Differing from the traditional approach of carrying hazard assessments, where historical data were used, the city practitioners were trained on the utilization of climate change projections taking into account the medium and extreme climate scenarios. Maps for the most threatening hazards (Floods, Typhoons, Heat/Cold waves) were developed at the city level in partnership with the Peoples Committees and other relevant technical departments. City-specific atlases of maps were generated for the two cities to be served as references for their risk-informed urban planning.

Incorporating climate change effects into hazard assessment

It is essential to select the appropriate projected climate data (Temperature & Precipitation) to develop future hazard maps under different Representative Concentration Pathway (RCP) scenarios. In the Viet Nam context, a selection of suitable climate data was carried out based on the report published by Viet Nam Institute of Meteorology, Hydrology and Climate Change (IMHEN) of Ministry of Natural Resources and Environment (MONRE) and CSIRO, Australia titled "High-Resolution Climate Projections for Viet Nam: Technical Report"[1] . Six climate models were identified by the Report as suitable in Vietnamese context.

The main aim of the climate-inclusive assessment was to identify the maximum possible hazardous levels of floods, strong winds and heat & cold waves for My Tho and Nam Dinh cities in the future time horizons of 2030s, 2050s and 2080s under the RCP 4.5 (intermediate scenario) and 8.5 (worst case scenario) scenarios. Therefore, it was needed to identify those models that predict the extreme events. The change in annual mean temperature (ΔT) and % change of annual precipitation (ΔP%) (with reference to the base period from 1976 to 2005) from each of the models under the RCP 4.5 and 8.5 scenarios were plotted in a scatter plot to determine the models which fall close to 10th and 90th percentile. The models close to 10th percentile predict the lowest rainfall and temperature whereas the models close to 90th percentile predict the highest rainfall and temperature. Based on the scatter plot analysis, the models CCSM4 and GFDL-CM3 were found to be predicting the most extreme events under the RCP4.5 scenario whereas the models CNRM-CM5 and NorESM1-M predict extreme conditions under the RCP8.5 scenario.



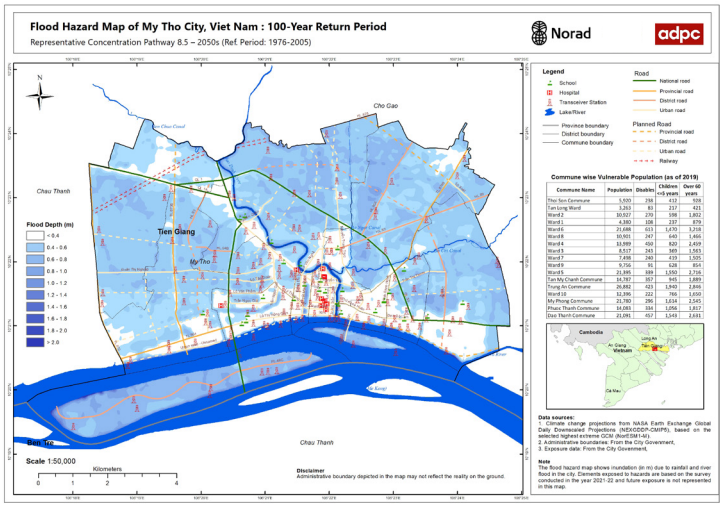
Scatter plot presenting the change in annual mean temperature (ΔT) and % change of annual precipitation (ΔP%) (with reference to the base period from 1976 to 2005) from selected climate models under the RCP 4.5 and 8.5 scenarios

[1]*Katzfey, JJ, McGregor, JL and Suppiah, R (2014). High-Resolution Climate Projections for Viet Nam: Technical Report. CSIRO, Australia. 266 pp*

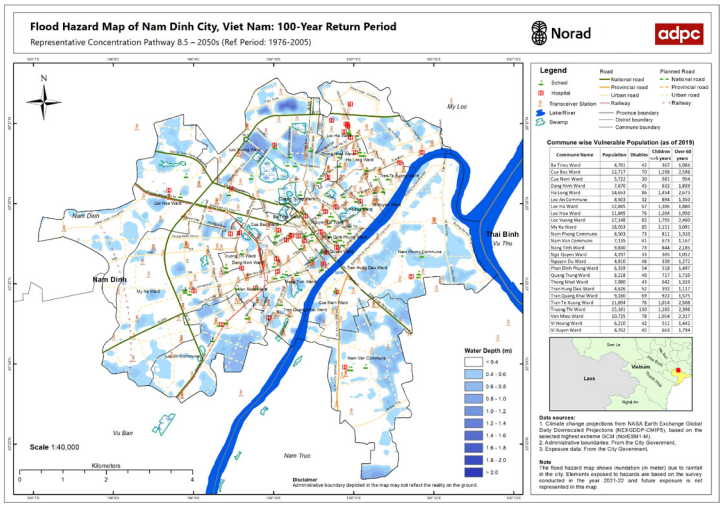
Hazard Assessment

The climate parameters (temperature and precipitation) from the above-selected models were used when modeling hazards in My Tho and Nam Dinh cities covering three future time horizons: 2030s, 2050s and 2080s. The hazards assessed were Floods, Typhoon and Heat wave/ Cold wave.

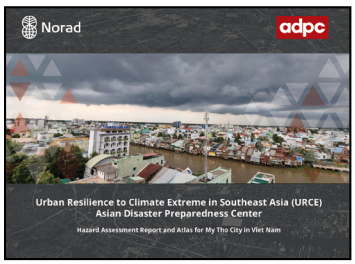
The maximum possible typhoon wind speeds, maximum & minimum temperatures, and maximum flood heights that the two cities may experience in future time horizons were determined from the assessment. In addition, all the hazards were presented in the form of maps indicating their spatial distribution. City-specific atlases of maps were compiled for both the cities as reference material for the cities. The online version of the atlases of maps are available on the URCE web page. (Atlas of My Tho City & Atlas of Nam Dinh City).

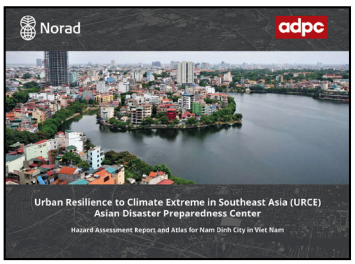


A flood hazard map from the Atlas of My Tho City, Viet Nam



A flood hazard map from the Atlas of Nam Dinh City, Viet Nam





The atlases of maps for the two target cities, My Tho and Nam Dinh Cities in Viet Nam

Contributions of Climate-inclusive Hazard Assessment to Risk-informed Urban Planning in My Tho and Nam Dinh cities

Climate-inclusive hazard assessment is vital for risk-informed urban planning. As cities grow and climate change accelerates, integrating climate projections into hazard assessments ensures urban areas are resilient, adaptive, and sustainable.

A few of the key contributions of climate-inclusive hazard assessment conducted in My Tho and Nam Dinh cities towards risk-informed planning can be listed as:

Enhanced Risk Understanding

Climate-inclusive assessments use climate models to project future hazard scenarios, providing a more accurate risk profile for urban areas. Moreover, climate change can lead to simultaneous or sequential hazards, such as heatwaves followed by intense storms. Climate-inclusive hazard assessments facilitate the recognition of these compound risks allowing planners to develop comprehensive risk mitigation strategies.

Improved Infrastructure Resilience

Incorporating future climate scenarios helps design infrastructure that can withstand extreme weather events, such as storm surges, flooding, and heatwaves. For example, building materials and designs can be selected to tolerate higher temperatures and more intense precipitation. Furthermore, Climate-inclusive assessments are able to highlight the importance of green infrastructure, such as parks, green roofs, and permeable pavements, which help manage stormwater, reduce heat islands, and improve urban resilience.

Informed Land Use and Development Decisions

As cities expand, climate-inclusive assessments guide the selection of sites for new developments, ensuring they are located in areas less prone to future climate impacts. High-risk areas,

such as floodplains or coastal zones, can be restricted for development, while safer areas are prioritized.

Enhanced Emergency Preparedness and Response

Integrating climate data into hazard assessments improves early warning systems, enabling timely and accurate alerts for extreme weather events. This enhances the ability of urban areas to prepare and respond to disasters. Developing emergency preparedness plans based on future climate scenarios ensures communities are better equipped to handle disasters. This includes identifying evacuation routes, emergency shelters, and communication strategies that account for changing hazards.

Policy and Decision-making Support

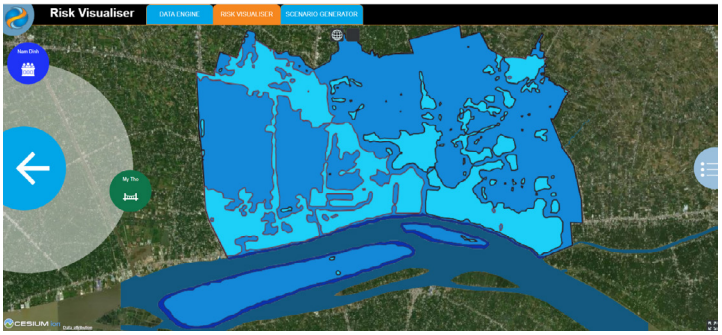
Climate-inclusive hazard assessments provide policymakers with scientific data to formulate policies that enhance urban resilience. This supports the creation of regulations, building codes, and land use plans that mitigate climate risks. Governments and private sector investors can make strategic decisions by understanding future risks. Investments in resilient infrastructure, adaptive technologies, and risk mitigation projects are prioritized, ensuring long-term urban sustainability.

Socio-economic Benefits

Proactive planning based on climate-inclusive hazard assessments can significantly reduce economic losses from climate-related disasters. By minimizing damage to infrastructure and disruptions to economic activities, cities can maintain economic stability and growth. Identifying vulnerable populations and areas allows for targeted interventions, ensuring that risk reduction measures benefit all residents, especially those who are most at risk.

Hazard & Risk Visualization Tool – MOBILISE

A hazard & risk visualization tool called MOBILISE was tailored to aid the Viet Nam Disaster and Dyke Management Authority (VDDMA) and My Tho & Nam Dinh in visualizing hazard and risks effectively. This was done in collaboration with the ThinkLab at the University of Salford in the United Kingdom. The MOBILISE Tool is a shared risk information database that can be accessed by a range of agencies involved in disaster preparedness, in order to establish a common understanding of the risk exposure, vulnerability and hazards in disaster-prone areas.



Risk Visualization tool - MOBILISE

Its visual interface can be used by decision-makers to collaborate on scenario building, risk reduction measures, and to develop disaster response plans. The tool is also capable of sending early warning messages to local offices and the community, and helps to establish situational awareness during disaster response.

The MOBILISE initiative is poised to play a pivotal role in facilitating risk-informed urban planning and development initiatives in the two cities as well as across the country.

Bottomline

Through these initiatives, ADPC was able to enhance knowledge and understanding of city officials to prepare and respond to climate-induced disasters more effectively, save recovery costs and improve the community's resilience. The Atlases of Maps and MOBILISE Tool enhanced utilization of risk information to improve urban governance (to be more risk-sensitive), community readiness and sectoral preparedness, resulting in enhancing the overall urban resilience in the two secondary/medium-sized cities (My Tho and Nam Dinh) in Viet Nam.

This case study was developed from the interventions of the **"Urban Resilience to Climate Extremes in Southeast Asia (URCE)"** program implemented in Viet Nam. The main aim of the program was to improve the resilience of urban systems and communities to climate extreme events.

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