

Da Nang, Vietnam

CLIMATE CHANGE IMPLICATIONS FOR DA NANG SURFACE WATER MANAGEMENT

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KEY FINDINGS

- Low flows during the dry season are likely to become yet smaller.
- Lower flows will result in increased saline intrusion. Both the upstream extent of and number of days when saline intrusion is a problem for water supply facilities will increase.
- Water conservation efforts will become increasingly important water demand management tools. The city should focus on both the planning of long-term water supplies, and implementing programs to manage demand for water use efficiency, especially in communities.
- Vu Gia – Thu Bon collaborative interregional and river basin management will become increasingly important.
- The Vu Gia bifurcation point will be increasingly challenged by floods. Without attention the channel will eventually shift.
- Available water resource data of Danang city in particular and the river basin in general is minimal; further investment in data collection should be made to provide the knowledge needed to effectively plan for and manage basin-wide water resources.
- The impacts of climate change are increasingly being manifested in declining flow, salinization, and erosion of river banks and coast, which in turn pose a clear and present danger to maintaining safe water sources. Loss of water supply would highly compromise the socio-economic development objectives of the city. Therefore, water security, particularly investment in water supply availability and quality should be reviewed carefully and should be reflected in the master planning, the overall strategy of the city.

Low flows will become smaller

Overall, dry season flow volume in the Cau Do River is likely to decrease in all future periods in the medium and high scenarios (high scenarios have the largest reduction). For the low scenario, water inflow tends to increase slightly.

The current period (1979-2012) of most scarce water in Cau Do River happens from March to May, when flows can drop to 20 m³/s or less (95% low flow is 18.73 m³/s). Therefore, despite abundant annual flow, the long dry season is a challenge for water management.

TABLE 1
CALCULATION OF SALINITY INTRUSION AT CAU DO

No.	Flow level	Salinity H Max (mg/l)	Salinity H Med (mg/l)	Salinity H Min (mg/l)
1	40	2760	1900	300
2	60	2740	840	0
3	80	1550	0	0
4	100	20	0	0
5	Q _{Discharge}	97 (m ³ /s)	74 (m ³ /s)	43 (m ³ /s)

Low flows are now being further reduced by hydropower operations. Especially after the Dak Mi 4 hydropower plant went into operation on the Cai River in 2012, each year about 1 billion m³ of water from the Vu Gia River (upstream of the Cau Do River) has been diverted to the Thu Bon River in the dry season. The hydropower reservoirs of Song Bung 2 (stable flow for Song Bung 4 reservoir), Song Bung 4, A Vuong 1 and Song Con 2, which hold and release water that ultimately flows to Cau Do, can only compensate about 600 million m³. Consequently, there is an expectation of decreased flow relative to the historic record from upstream to Cau Do River. Coupled with increased sea levels, it is anticipated that this will exacerbate already existing challenges from saline intrusion.

Increasing saline intrusion

To calculate projected salinity in Cau Do River, the technical group used a Mike 11 hydraulic model to identify the relationship between discharge flow through An Trach spillway and salinity level at the Cau Do WSP intake in correspondence with low, medium and high tide. They then identified discharge flow through An Trach required to maintain salinity at the water intake of 250 mg/l for each tidal level. More detailed information is presented in the B3 report in the salinity section. Summarized results are as described in table 1.

These flows represent the flow needed to address current salinity issue. Already these flows are significantly larger than low flows during the dry season. Sea level rise will further increase saline intrusion and further increase the flows needed to maintain fresh water at the Cau Do intake. Including sea level rise projections in the current salinity

assessment was beyond the scope of this study. However, salinity is a growing threat to the Da Nang water supply and requires study moving forward, including the impacts that sea level rise will have on salinity.

Increase water conservation policies and mechanisms

To limit water shortage, it is essential not just to enhance supply capacity, but to also manage water demand. Related departments and agencies of the city need to enhance public awareness regarding water conditions and usage and promote water saving behaviors. The incentive policies for water saving within Decision no.40/QĐ-UBND dated 13 November 2014 of Da Nang People's Committee should be considered.

Additionally, the city should consider application of policies to mobilize public participation in management and reforestation within upstream area to further contribute to sustainable surface water management of the city.

Develop coordinated basin-wide management

The Vu Gia – Thu Bon river basin is located in both Quang Nam and Da Nang city. Consequently, river basin management requires the participation of both provinces, relevant stakeholders and coordination of MONRE. Formation of a fully operational River Basin Organization (RBO), composed of a River Basin Management Board and a Research Center, is needed to meet this need.

Previous attempts to establish a basin-wide management board and research center have been made. To re-establish VGTB River basin Management Board and VGTB

Research Center, there must be a high determination and commitment of resources from Quang Nam and Da Nang city, and close collaboration among stakeholders including private sector, authorities at central and local levels, and community groups in the basin. In addition to financial resources to maintain effective operation, the organization must be stipulated specifically for its feasibility. In particular, to undertake in-depth study and resource mobilization, it is essential to have the participation of the two main local departments of DONRE in Quang Nam and Da Nang to exchange, consider and propose specific solutions.

A key role for the Management Board will be to convene stakeholders to discuss basin-wide water operations to optimize supply for all basin users. The Research Center should be tasked with exploring salinity and pollution issues and possible reservoir, spillway and diversion operations models to address these issues.

Address the Vu Gia bifurcation

Upstream of Ai Nghia the Vu Gia River bifurcates into two branches that flow to the Han Estuary through the rivers of Yen, Lac Thanh, La Tho, Thanh Quyt, Qua Giang, Vinh Dien, Cau Do, Cam Le and Han, and from Quang Hue River to Thu Bon River at Giao Thuy. The bifurcation is controlled by the Vu Gia and Thu Bon delta area. The geology of the area is mainly alluvial river, and the riverbed level of Vu Gia River is higher than Thu Bon riverbed by around 1 meter.

Given these natural characteristics, the potential for flow from the Vu Gia to Thu Bon River to change in volume is very high. From 1999 to 2001, flow from the Vu Gia river into Quang Hue River was severely curtailed, causing severe water shortages at Ai Nghia River and substantial damages to livelihoods and economic activities in Vu Gia River downstream, including Da Nang city, Dai Loc, Dien Ban and Hoi An city in Quang Nam province. MARD had to implement emergency projects to fix the Vu Gia River. Begun in 2002, these were not completed until 2012.

Should the relative distribution of flows at the bifurcation change, and in particular result in reduced flow past the Cau Do WSP, it will take a long time and huge budget to recover from water shortages, depletion, pollution and severe salinity in the downstream Vu Gia River. Damages and impacts on life and the socio-economic development

of Da Nang city could be enormous. Potential solutions include:

- Construct a temporary dam to restrict flow through the Quang Hue River to maintain a minimum flow towards Ai Nghia.
- For small and medium levels of water shortage, implement a temporary dam to block Tuy Loan River (in Cau Giang) and operate the backup pumping station in Tuy Loan to increase water for Cau Do WSP.
- For severe water shortage, build a temporary dam at Cau Do and increase withdrawals from the Yen River at An Trach.
- Strengthen exploitation of water resources in Cu De River (once the Hoa Lien WSP is in operation), harvest water from Hoa Trung, Dong Nghe and other backup reservoirs (if these have been constructed).

Increase investment in water resource data collection

Both climate change and development are placing new and increasing demands on water resource management in Da Nang. If the city is to pro-actively plan and prepare for these challenges, water resource personnel will need a clear understanding of conditions and how they are changing. To support water monitoring, prediction and management efforts, the city should increase investment in monitoring stations and meteorological and hydrological equipment. In particular, to support future water supply development, additional monitoring and data collection stations should be installed in the Tuy Loan and Cu De basins.

Invest in water security

There are no longer sufficient water resources in the Vu Gia- Thu Bon basin to add new water demands without considering the impacts to existing uses and downstream entities, and climate change is likely to further reduce water resources in the dry season and increase salinity issues. At the same time, water demand in Da Nang City is projected to at least double by 2050, and demands elsewhere in the basin are also likely to increase. Actions need to begin now to address future water security for the entire basin. Actions should include:

- Coordinated river basin management to assure water resources are optimally used and that water supply for Da Nang, Vietnam's fourth largest city, is maintained.

- City implementation of measures to promote effective use of water resources through community based water saving actions.
- Actions to address increasing salinity levels, including the development of collaborative water resource management mechanisms, review and negotiation of upstream hydropower operations to support water supply usage, exploration of flow enhancement mechanisms including reservoir storage for water supply, and alternative water treatment plant intake options.
- Construction of the Hoa Lien WSP on the Cu De River to diversify the Da Nang City water supply. Because the Hoa Lien WSP will be subject to salinity issues and will require other works to increase storage and augment flow, water harvest from Dong Nghe, Hoa Trung and Truoc Dong and other reservoirs should be considered when the irrigation responsibilities of these reservoirs further decreases in the future.
- Updating and enforcing operating procedures for water infrastructure throughout the basin.

FURTHER READING

This policy brief does not provide the technical details of the water resource analysis for Da Nang. The following resources provide more information on Da Nang water resource activities:

The Climate Change Coordination Office of Da Nang City (CCCO Da Nang) [website](#)

Institute for Social and Environmental Transition-International (ISET-International) [website](#)

City project report can be found [here](#).

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Funded by the Rockefeller Foundation



Implemented by the Institute for Social and Environmental Transition-International (ISET), Center Vietnam Institute of Water Resources and the Climate Change Coordination Office of Da Nang city (CCCO Da Nang)

