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Success story #3

Flood modelling & city drainage planning

The problem

Floods occur frequently in Vietnam's cities. According to the World Bank, Vietnam loses around 1%-1.5% of its annual Gross Domestic Product to natural hazards. An estimated 70% of the population is at risk of cyclones and floods. In addition to seasonal flooding, extreme flood events in the years 1961, 1978, 1991, 2000, 2001, 2005 and 2009 had disastrous economic and civilian impacts. The flood in the year 2000 alone took over 800 lives. Of all natural hazards present in Vietnam, flooding is the most frequent, the most economically damaging and the deadliest.

Two simultaneous developments exacerbate the negative impacts of floods on cities. The first is climate change. Urban flooding will increase due to rising sea levels and more frequent intense rainfall events. Both overflowing rivers and insufficient drainage capacity to deal with intense rainfall are responsible for flooding. The second development is rapid urbanization. The number of urban dwellers is expected to rise from 33% in 2014 to 45% or 44 Million people in 2020. In 2025 there will be 1000 urban centers that are home to 52 million people or 50% of the population. Yet, neither current nor future flood risks are effectively considered in urban planning. Rather, urban development increases risks of pluvial flooding as it reduces the natural drainage capacity and increases river flood risk as buildings are often constructed in flood plains.

Cities in Vietnam overly rely on traditional drainage systems to discharge surface-runoff. Often, when overflowing rivers concur with intense rainfall, this underground infrastructure does not have the capacity to drain the water in time. As a result, areas with high population density, critical infrastructure, such as hospitals and schools, and low-lying areas, where the poor and vulnerable often dwell, get flooded. In particular in the Mekong-Delta, urban flooding will increase due to climate change and other factors. In summary, a number of issues can be quoted as reasons for urban flooding in Vietnam:

- Uncontrolled and rapid urban development, settling in flood plains and urban surface-sealing prevents local infiltration of runoff;
- Drainage infrastructure is often incomplete, under-dimensioned and of low construction and material quality;
- Drainage planning is unsystematic, insufficiently prioritized, technically sophisticated and requires costly data surveys to gather reliable data as planning basis;
- Insufficient O&M and adverse public behavior lead to reduced hydraulic flow capacity, deteriorated civil works, faulty equipment and clogged-up inlets, pipes and manholes;
- Climate change causes raising sea levels and more intense and unpredictable rain, intensifying the problem.



The solution

Recognizing these challenges, the Government of Vietnam (GoV) has carried out significant changes in the national legal and policy framework for urban drainage planning and has renewed publicly its commitment to reduce flood risks in urban centers in its strategic sector development plan signed by the Prime Minister. In particular, the legal and policy framework for government planning and budgeting has significantly changed during the last two years. The Law on Planning was passed by the National Assembly in November 2017. The law consolidates the role of national, provincial and city authorities and introduces the concept of 'regional planning'. One important function of the regional master plans is to improve climate resilience through the planning, construction and operation of infrastructure, such as drainage, wastewater treatment, flood control and water supply. Below regional master plans, provincial and urban master plans follow in the planning hierarchy.

Further important legal documents regulating urban master planning in Vietnam are:

- Law on Urban Planning (Law 30/2009/QH12)
- Decree 37/2010/NĐ-CP on establishing, appraising, approving and managing urban master plans;
- Decree 80/2014/NĐ-CP on urban drainage and wastewater treatment;
- Law on Construction (Law 50/2014/QH13);
- Decree 44/2015/NĐ-CP giving detailed instructions on some issues related to construction master planning;
- Law on Planning (Law 21/2017/QH14) reforming the methods by which national sectoral master plans are translated into master plans at regional and local level (effective 01 January 2019);
- Decree 37/2019/NĐ-CP giving detailed instructions on implementing some content of the Law 21/2017/QH14 on Planning;
- Decree 72/2019/NĐ-CP revising and amending some content of Decree 37/2010/NĐ-CP and Decree 44/2015/NĐ-CP.

Of these, the 2009 Law on Urban Planning and its implementation Decree 37/2010/NĐ-CP, as well as the 2014 Decree 80/2014/NĐ-CP are the most important for urban drainage master planning. According to the Law on Urban Planning, cities at all levels are required to establish Overall City Master Plans. These are then to be broken down into Zonal Master Plans for specific geographic zones within a city. Additionally, for each zone, Detailed Master Plans may be developed based

on development objectives and local requirements. The Law also foresees the establishment of Technical Infrastructure Master Plans, which include urban sewerage and drainage planning. Article 23 of Decree 37/2010/NĐ-CP regulates the content requirements for drainage planning under these Technical Infrastructure Master Plans:

1. Assessment of the current state of the terrain, geological conditions of the project, hydrogeology, and of areas with environmental hazards (subsidence, depression, geology, erosion)
2. General assessment of urban construction land for each urban zone, including determination of favorable, unfavorable, limited and prohibited areas.
3. General assessment of the situation of urban drainage and inundation: frequency, extent in each zone, depth, current status of drainage system, location and scale of drainage pumping stations.
4. Identification of basic indicators and parameters for each catchment basin; of the drainage network and receiving water bodies; locations and sizes of major drainage facilities; solutions to prevent natural disasters.
5. Determination of relevant construction foundations for each specific construction area and main urban streets.
6. Preliminary determination of excavation and embankment volumes for each area.
7. Determination of priority investment programmes and projects, preliminary determination of total investment amounts and projection of resources for implementation.
8. Strategic environmental assessment.
9. Maps of current situation, the planning of ground elevation and urban surface runoff drainage at scales 1/10.000 to 1/25.000.

For province-level cities that are directly subordinated to the central government¹, Technical Infrastructure Master Plans are to be established as separate plans, while for all lower-level cities, such as the three cities supported under FPP phase two, they are to be established as a section or chapter in the Overall City Master Plan.

However, Article 5 of Decree 80 grants an exception to this rule. Should the drainage section of Overall Urban Master Plans be insufficiently detailed to be useful for planning drainage infrastructure projects, separate City Drainage Master Plans may be developed also by cities under provincial administration. Following Decree 80, such a City Drainage Master Plan should, at minimum, include the following content:

¹ There are five province-level cities in Vietnam: Hanoi, Ho-Chi-Minh City, Hai Phong, Da Nang and Can Tho

- Scope and limitations of the plan;
- Economic-technical indicators and design standards applied;
- Determination and division of rainwater drainage catchments;
- Status of receiving water bodies, projection of total drainage volumes;
- Locations of drainage network, facilities and installations.

FPP contribution

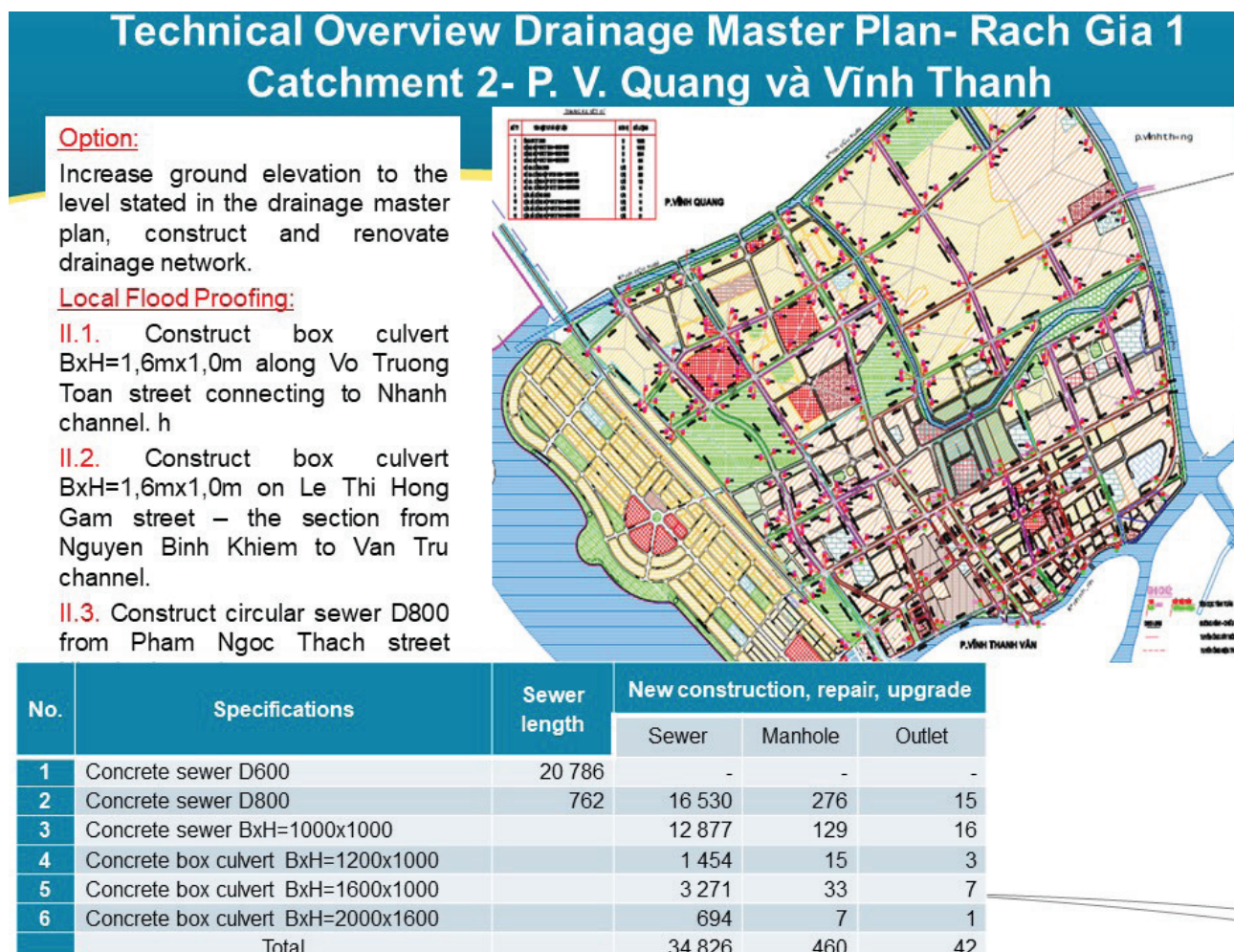
Co-financed by Switzerland and Germany and implemented by MOC and GIZ, the programme “Flood Proofing and Drainage for Medium-sized Coastal Cities in Viet Nam” (FPP) in its phase two has targeted to tackle urban climate resilience via a holistic approach to urban flood prevention and management. To this end, at national level, FPP supported MoC to develop a chapter on urban spatial land use planning for the new law on urban development and management (to be approved in late 2020). This chapter includes spatial planning, urban resilience, smart cities and green growth.

At local level, the FPP support included the

strengthening of urban drainage capacities through an improved modelling of flood hazards and the development of dedicated city drainage plans. Contributing to the objective to increase climate-resilience by reducing and gradually eliminating inundation in urban areas of the supported cities, the scope of work under this component of FPP phase two included:

1. Developing flood models for the three cities Long Xuyen, Rach Gia and Ca Mau
2. Investigate, process and store data from extreme rainfall events and floods as inputs for flood models
3. Build capacity at local government levels to operate the flood risk modelling software
4. Identify drainage catchments, drainage directions, locations and sizes of key construction works (if any) and drainage networks
5. Revise existing drainage plans and prepare separate City Drainage Master Plans for each city
6. Prepare cost estimates and indicate priority investment projects for drainage system upgrades

Led by the provincial Departments of Construction, the development of the three City Drainage Master Plans was a major undertaking, implemented over a



period of two years 2018/2019 in a joint effort between local authorities and a large team of GIZ advisors and consultants. In summary, the following key outcomes were achieved under this component:

- Three City Drainage Master Plans were developed: the plans were approved in each province by local authorities in late 2019 and now serve as a basis for a more systematic planning of drainage infrastructure investments.
- Primary data were generated: Large amounts of data were generated as result of various field surveys conducted in each city. These include:
 - o Socio-economic data;
 - o Hydrological data on existing surface water bodies and topographic data (terrain mapping);
 - o Hydro-meteorological data (patterns and extremes in rainfall events, flooding) considering climate change projections;
 - o Asset data on the location and hydraulic capacity of the existing drainage system.
- Flood models were developed: flood models are based on hydraulic models of existing drainage infrastructure and digital elevation models (DEM) that were developed for each city, merging data from various existing DEM with primary data collected in surveys; the models serve as basis for the City Drainage Master Plan and were also handed over to local weather stations which use them for improved flood forecasting.
- Local capacities were developed: Local planners participated actively in the planning process and were enabled to understand, endorse and take ownership of the final products after their completion; IT hardware and different software packages for hydraulic and flood modelling were handed over to relevant local authorities and users were trained intensively in their application.



The drainage planning approach pursued by FPP integrates a number of innovative concepts. For example, the concept of sustainable urban drainage systems (SUDS) was integrated successfully in each plan. SUDS stands for a large and diverse number of usually simple technologies that help manage surface runoff locally through reducing the area of sealed surfaces, retaining and infiltrating rain water close to where it lands. If applied on a larger scale, SUDS can significantly help reduce necessary drainage capacities and therewith investment costs for centralized urban drainage infrastructure.

The DEM developed for the three cities served not only as basis for drainage planning, but was also applied to develop GIS-based multi-hazard risk analysis tools for each city, called 'suitability maps'. A suitability map helps urban planners, disaster response authorities, investors or insurers to determine specific risks from various types of natural disasters (floods, earthquakes, storms, etc.) at any given location or land plot in a city or country. In addition, a wind hazard and residential building suitability map was developed for the whole of Vietnam. The suitability mapping concept was introduced to a number of stakeholders and potential users, including the national reinsurer VinaRe and the Vietnam Meteorological and Hydrological Administration (VNMHA) of MoNRE during training workshops in Can Tho and Hanoi.

The drainage master plans are of high quality and are highly appreciated by provincial authorities. The future focus on supporting the implementation of the new Law on Planning will ensure these plans are integrated into the new provincial master plans. Combined with additional trainings on hydraulic modelling and data collection, the plans are assessed as having a very high probability for sustainability.

In addition to developing City Drainage Master Plans and flood models, FPP provided related technical assistance to establish provincial orientation plans



for flood management and drainage in urban centers in each supported province. The PPC, relevant departments, companies and agencies developed a consensus on the vision, objectives, solutions and priorities for flood management and drainage. The three provincial working groups finalized the orientation plans and the PPCs approved them. The orientation plans provide an integrated approach for the selection of investments, which helps to ensure they are practical, improve the resilience of cities and the urban population to floods and other natural disasters. Also, roadmaps for a gradual introduction of tariffs to cover the costs for operation and preventive maintenance of urban drainage systems were developed together with each province. Two of the three tariff roadmaps have so far been approved.

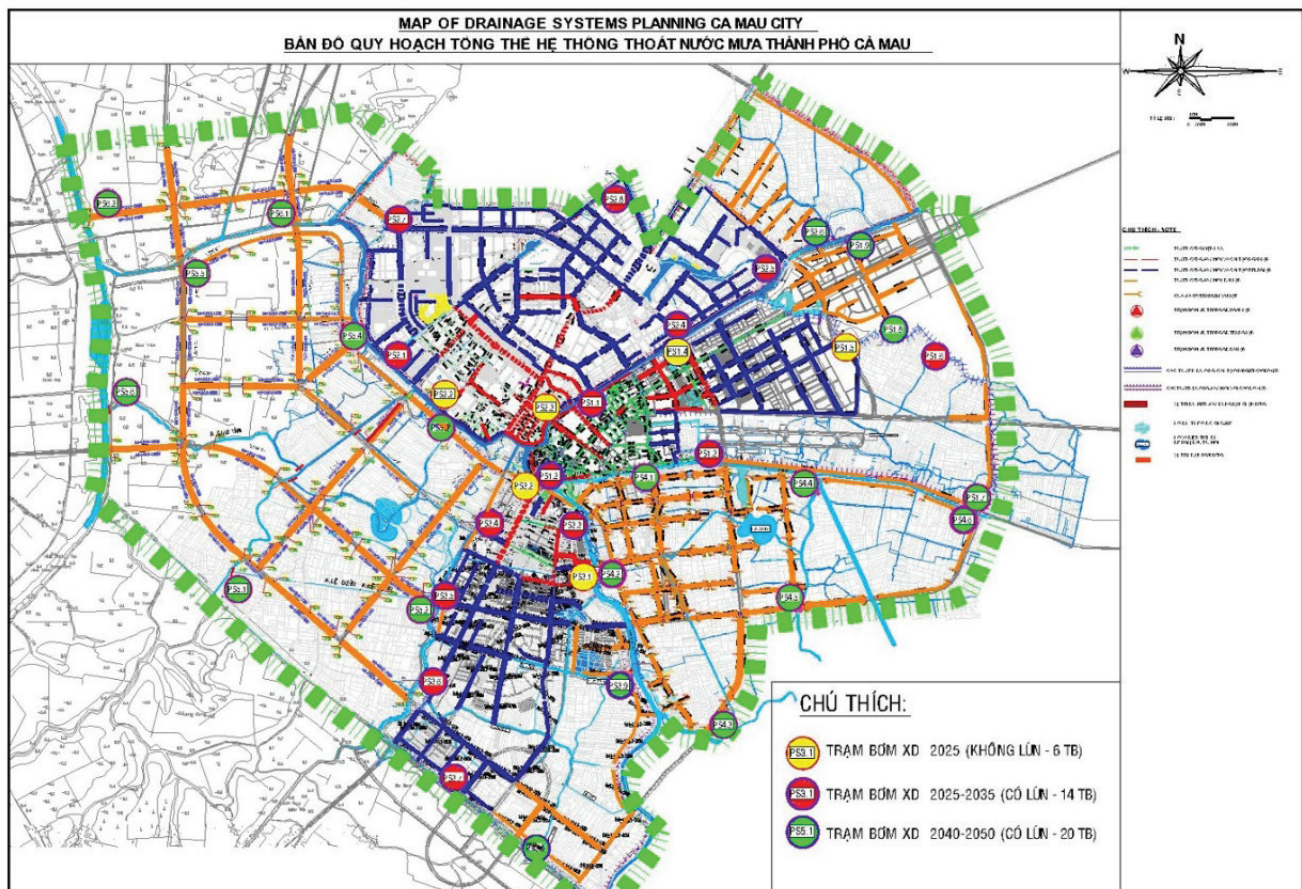
FPP approach

To ensure sustainability in the implementation of its activities, FPP II applied a uniquely integrated advisory approach that gathers concrete experiences on the ground and channels these from local to central government levels in order to provide practical evidence for central level policy formulation. FPP II successfully established close linkages between national and provincial levels. Provincial experiences and requirements for policy were presented to the central level and advocacy was carried out to support policy amendments and changes.

In addition the approach also emphasized cross-exchange of experiences and the sharing of lessons-learned on a horizontal level (province-to-province, city-to-city) leading to effective learning and high motivation through a healthy spirit of competition.

On provincial level, the FPP II way of working involved the establishment of inter-departmental work groups headed by each provinces PPC and managed by DOC. The work groups comprised leaders and technical officers of all relevant local government agencies, including the provincial line departments for construction, environment, agriculture, planning, health and finance as well as provincial statistical offices, provincial hydro-meteorological stations and city-level authorities. All programme activities were planned and steered by each provincial work group, ensuring a unified approach, common goals and an open exchange of information among involved stakeholders. Working meetings between each work group and FPP II advisors were held in regular intervals at high frequency, ensuring high efficiency in output creation and quick decision-making and approval procedures.

The work on province level commenced with the development of programme implementation plans with each work group and their approval by the PPC. Through these plans, roles and responsibilities were clarified, availability of budget for implementation and further operations of work groups and, for example, technical systems could be assured.



Policy dialogues at provincial level, but also between the provincial and the national levels ensure that all relevant stakeholders gain a sound understanding of the issues at hand, and that national policies are based on the experiences and capacities of the provincial governments. Specifically through the development of guidelines and supporting central-level authorities in the development of laws, decrees and regulations, the lessons learned on a provincial level gained sustainability through institutionalization in national laws, targets, codes and regulations. Through influencing urban planning and budgets on the provincial level, impacts went beyond the mere implementation of technical systems.

The human impact

Mr. Do Van Khanh, a resident of Long Xuyen city, shares his thoughts on climate change scenarios and the city drainage master plan:

“I have been born here and have lived in Long Xuyen all my life. I often talk with my wife, friends and members of my local community here about the development of our city. It’s just a topic I am very interested in. Especially water infrastructure. Climate change is a topic that often comes up when we talk. I also read a lot about it online and in local papers. Honestly, we are sometimes a bit doubtful when we hear about these horror scenarios about the impacts of climate change on the Mekong Delta, that the

media sometimes draw. They make it appear as if the Delta will be covered by the ocean like once the legendary Atlantis. So far, nobody I have talked with is really concerned about that.

Sure, we do feel that weather patterns have been changing during the past decades. Especially the periods of dry hot weather are longer than they used to and that makes life more uncomfortable for us city dwellers, and it has a severe impact on the agricultural output of our farmers. But signs of sea level rise and increased flooding are not yet apparent to our naked eyes. Beside, we people in the Mekong-Delta, we have grown used to floods. Another word we use for wet season here is “flood season”. We have grown up with frequent flooding. Especially here more upstream in An Giang farmers livelihoods depend on the regular flooding of their fields. We see it as something positive when floods are imminent.

In the city, of course, flooding is perceived as a nuisance and we are not happy about it. Although not life-threatening, the floods impact our life as during floods transportation is very limited. And the flood water is extremely dirty as it mixes with wastewater from the sewers. This affects our health and also, at times, our property.

Having said all that, I do believe the scientific predictions on climate change and I am convinced that things are going to change for the worse. So we



need to be prepared. It is great news that our city has now developed a drainage master plan. As I understand, this plan is an important first step to identify investment projects and upgrade our drainage capacities in a systematic manner. Now I hope we can attract the necessary funds. I think our local Government is very pro-active in all this, they also receive a lot of support from international organizations. We are all grateful for that. But we as citizens should not only wait for the Government to solve all our problems. We have to start with ourselves. Everybody must contribute to improve the drainage performance of our city infrastructure. We should start by keeping our rubbish away from the inlets and drains in our backyard.

And in preparation for the worst case, we should all raise the foundations of our houses. Better act now, before it is too late. The problem is that there are many poor families that are not able to afford this. For them the Government should provide support.”



Mr. Nguyen Quoc Cuong, An Giang DoC



Mr. Nguyen Quoc Cuong is a civil engineer and the head of the Office for Management of Housing, Real Estate Market and Technical Infrastructure of the Department of Construction under the An Giang Provincial People’s Committee. Mr. Cuong was assigned by An Giang PPC to evaluate and appraise the draft City Drainage Master Plan developed for Long Xuyen. He was also involved in steering the plan’s development from the very beginning. Reflecting on this work that took two years to complete, he shares:

“Looking back, I have to say GIZ and the consultant who developed the master plan did an absolutely outstanding job in a very limited time frame. After all, they had to split their time between three cities, they did not just work for us. I am very happy with the result. The final plan reaches a level of detail that we haven’t had before. I am responsible to manage the technical infrastructure in Long Xuyen and other cities in An Giang, but so far I have never had such a clear overview of what infrastructure we actually have and how it performs. It is all underground, you can’t just look at it like you look at a road.

Another important outcome of the technical support we received is the flood model they provided us with. They collected a lot of data and even used satellites to verify and adjust our digital elevation models we had given them. Now we have a much more accurate DEM than we used to. Using this updated DEM, in combination with the hydraulic model of our drainage system and topographic and hydrological data that was collected, we have an accurate basis to apply the flood modelling software and predict floods better. Our provincial weather station now uses this model regularly.

GIZ and the consultant also convinced me to consider alternative approaches for drainage, specifically to integrate what is called sustainable urban drainage systems into our master plan. We have foreseen

these systems at many locations throughout the city. A demonstration plant has also been constructed here in Long Xuyen. SUDS follow the logical idea to temporarily store and locally infiltrate rain water where it lands on the ground, rather than trying to drain all of it out of the city as fast as possible. This way we reduce the pipe diameters and pump dimensions we need for our drains. Smaller pipes and pumps mean less costs. But this only works if we implement SUDS anywhere possible. Just a few systems won't be enough to have an impact. In the mid-term, we also need to give incentives to property owners to unseal their impermeable concrete surfaces and store or infiltrate rain water on their grounds. I have seen SUDS pictures from Europe and Singapore.

If done right, they not only serve for drainage, but also make the city more beautiful. Our City Drainage Master Plan is approved now and my mission is from now on to get it implemented. Luckily I was involved in the entire planning process from the very beginning and GIZ and the consultant provided me and my colleagues with a lot of advice and training. We feel confident to go ahead and apply the new tools we received to the best of our abilities. The implementation will take many years to come, but I am excited and looking forward to the time ahead.”



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