Published December 2013 City Level

INSTITUTE FOR SOCIAL AND ENVIRONMENTAL TRANSITION-INTERNATIONAL

POLICY BRIEF

Da Nang, Vietnam

ALTERNATIVE DEVELOPMENT PATHWAYS: EXAMINING THE DA NANG MASTER PLAN

Authors | Dr. Phong Tran, ISET–International

Dr. Tuan Tran, Hue University

KEY FINDINGS

- Development in flood plain areas increase flood severity in existing flood prone areas in Da Nang and Quang Nam during extreme rain events;
- Climate change will increase the intensity and possibly frequency of extreme rainfall events in and around Da Nang;
- If flood risks are not addressed, home owners and private investors in Da Nang real estate will face higher future damage and recovery costs—affecting the city's reputation and future land prices. Also, the local government will face higher costs to repair urban infrastructure such as roads;
- Conventional urban planning, infrastructure design and foundation standards based on historical experience will not prepare houses and infrastructure for future events;
- The current city master plan that expands the city into flood plain areas will cause more economic damage and possible loss of life in both existing urban and new construction areas;
- International practices for urban planning and development of "Green Cities" require protection of large areas of the floodplain for emergency flood retention. These areas can be used for recreational or agricultural purposes, but not for urban development. Development of floodplain areas in the face of climate change is not sustainable.

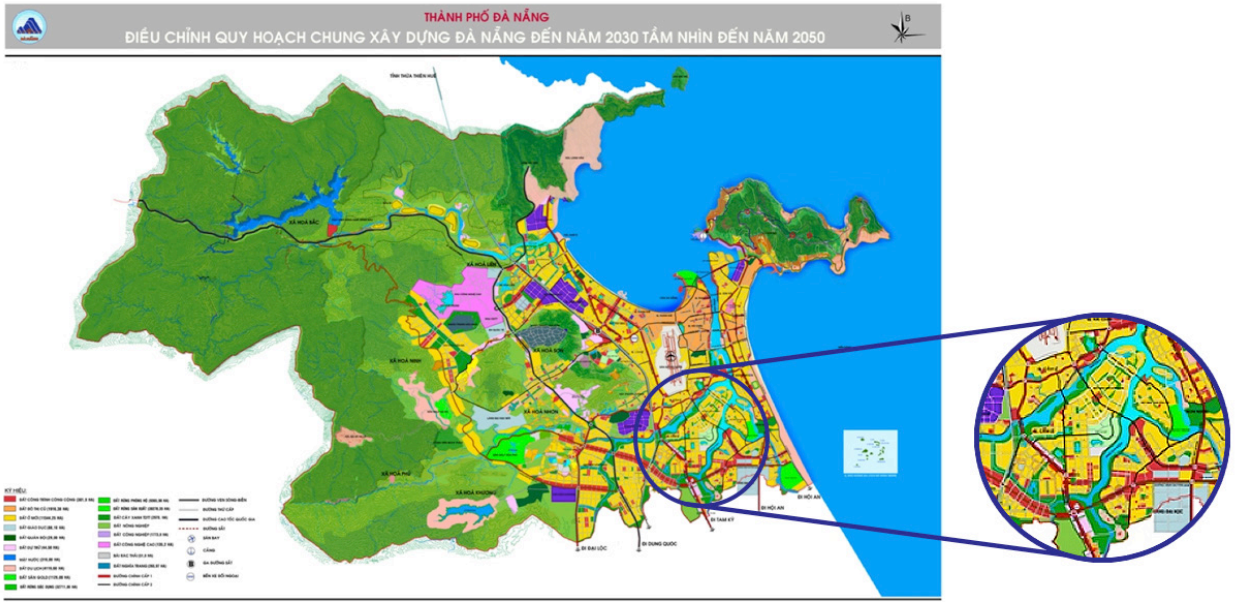
Da Nang's Context

Da Nang, located along the central Vietnamese coast, is experiencing rapid development in response to a growing population and diversifying economy. Much of the new and planned growth, as outlined in the city master plan, is in the low-lying floodplain to the south of the city center (see Figure 1). In these areas, developers are hauling huge volumes of fill to raise the surface level by 2 to 4 m, yet this fill constricts drainage and eliminates floodwater retention zones, increasing the risk in upstream and adjoining areas. Poor communities upstream or adjacent to new development are likely to be heavily impacted. These urbanization processes have changed the nature of flooding hazards for the city. As they accelerate, so too will the changes in flood hazards and their potential to affect all residents, infrastructure, and economic activities located in lower lying areas. Yet, flood hazards will also increase due to climate change. Current flooding is often triggered by rainfall events associated with the seasonal monsoon or typhoons either in the city or upstream of the city in the Vu Gia-Thu Bon river basin. Storm surges and high tides during rain events can exacerbate flooding. Climate change will increase sea levels and likely alter the intensity of rainfall events that contribute to Da Nang's flooding.

FIGURE 1

DA NANG CITY MASTER PLAN TO 2030 AND VISION TO 2050[1]

Extensive residential development proposed for the Southern floodplian area are circled.



Increased flood frequency and severity

Flood frequency and severity in Da Nang city is increasing because of land use, the orientation of roads, and other infrastructure that interact with heavy rainfall by blocking drainage or diverting water to locations that were previously not at risk. Da Nang is susceptible to regular flooding from intense precipitation events coupled with high tides and storm surges. During the last 15 years, substantial damage from flooding occurred in 1999, 2007, and 2009. Historically, the majority of this flooding has been concentrated to the north of the city center along the Cu De River and to the south in the southern floodplain, which lies between the Cam Le and Qua Giang Rivers. Based on the calculation of ARUP experts[2], the capacity of Vu Gia and Thu Bon river system is 20 times lower than the capacity required to reduce the impact of potential flood events. The problem gets worse with land filling along the flood plain and sea level rise. This fact poses real challenges to present plans and strategies of urban expansion in low-lying areas.

According to the results of the flood modeling project implemented by The Da Nang Department of Construction (DOT), Da Nang Technical University (DUT), Southern Institute of Water Resources Research, and Institute for Social and Environmental Transition-International (ISET-International), if the 2030 master plan was fully implemented, even for 10% flood probability events (i.e. 1-in-10 year events), sections of the newly developed floodplain are likely to flood to depths of 0.3 to 0.5 meters, and adjacent low-lying areas would be under 3 meters of water[3].

Increased Extreme Rainfall

Our analysis indicates that climate change is likely to increase the intensity of moderate to severe rain events in and around Da Nang. More common rainfall events that happen on average, every 10 years or less, might not change that much. Table 1 shows the possible changes in rainfall intensities by the 2020s and 2050s, when compared to 1961–1999, for rainfall events that have caused flooding in Da Nang.

TABLE 1

POSSIBLE CHANGES IN RAINFALL INTENSITIES[4]

Rainfall Event	Percent Change 2020s	Percent Change 2050s
1999	9.1 to 29.4%	13.1 to 48.1%
2007	3.0 to 23.6%	26.4 to 63.2%
2009	-4.9 to 13.8%	3.1 to 22.9%
2010	-10.6 to 4.0%	-0.6 to 14.9%

Source: ISET-International, 2013

1 Extensive residential development proposed for the southern floodplain area circled.

2 Presentation of ARUP on "Inundation management solutions for climate change resilience in the new residential areas in Da Nang city" in the Da Nang policy forum on 1st April 2013.

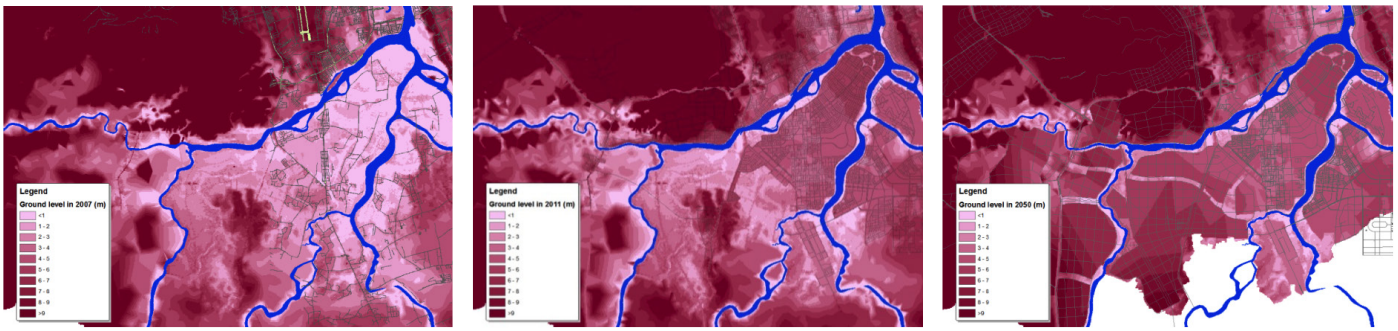
3 Final report of the project "Building hydrologic-hydraulic model and simulating urban development for the Da Nang city" produced by Da Nang University.

4 Sarah Opitz Stapleton, 2013 Da Nang's extreme rainfall and climate change by the 2020s & 2050s.

FIGURE 2

GROUND LEVEL IN SOUTHERN DA NANG AS OF 2007, 2011 AND VISION IN 2050

(Source Da Nang Department of Construction, 2013)



Urban planning based on historical experience under pressure

According to the city master plan, the minimum elevation of construction foundations should be equal to the river level at the flood probability of 1–5% (20-year to 100-year flood) based on historical records. The minimum elevation for construction in the new urban areas in the south needs to correspond to the flood probability of 5% (20-year flood). Therefore, the ground level of new residential areas has been raised from 1m to 6m compared to existing ground level depending on locations to meet this requirement (see Figure 2). However, increasing elevation for construction triggers more flood damage to the whole region. Increasing ground elevation, in turn, blocks waterways, eliminates wetlands and flood retention areas where water can spread out and slow down, and accelerates river flow into the central city districts.

Based on the final report of the project ,"Building hydrologic-hydraulic model and simulating urban development for the Da Nang city" produced by Da Nang University, it shows that climate change has resulted in an increase of water-level of 0.105m in 2030 in Cam Le District, much smaller than the impact of urban development (estimated 0.62m). Specifically, when Hoa Xuan and other regions are not covered, water level in Cam Le District can reach 3.98m. When they are covered, the water level in this district is 4.6m. This is a considerable issue when making urban planning and development strategies. Flooding is more severe for more extreme events, with climate change, and with further development. However, in spite of this confirmation, current plans will create a high-risk residential zone in the floodplain. Furthermore, as of late 2013, implementation of these plans are still proceeding without significant modification.

More economic damage and possible loss of life in current master plan

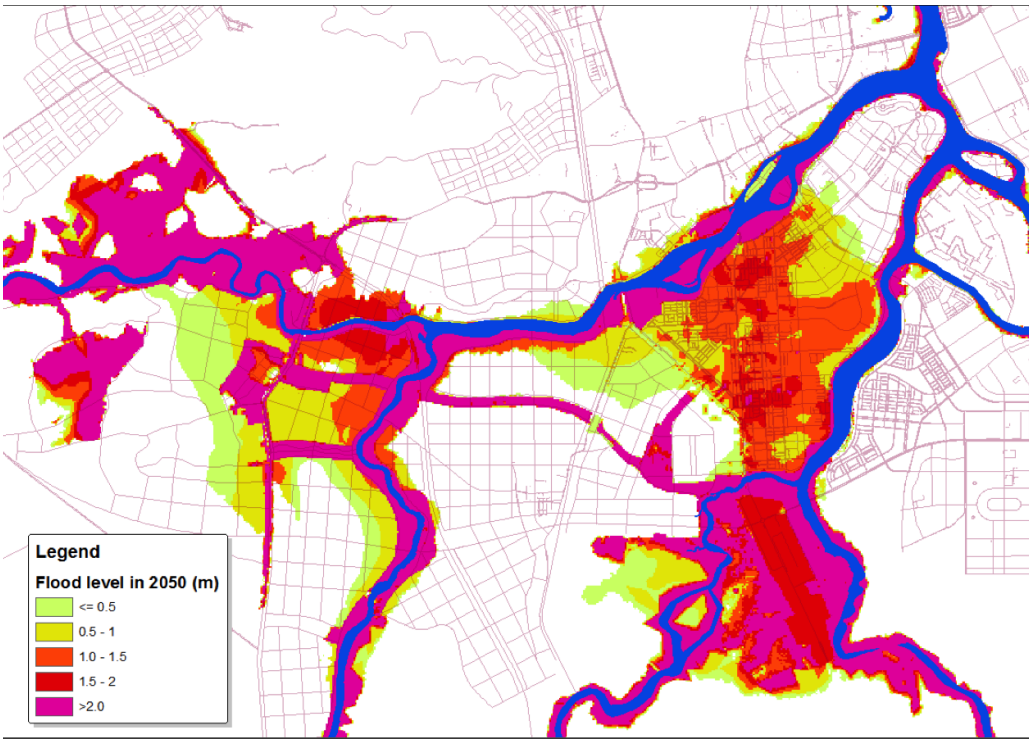
The flood model shows that with future development completed to 2050, as proposed in the city master plan, the flooded area will be relatively large, covering almost the entire southern part of the city despite the elevated ground levels[5]. Flood levels will increase in the upstream rural communes adjacent to the newly filled urban areas, local livelihoods, housing, property, and infrastructure of these agricultural based communes will be seriously affected by flooding.

It can be concluded that the development of Da Nang city in the floodplain areas of the lower Vu Gia-Han basin creates a bottleneck of the flow of water into the east and reduces retention capacity. Therefore, it increases flooding in vulnerable communes in the upstream areas of Quang Nam province and in the existing flood prone areas in Da Nang city. With extreme rainfall, floodwater will back up behind roads and will overtop the filled residential areas within the flood plain. Reducing the effect of barriers in the floodplain and, at the same time, managing the flood protection and water management system to improve drainage is the only sustainable means of reducing threats associated with flooding both now and under the longer term influence of climate change. First, conventional dike systems and filling land for urban flood protection will transfer flood risk to other areas; it cannot prevent floods. In practice, therefore, conventional climate change adaptation strategies that rely only on dikes or heightening land redistribute risks rather than reducing them.

5 Simulation based on the 2050 built out vision, 2007 flood event rainfall coupled with increasing in rainfall and sea level rise.

FIGURE 3

FLOOD MAP WITH THE 2050 BUILT OUT VISION, 2007 FLOOD EVENT RAINFALL COUPLED WITH INCREASING IN RAINFALL AND SEA LEVEL RISE



HOUSING

The large newly developed residential area will also be flooded to a depth of 1–1.5m, leading to damage of new homes, reduced value, lower land prices and lower interest from investors.

LAND USE PLANNING

The areas flooded to a depth of more than 2m will be seriously damaged due to long-lasting heavy inundation.

TRANSPORTATION

The traffic system, mainly constructed of concrete roads and located in low-lying areas, is likely to be completely cut off during major floods, preventing emergency evacuation, rescue, and response.

Second, flood hazards permanently exist, with or without protection systems. If the city expands into flood plain areas, it will face severe economic damage and possible loss of life in extreme flood events. At the same time, however, seasonal flooding provides benefits to agriculture and holds salinization in check. In principle, therefore, flood protection and water management infrastructure should allow for seasonal flooding while protecting people and property from life-threatening climate events. Third, if the current city master plan is implemented without modification, flooding will become worse, and damage and loss of life from a disaster similar to the flood in 2007 would be much higher.

Resilience approach to protect future urban development

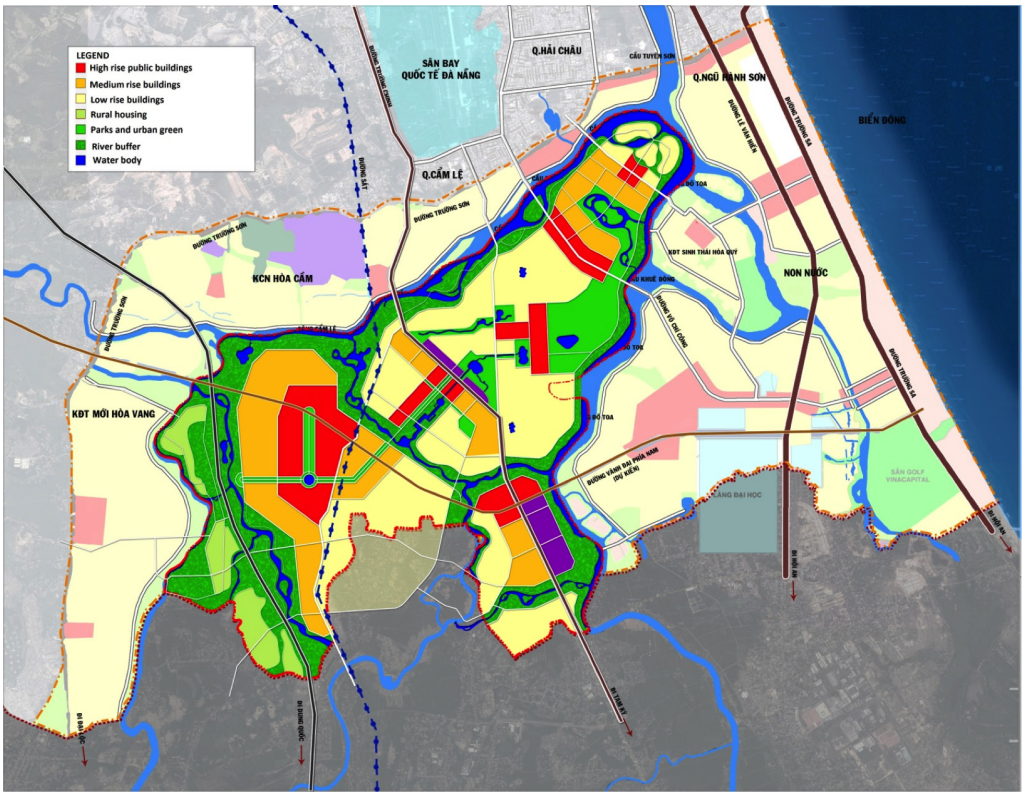
Based on these conclusions, we offer some suggestions for local government action to reduce current flood risks and increase resilience to future climate change. Each action would require further study and detailed design, but all are within the capacity and mandate of existing provincial technical departments. First, building new urban areas above flood levels has, in fact, increased flooding by creating new and higher barriers to the discharge of floodwater in the lower Han River. Bridges are not wide enough, new roads limit surface flows, new residential areas have been built in the middle of floodways, and the raised foundations of project sites in the floodplain shift the flow of water into existing settlements that previously were not seriously flooded. These measures must be corrected in order to reduce the risk of even worse flooding in the future. The relevant technical departments and the leadership of Da Nang city need to urgently revise the existing spatial plans to stipulate that any construction that occupies space for water should be regulated.

Second, if master plans and project plans are completed as proposed, the result will be increased flooding along with increased loss of life and property. Limiting new construction in the flood plain in the south is a difficult but, ultimately, necessary requirement. Limiting construction

FIGURE 4

RESILIENCE APPROACH

(ISET-International, 2013)



HOUSING

Areas of low density and low-rise buildings can also function as flood ways. Raised or stilt structures may be considered as a model for living with floods in these areas.

LAND USE PLANNING

Our goal was to create flood-ways along the rivers and within low-lying areas as well as develop compact zones with high-rise buildings in order to minimize water obstructions.

TRANSPORTATION

We have also assumed that all bridges would need to be widened and that any new roads would either be built on columns above the floodways or built near ground level and allowed to flood.

along with improving drainage will reduce and share risks more equitably. We have prepared a concept design of what a revised plan for urbanization in the south may look like. We offer this plan in Figure 4 as a means of visualizing alternative development models.

In the world's leading cities that are subject to increasing flood risks from climate change, there is more and more attention to preserving space for flood water in extreme situations, with a recognition that flooding can not always be prevented as future conditions change. To allow for unprecedented extreme events, which are likely to occur in the next 40–50 years, Da Nang city must plan a variety of measures to accommodate high water levels and to avoid making these problems worse. A city with increased flood risks through poor planning and misguided urban development will quickly lose its reputation as a "green city".

REFERENCES

ACCCRN (2010), *Summary of Da Nang city climate change resilience action plan (2011-2020).* Asian Cities Climate Change Resilience Network, 2010

ARUP (2013). *Inundation management solutions for climate change resilience in the new residential areas in Da Nang city.* Paper presented at High policy forum in Da Nang city on 1st April 2012

Da Nang People's Committee (2012). *Action plan to respond to climate change and sea level rise to 2020,* Da Nang People Committee, 2012

Da Nang Urban Planning Institute (2012). *Modification of urban master plan for Da Nang city to 2030 and vision to 2050.*

Da Nang University (2013). *Technical report of the "Building hydrologic-hydraulic model and simulating urban development for the Da Nang city" project.*

ISET-International (2013). *Da Nang's Extreme Rainfall and Climate Change by the 2020s and 2050s.*

RELEVANT LINKS

For further information concerning our work in Da Nang, please visit:
http://www.i-s-e-t.org/images/pdfs/3852RF_DaNangCaseStudy_130924.pdf

Funded by

THE ROCKEFELLER FOUNDATION