

## Da Nang, Vietnam

### WATER RESOURCE TRENDS AND THE IMPLICATIONS FOR WATER MANAGEMENT

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#### KEY FINDINGS

- In 2014, 87.3% of city residents had access to city water supply. The rate of water loss in the piping system is controlled at below 17%.
- Water demand for domestic, industrial, trade-service and public use is projected to at least double and possibly more than triple by 2050.
- Dry season flow in Da Nang is increasingly subject to salinity, which increases treatment costs. Salinity is projected to increase in the future due to both reductions in low flow and sea level rise.
- Irrigation systems are poorly maintained and management is split across different organizations and governance levels. This both poses physical risk and increases inefficiencies.
- Operating procedures for reservoirs, dams and spillways are, in many places, outdated or problematic and should be revised.

## City Water Supply

Water resources in the Vu Gia and Thu Bon river basins are abundant, particularly the streamflow of Vu Gia River, which is one of the highest flow river systems in Vietnam. However, flow is unevenly distributed across different river branches. Specifically, total annual flow in the Cau Do River makes up 76.4% of total inflow to Da Nang city. The Tuy Loan and Cu De River contribute 7.6 % and 16% of the total inflow respectively.

With large flows concentrated in specific river branches, the construction of hydropower in those basins influences the main flow, causing impacts downstream. For instance, the Bung and Cai river branches carry over 80% of the

total flow of the Vu Gia River. As a result, the construction of the DakMi 1, DakMi 4, A Vuong, Song Bung 2, Song Bung 4 hydropower plants in these branches has significantly influenced flow of the Vu Gia River downstream.

Flows vary significantly between the rainy and dry seasons. High flows during the rainy season cause flooding risks and erosion; low flows in the dry season, which can last for months, result in water shortage and salinity intrusion for the city. In particular, this affects flow intake at the Cau Do WSP at Yen River and the pumping station downstream of An Trach dam in the Vinh Dien River.

Low flows are now being further reduced by hydropower operations. Especially after the DakMi 4 hydropower plant went into operation on the Cai River in 2012, each year about 1 billion m<sup>3</sup> 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 m<sup>3</sup>. Consequently, there is an expectation of decreased flow relative to the historic record from upstream to Cau Do River.

There is a clear need for 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. However, previous attempts to establish a basin-wide management board and research center have been ineffective. 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 its effective operation, the organization must be stipulated specifically for its feasibility. 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.

## Water Demand

Historic water demand (1979 – 2012) for Da Nang for domestic, industrial, trade-service and public use is 50 million m<sup>3</sup>. There is an additional agricultural demand of 46.6 million m<sup>3</sup>.

Water demands for all sectors are projected to increase. Projected total demand, not including agriculture, is shown in Table 1 for the study time periods and scenarios. The numbers indicate that demand is likely to at least double by 2050, and may more than triple.

The city has only limited water supply options and water production capacity may be reduced by climate change impacts in the future. Clearly, the city needs to begin

implementing measures to promote effective use of water resources through community based water saving actions. Initially, the city should develop a comprehensive communication campaign to raise public awareness of water saving. In the long term, the city must develop successful models for water consumption reduction.

## Salinity

Surface water quality in Da Nang city is relatively good and displays no signs of pollution. However, in recent years saline intrusion has significantly increased in most rivers in the city (Cau Do, Cu De, Tuy Loan, Vinh Dien, etc.) in the dry season. This has significantly and increasingly impacted city water supply. Historically, salinity at the Cau Do water supply plant intake exceeded acceptable level only periodically between March and August. However, the number of days of impact and the upstream extent of salinity has been on an upward trend. In 2013 and 2014, the number of days with salinity increased to almost 90 days – a full quarter of the year. Measured salinity on some of these days reached 4,000 mg/l. This has increase operation costs at the Cau Do water supply plant. Additionally, the area of salinity has expanded to upstream areas, causing substantial impacts to agriculture production and well water supply for domestic use.

Prior to this study there had been no evaluation or detailed prediction of salinity from which to develop new operating rules and plans. DAWACO has installed salinity monitoring equipment for immediate decisions concerning pumping of raw water. However, this is insufficient given the rapidly growing impact salinity is having on city water supply.

Actions to address increasing future salinity levels need to begin now. Actions should include 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.

Future city water supply plans include proposed construction of the Hoa Lien WSP on the Cu De River. Findings from this project indicate that dry season flows in Cu De River can be quite small and that the river at the proposed water intake sites is subject to saline instruction.

A water supply plant on the Cu De river 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.

## Irrigation

Water management from headworks to fields is undertaken by two different units — the DNIEC and district People's Committees, agricultural services cooperatives and infield irrigation teams. This results in less coordination and control compared to one unit and increases the potential for water wastage.

Most irrigation reservoirs in and around Da Nang are small or medium sized (except Hoa Trung, Dong Nghe, and the An Trach Spillway). If well-managed and maintained, their state is good and safe. However, there are not enough qualified irrigation and water resource officials at the district and commune levels, calling into question whether management and maintenance is being performed as needed. Even for those reservoirs that are safe and well maintained, their operating rules were developed long ago and are no longer suitable for current practical demands.

Most of the small and medium irrigation works are served by infield channels managed by local authorities. Many of these local works lack regular evaluation and maintenance and are degraded and sedimented due to lack of maintenance and insufficient budget. Capacity of these works has deteriorated and most of them function at only 50% of design capacity.

Finally, only Dong Nghe reservoir, among 21 existing agricultural reservoirs, has an adequate monitoring system (including dam seepage, rainfall, water levels, and water gate opening). In the rainy season, there are only a few management personnel and those that exist generally lack adequate expertise. Thus the likelihood of reservoir accidents is quite high. The consequences of those accidents to downstream areas, should they happen, are substantial.

Since the district and commune level peoples committees and cooperatives do not currently have qualified professionals to manage irrigation works, the management of small and medium-sized irrigation works (especially reservoirs) should be transferred from local authorities to

the Da Nang Irrigation Exploitation Company. This will enhance management of current irrigation works, especially around reservoir safety, protection of irrigation corridors, system maintenance and safety upgrades.

It is proposed that DNIEC manage both branch and infield canal systems, and manage infield irrigation groups (currently managed by cooperatives). This would put the management of irrigation works from headwork to fields under the responsibility of one agency, further enhancing management and water use efficiency. The risk with this plan is that it could lead to monopoly management, resulting in inefficient use of financial resources through the form of allocation. To avoid that consequence, there should be a cross-functional management mechanism, whereby all DNIEC local activities with a budget of over 20 million dong must have a record of District People's Committee's acceptance.

## Operating Procedures

There are a number of places where operating procedures are outdated, poorly conceived, or not enforced that result in problems and challenges for Da Nang water resources. Several of the more problematic of these are discussed below.

1. The salinity prevention pumping station at An Trach is critical to the operation of the Cau Do water supply plant during periods of saline intrusion. However, there are shortcomings in the operating procedures governing the pumping station operation. The flows specified by the operating systems are insufficient to provide the needed water levels at the spillway. Clearly, the current operating rules for An Trach spillway were issued in 2005 and are no longer sufficient given up-stream changes. Full-year operating rule for the Song Tranh 2, DakMi 4, A Vuong and Song Bung 4 multi-reservoir system have been issued. Da Nang city now needs to immediately study and develop new draft operating procedure for An Trach spillway in accordance with assumed scenarios relating to the operating rules of the multi-reservoir system.
2. Hydropower reservoirs are responsible for reducing and slowing flood pulses during the rainy season. However, most of hydropower plants in VGTB do not operate with significant flood capacity (except A Vuong). Therefore, in the rainy season, the hydropower reservoirs do not play a role in reducing downstream flooding. Worse, they frequently operate such that they have difficulty meeting multi-reservoir operating rules in the rainy season,

running the risk of cascading emergency dam releases during flood conditions. Existing rainy season operations rules and flood storage capacity requirements should be enforced, and failure heavily fined.

3. There is a lack of collaboration on the part of hydropower management to ensure common benefits between upstream and downstream areas resulting in conflicts and disputes. For example, in the rainy season natural flow in big rivers together with flooding discharge from reservoirs increases flood risks downstream. Similarly, water storage for electricity generation affect water supply in dry season because hydropower management only focuses on electricity generation during peak hours rather than also maintaining minimum flows for salinity control. Operating procedures should be collaboratively revised by all basin stakeholders to maximize social benefit.

4. The bifurcation of the Vu Gia at Quang Hue is controlled by sediment deposition and erosion in the river bed. Currently, the percentage of water flowing to the Quang Hue is increasing and the flow to Ai Nghia, Yen and Cau Do rivers is on the downward trend. The Quang Hue riverbed has been deeply eroded and expanded, while the Ai Nghia riverbed is increasingly filling with sediment. This means that though water levels may remain unchanged, for a given water level there is less flow moving downstream. Because the procedural rule are tied to water level and not flow rates or flow volumes at Ai Nghia station, the rules fail to deliver the needed flow over time. Accordingly, it is necessary to continue evaluation and research to improve the operating rules of multi-reservoir systems in VGTB river basin to match the terrain changes in the basin while meeting downstream needs.

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## 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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