

# G20 Action Agenda on Adaptation and Resilient Infrastructure

## ANNEX

### Additional List of Action

Provided in G20 Climate Sustainability Working Group  
Adaptation Work Program (2018-2019)

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Provided in Climate Sustainability Working Group Adaptation Work Program (2018-2019)

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## Argentina

### Resilient Infrastructure and the Argentina's National Adaptation Plan

#### Description

Changes in the climate conditions affect infrastructure assets and the services they provide. Thus, it is key to rethink projects and infrastructure design options, materials, technologies, and processes to be used in order to enhance the resilience of the asset, as well as its maintenance. In this regard, within the framework of the National Adaptation Plan of Argentina, it is proposed to include climate change considerations in infrastructure projects, in some or all of its stages, and to promote the development of infrastructure resilience to climate change.

Accordingly, in 2019 Argentina has concluded a National Infrastructure and Territory, and Climate Change Action Plan, which was jointly developed by the National Directorate of Climate Change of the Government Secretariat of Environment and Sustainable Development and the Ministry of Interior, Public Works and Housing. This Action Plan was also agreed by different stakeholders, whom represent the business and academic sector, non-governmental organizations, chambers, civil society, workers, and make up the National Cabinet of Climate Change.

Vision, scope and adaptation target of the National Infrastructure and Territory, and Climate Change Action Plan

- **Vision:** Argentina will implement policies, actions and measures for the national economic and social development by promoting access to energy, safe water, services and housing, improving country's competitiveness, promoting low-carbon and sustainable productive and social growth, achieving a substantial reduction of greenhouse gas (GHG) emissions, and incorporating resilient infrastructure, which favors adaptation and reduces exposure to risk and vulnerability of economic, social and environmental systems.
- **Scope:** the scope of the Action Plan for the year 2030 involves aspects related to water infrastructure, housing and urban planning, and waste in the national territory.
- **Adaptation target:** promote the development of resilient infrastructure to climate change, boosting the growth and development of the economy and society through the planning of a set of measures and actions focused on axes related to water, housing and urban planning and waste.

#### Timeline

The National Adaptation Plan and the National Infrastructure and Territory, and Climate Change Action Plan will be implemented in the short- medium- and long-term and will be constantly updated in order to improve its adaptation measures.

#### Status of Implementation/progress

The National Infrastructure and Territory, and Climate Change Action Plan was published in 2019. In 2020, within the framework of the National Cabinet of Climate Change, the development of measures and strategies associated with the Water and Waste sector will be addressed.

For the development of adaptation activities, studies will be carried out to reinforce the identification of needs, risks and vulnerabilities that allow the development and prioritization of specific adaptation measures to be deepened, in line with the projected future climate changes and potential impacts in the sector.

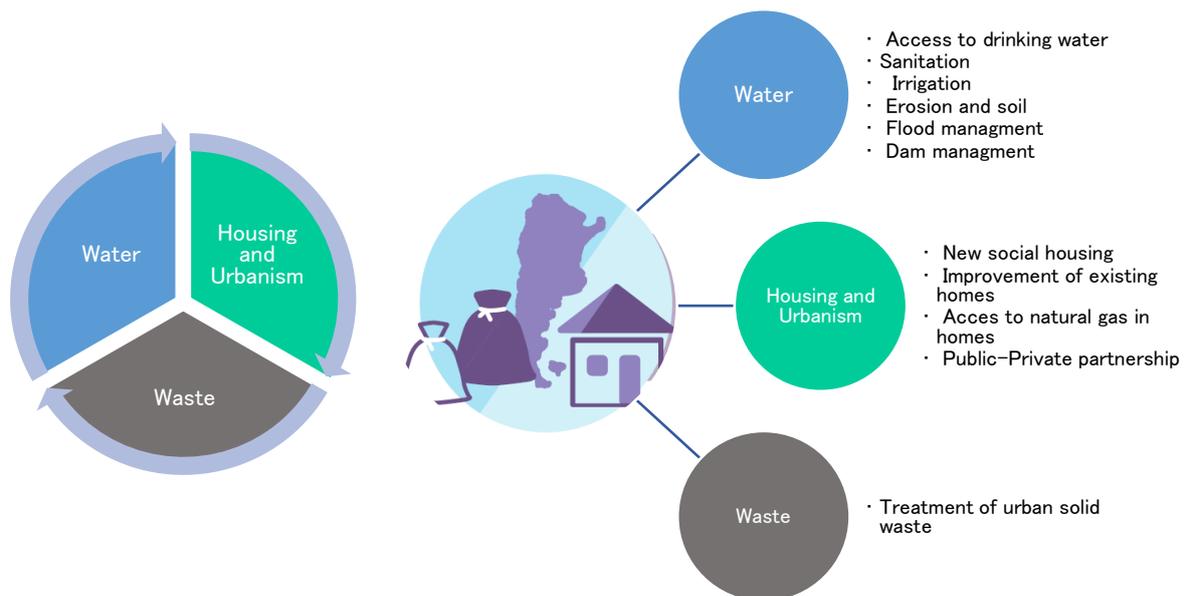
Moreover, an in-depth analysis of the interactions between measures and financing is required for the actual implementation of the measures.

These issues, together with aspects related to the monitoring and evaluation plan for mitigation and adaptation measures, will continue to work to complete the development and linkage with education issues for climate action and with the Sustainable Development Goals and gender.

## Lessons learned

Argentina has made significant progress in planning and implementing measures to adapt to climate change. As a precedent to highlight, the National Communications have made valuable contributions in terms of information and diagnosis, and made it possible to identify information gaps and needs. Moreover, the work carried out within the framework of the National Cabinet of Climate Change, made it possible to obtain more solid information and to secure sectoral commitments on climate change. This was achieved by identifying sectoral and provincial initiatives that are directly or indirectly linked to adaptation to climate change, and identifying gaps, needs, priorities and vulnerability studies at the national, subnational and sectoral level. In this sense, the National Adaptation Plan is being developed based on existing institutional arrangements, progress made so far, improving and expanding its scope and the work done in a permanent and iterative process that includes actions to generate capacities at all levels.

**Figure: Main areas of work of the National Infrastructure and Territory, and Climate Change Action Plan**



**Source:** National Cabinet of Climate Change.

**Table: Adaptation measures of National Infrastructure and Territory, and Climate Change Action Plan**

Area of work	Adaptation measure
Crosscutting	Incorporate climate change considerations into infrastructure projects.
Crosscutting	Facilitate / promote climate risk analysis of infrastructure projects and works, and take measures to promote climate resilience.
Crosscutting	Implement early warning systems.
Crosscutting	Improve or relocate infrastructure at risk.
Crosscutting	Promote an ecosystem-based adaptation approach in infrastructure planning and resilient systems.
Housing and urban areas	Construction of new homes complying with the Minimum Quality Standards for Housing of Social Interest.
Housing and urban areas	Reconditioning of homes in qualitative deficit - Best Sustainable Home.
Housing and urban areas	Development of new sustainable private homes.
Housing and urban areas	Creation of a Monitoring and Response Plan for housing overheating in climate risk zones.
Housing and urban areas	Inventory of urbanizations under risk of extraordinary floods caused by climate change, and development of contingency plans,
Housing and urban areas	Construction of storage tanks (reservoirs) for damping of extreme rain events in urban areas.
Housing and urban areas	Development of an afforestation plan in urbanizations and increase of the permeable surface.
Housing and urban areas	Promote the development of green infrastructure and other nature-based solutions for climate change adaptation.
Water	Work in progress.
Waste	Work in progress.

**Source:** National Cabinet of Climate Change, Government Secretariat of Environment and Sustainable Development and Ministry of Interior, Public Works and Housing (work in progress).

## China

### Meteorological Disaster Risk Management in China

#### Description

China's Meteorological Disaster Risk Management System with the following components and features.

#### **Comprehensive and multi-dimensional meteorological disaster monitoring network**

With over 60,000 observing stations, 190 weather radars and 8 on-orbit meteorological satellites, China has established an integrated space, sky, lands and sea meteorological monitoring network.

#### **Fast real-time operational data processing system**

Through update and iteration of high-performance computers, the calculating ability has been increasing by one order of magnitude every five years. China has established a robust big data processing center.

#### **High-resolution, timely forecast and early warning system**

Weather forecast, climate prediction as well as real-time early warnings for various disasters are issued by China and shared with different countries and regions. China holds 20 global and regional centers, including WMO's Asian sandstorm regional warning center, regional nuclear emergency response center, regional climate center and the global information center, providing meteorological support and service to countries in Asia and around the world.

#### Timeline

- 1998, National Disaster Reduction Plan of the People's Republic of China(1998-2010)
- 1999, Meteorology Law
- 2007, National Comprehensive Disaster Reduction 11th Five-Year Plan, updated every 5 years
- 2013, National Climate Change Adaptation Strategy

- 2015, The National Warning Information Release Center
- 2016, Opinions on promoting the reform of disaster prevention, reduction and relief system
- 2018, Opinions on strengthening meteorological disaster prevention, reduction and relief work



#### Status of Implementation/progress

Four-level emergency warning information release system with institution and financial resources : 1 national warning information release center; 31 provincial centers; 343 municipal-level agencies; 2015 county-level agencies; 9026 full-time staff; 12.1 billion cumulative investment.

#### Lessons learned

Effective national meteorological disaster risk management require concerted efforts from multistakeholders with government playing a central role. It needs comprehensive measures including policy guidance and planning from national level, inter-agency coordination and synergy among policy, science and technology, raising public awareness and enhancing social participation.

## Germany

### Ghana, Peru and the Philippines Study “Common Ground between Paris Agreement and Sendai Framework” by NAP Global Network

#### Description

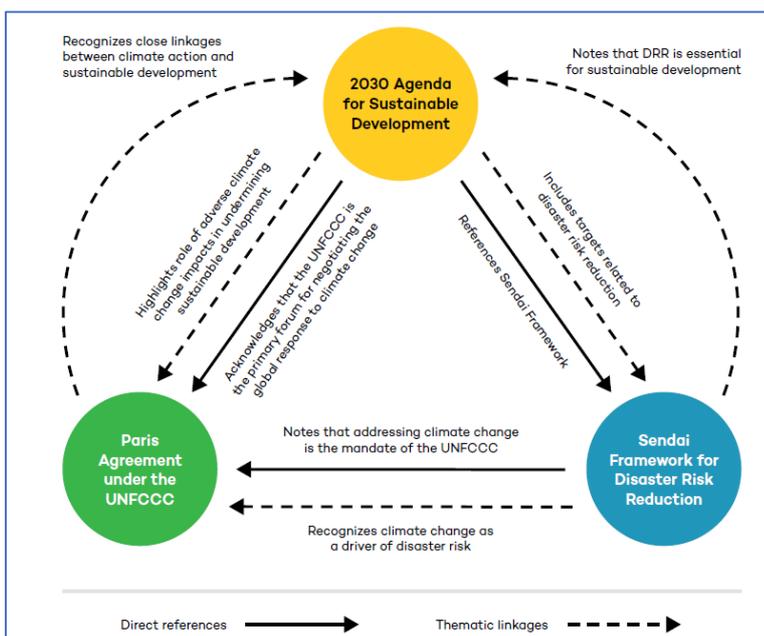
The study “**Common Grounds between the Paris Agreement and the Sendai Framework**” was commissioned to the Organisation for Economic Co-operation and Development (OECD) **by Germany/Federal Ministry for Economic Cooperation and Development (BMZ)** in contribution to the **G20 Adaptation Work Program**. The study points out challenges and potentials for coherent implementation of the Paris Agreement and the Sendai Framework at a global, national and sub-national level.

It draws on lessons and comparisons from **three case studies** in developing countries (**Ghana, Peru and the Philippines**) to identify good practices to scale-up concrete actions to accelerate the integration of disaster risk management (DRM) and climate change adaptation (CCA) in implementation processes. The analysis is structured around **five headings** to identify good practice approaches for implementing aligned CCA and DRM measures: 1) **governance**, 2) **data and information**, 3) **implementation**, 4) **finance**, and 5) **monitoring and evaluation**.

The study also builds upon successful implementation examples of the most important initiatives and actors in international support. It draws on work of **existing G20 initiatives**, such as the **InsuResilience Global Partnership, NAP Global Network** and other important actors/platforms, such as the **NDC Partnership** and **UNISDR/the Global Platform**.

Ultimately, the study will identify **entry points** and **recommendations** for **collective action** for the **G20 countries** on promoting synergies in implementing the Paris Agenda and the Sendai Framework. These include identification of the **practical and priority strategies and actions** for integrating the CCA and disaster risk reduction (DRR) agendas targeted at national governments in developing countries, donors and international organizations. By outlining **sources of finance relevant for the Paris Agreement and the Sendai Framework**, the study provides an overview and contributes to

an increased understanding of the financial support they are providing for planning and implementation at the intersection of adaptation and disaster risk management. These findings could be **included in the G20 Action Agenda on Adaptation and Resilient Infrastructure** and contribute not only in terms of **knowledge and information provision** but also to **capacity development**.



Source: NAP Global Network 2018. Alignment to Advance Climate-Resilient Development OVERVIEW BRIEF 1: Introduction to Alignment, p.4

## Timeline

### **Current Status:**

The fact-finding missions in the three pilot countries have been successfully completed (Ghana: May 2019, Peru: May 2019, Philippines: June 2019) and the first drafts of the case studies are available. The three case studies will form the second part of the overall study; the first part will illustrate the discussions and background of the issue of coherence at policy level.

The study formed the basis for a workshop jointly organized by OECD and the Global Center on Adaptation (GCA) on October 25, 2019 in Paris. At the request of the Ghanaian Environmental Protection Agency (EPA) ("Focal Point" for the case study) and in consultation with BMZ, the case study on Ghana and will be published as a stand-alone document (EPA will be co-author). It will be published in addition to the comprehensive study and will allow for a better use of the results (greater "ownership") by the Ghanaian government representatives, enabling the introduction of the results into the policy decision cycle of the government.

The entire study will be published by January 2020. A four-page summary with recommendations will be finalized by November 2019.

### **Status of Implementation/progress**

No additional activities under the case studies have been implemented yet. It is however worth noting that Peru's participation in this study led to/effectively facilitated a dialogue between government ministries and agencies responsible of CCA and CRM measures. As a concrete outcome, they are now exploring how coherence between the government ministries and agencies towards a common approach on CCA and CRM can be strengthened.

For the future, the study aims at informing and providing policy recommendations for governmental stakeholders.

## Lessons learned

### **Ghana**

At the national level, a mainstreamed approach is taken to CCA, both through policy frameworks, such as the National Climate Change Action Plan, National Adaptation Plan (NAP), the Climate Smart Agriculture Plan, and institutional arrangements.

In the context of DRM, the focus is primarily on response measures. Institutional mechanisms are in place to facilitate synergies between CCA and DRM at the national level.

### **Peru**

Peru has engaged strategically with development cooperation partners to develop DRM and CCA policies and best benefit from technical assistance, innovative approaches and exchanges of best practices. Going forward, Peru is well positioned to further benefit from climate financing, provided that it further demonstrates its ability to implement practical resilience measures.

### **Philippines**

The Philippines made great efforts to integrate CCA and DRM in their core institutions. Each policy area has a champion at national level (the Climate Change Commission and the National Disaster Risk Management Council), who hold a coordination role, are mandated in law, and have associated dedicated funding mechanisms.

## Italy

### Measures for energy efficiency, sustainable mobility and climate change adaptation in the small islands

#### Description

On 14<sup>th</sup> July 2017 the Department for Climate and Energy published the notice “Measures for energy efficiency, sustainable mobility and climate change adaptation in the small islands”, to reduce greenhouse gas emissions, promote low emission mode of transport and take climate change adaptation measures. The beneficiaries of funding are the municipalities (*Comuni*) of not interconnected small islands, carrying out projects in each own territorial constituency. Types of adaptation measures eligible for funding were: conversion of irrigation systems for water saving; reducing losses for water networks; maintenance of the dunes with restoration of psammofila flora; maintenance interventions and protection of internal ecosystems, also for prevention of forest fires; plantation of trees and urban pavement regeneration to reduce heat wave impacts; desalination plants from renewable sources.

#### Timeline

2017 – ongoing

#### State of implementation/progress

In 2018 fourteen projects, including adaptation measures, were selected for funding, up to a maximum of EUR 1 million for each intervention and with a total amount of EUR 13.772.604,21.

## Italy

**National programme on resilience increase of natural and semi-natural forestry systems, through the recovery, the structural and functional restoration of ecosystems and their service functionality and through consistent actions with the biodiversity protection and conservation (flora, fauna, vegetation and natural and rural landscape) in the protected areas crossed by the fire.**

### Description

On 11<sup>th</sup> October 2017 the Department for Climate and Energy published the notice of the initiative mentioned above. After that, in September 2018 fifteen applications were submitted and the Commission for project evaluation was appointed. Currently the selection of the eligible proposals is ongoing. The resources allocated for the purpose amount to EUR 5 million, for each initiative up to EUR 500.000. Beneficiaries of funding are public administrations managing protected areas, whose constituencies are affected by forest fires, that are fire risk protected areas requiring forestry biodiversity conservation actions, in order to implement measures for soil protection, hydrogeological risk reduction, CO<sub>2</sub> absorption and also for biodiversity preservation and ecosystem functionality.

### Timeline

2017 – ongoing

### State of implementation/progress

With regard to define measure implementation procedures, the signing of procedural agreements is scheduled by the end of the year.

## Italy

### **Notice on Small Landslides: hydrogeological risk reduction due to mountain municipality landslides in order to promote climate change adaptation.**

#### **Description**

In 2015 the Department for Climate and Energy committed EUR 44,5 million to seventeen Regions, to implement measures for hydrogeological risk reduction caused by landslides in mountain municipalities (*Comuni montani*). Totally fifty-five actions were financed and in 2016 the signing of seventeen procedural agreements regulated control and monitoring activities.

#### **Timeline**

2015 – ongoing

#### **State of implementation/progress**

To regulate control and monitoring procedures of the financed measures, in 2016, procedural agreements with the Regions entered into force. Then a ministerial funding of 30 % was transferred to each Region.

## Italy

**CRelAMO PA Project: Action L5: Skills and Networks for the Environmental Integration to better organise the Public Administrations and strengthen the administrative capacity for climate change adaptation.**

### Description

In June 2018 the action L5 (Strengthening of administrative capacity for climate change adaptation) of the CRelAMO PA Project started. The initiative is covered by the European Social Fund, under the NOP Governance and Institutional Capacity 2014 – 2020. The objective is promoting climate change adaptation knowledge at local and regional level, overcoming the territorial disparities regarding adaptation progress, facilitating the integration of adaptation in spatial planning.

### Timeline

2017 – 2023

### State of implementation/progress

During 2018 four on-the-job training sessions took place, in Sardinia, Apulia, Calabria and Abruzzo.

## Japan

### The Asia-Pacific Seminar on Climate Change

#### Description

The Ministry of the Environment, Japan (MOEJ), initiated organizing the Asia-Pacific Seminar on Climate Change (AP Seminar) in 1990. The Seminar has served as a regional vehicle for countries to build confidence through exchange of views and experiences on climate change issues in a practical manner. Since the 13th Seminar in 2003, the Government of Australia joined as a co-organizer, and continued to take the joint initiative.

In response to growing attention, the recent Seminar has taken topics related to adaptation. In particular, the 27th Seminar in 2018 hosted the UNFCCC Adaptation Committee expert meeting on national adaptation goals/indicators and their relationship with the Sustainable Development Goals (SDGs) and the Sendai Framework for Disaster Reduction.

The experts discussed how synergies of UNFCCC, the SDGs and the Sendai Framework could be enhanced, in particular topics described in the box to the left.

The momentum created in the UNFCCC AC expert meeting/the 27th AP Seminar were brought to further discussion in 28th Seminar, where participants discussed 1) sharing practical cases of synergies of the above three agenda, 2) capacity building, strengthening, promoting innovation, and development of new business models, and 3) mobilization of private finances. The result of discussion was provided as an input to the G20 Climate Sustainability Working Group meeting.

Box. Highlighted discussion topics of UNFCCC Expert Meeting (2018)

1. National reporting system under the SDGs and Sendai Framework and their approaches to connect them with adaptation progress assessment;
2. Creating Synergies among adaptation, the SDGs and Sendai Framework and improving M&E at national level and its opportunities and limitations;
3. Addressing capacity constraints and overcoming barriers at national level
4. Integration of M&E systems from local to national and global level

#### Timeline

Annual organization since 1990 and onward



Photo: Discussion in the UNFCCC AC expert meeting/the 27 AP Seminar (Tokyo)

## Status of Implementation/progress

Since the start of Seminar in early 1990, the Seminar gradually developed its scope and the depth of discussion. In recent years, participants, in particular from developing countries in the Asia-Pacific, have led the discussion, introducing good practices of policy development and implementation in the related area.

Also, the AP Seminar has also functioned as a space for key international events and initiatives on climate change adaptation. Not only hosting UNFCCC/AC expert meeting, and providing inputs to the G20 CSWG meeting, but also the 26th AP Seminar, held in Suva, Fiji, was recognized as a UNFCCC COP23 endorsed event, and the Seminar supported the preparation for the adaptation discussion for the COP.

## Lessons learned

Major part of the participants are climate change negotiators, however, the format of discussion has been designed as quite practical, with hybrid participation by practitioners, such as domestic and international practitioners, scientists, the private sector etc. This unique setting has promoted practical interactions between participants, networking toward cooperation, as well as knowledge transfer.

Also, by hosting key international events on adaptation enriched the discussion, based on its well established cooperative relationship among countries in the Asia-Pacific region.



Photo: The 27 AP Seminar in Suva, Fiji, in support of the Fijian COP Presidency

## Japan

### The Asia-Pacific Seminar on Climate Change

#### Description

Climate change is considered as one of the most serious challenges that pose threats to global security and economic prosperity. In light of this, the Ministry of Foreign Affairs of Japan (MOFA) organized a roundtable seminar on climate change and fragility implications on international security in January 2017 which was followed by several review meetings. One of the actions proposed by the seminar and follow-up meetings was: study and discuss climate change and fragility in Asia and Pacific region. Since then, MOFA holds International Conferences on Climate Change and Fragility every year.

#### Timeline

2017 and onward

#### Status of Implementation/progress

In July 2018, MOFA held the **International Conference on Climate Change and Fragility in the Asia-Pacific Region — Interlinkage among Science, Regional Studies and Business from the Perspective of Long-term Climate Risks** in Tokyo.

In 2019, considering that ocean plays a key role in climate change issues, and the Intergovernmental Panel on Climate Change (IPCC) published the **Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC)** in September, MOFA decided to uphold ocean as the theme of this year's Conference. The 2019 Conference was scheduled on 12<sup>th</sup> October, but unfortunately cancelled due to the Typhoon *Hagibis*. In cooperation with the Panelists, MOFA is holding several online meetings in November to have the panel discussions. Presentations and discussion videos and a summary report of them will be published in due course.



Photo: Online meeting of the Session 1 — Pacific Ocean affected by Climate Change

#### Lessons learned

The achievement and key findings of the 2018 Conference are as below.

(1) Both climate change experts and corporate representatives attended the Conference and actively discussed the recent trend of climate change and its complex challenges. Through the one-day conference, it was recognized that climate change affects not only the environment but has significant impact on economy, society and global security. The scenario exercise in the breakout session provided an opportunity for the participants to examine impacts that long-term climate risks have on socio-economic development of countries and region from various points of view.

(2) Many participants made positive comments on the approach taken by the Conference which gathered experts from a broad range of specialization related to climate change. The participants commented that they were able to examine climate change from a new perspective as they were able to interject with experts on various fields such as natural science, regional studies, business and investment. Other attendees pointed out that they could have better appreciation on what kind of role scientific data evidence can play in providing basis for stakeholders when

they make important policy decisions and business strategy.

(3) In order to take effective climate action, it is imperative that stakeholders related to climate change have critical awareness and sense of urgency. They also need to take into account the opportunity for economic growth provided by robust actions taken in order to assess climate change. At various international fora such as G7 or G20 meetings, active discussions are underway to link climate change and global security as well as efforts to connect climate change measures to the promotion of economic growth.

MOFA intends to make the best use of views and feedback acquired through the Conferences for the future international discussions.



Photo: Panel discussion 2 of the 2018 Conference  
To see the whole summary of the 2018 Conference, visit [https://www.mofa.go.jp/ic/ch/page22e\\_000847.html](https://www.mofa.go.jp/ic/ch/page22e_000847.html)

## Japan

# Capacity Strengthening for Development and Implementation of the Bangkok Master Plan on Climate Change 2013-2023

### Description

Japan International Cooperation Agency (JICA) has been conducting technical cooperation projects with the Bangkok Metropolitan Administration (BMA), Thailand. As the local government of the capital city of Bangkok, with more than 800 million of population, the BMA has endeavored to address climate change mitigation and adaptation through developing and implementing the Bangkok Master Plan on Climate Change 2013-2023.

In the adaptation component, technical cooperation activities included;

1. Prioritization of climate risks and adaptation response based on vulnerability assessment;
2. Translating the results of prioritization into adaptation planning, as part of the Master Plan;
3. Introduction of good practices and engagement in policy dialog with other local governments;
4. Support to improve designing and implementing adaptation projects;
5. Enhancement of institutional arrangement and stakeholder engagement

### Timeline

2009-2012 (Phase 1),  
2013-2015 (Phase 2),  
2017-2022 (Phase 3/ongoing)



Photo: Flood in Bangkok in 2011

### Status of Implementation/progress

In 2018 and 2019, the Project supported the BMA to conduct a 5 year mid-term Comprehensive Review of the Progress of Implementation, and the results showed that infrastructure development, such as building drainage facilities, flood prevention dykes and water retention ponds, improved the resilience of Bangkok against negative impacts of climate change to some extent. As a snap shot of 2019, the BMA invested approximately 560 million Baht for adaptation projects under the Master Plan.

Also, as an effort to mainstream adaptation, the Project successfully supported the BMA to integrate adaptation-related investments into its annual planning and budgetary processes. In this approach, the BMA is routinizing its adaptation actions within its regular operational system.

In 2019, the BMA, supported by JICA, initiated its work to develop a master plan with a target with a view to covering the period of 2024-2030, in line with Thailand Nationally Determined Contribution (NDC) and the National Adaptation Plan (NAP).

For the development of further actions, the Authorities of Thailand, such as the Ministry of Natural Resources and Environment (MONRE) and other line ministries also participated through the Steering Committee of the Master Plan.



Photo: High-level policy dialogue for city-to-city cooperation (Ms. Wiparat, Deputy Permanent Secretary, BMA and Mr. Kobayashi, Deputy Mayor, City of Yokohama) (Aug 2019)

## Lessons learned

From the experiences of the long term cooperation, the BMA has strengthened its ownership to design and implement adaptation actions. Also, the capacity to coordinate and engage key stakeholders have been dramatically improved by establishment of the institutional arrangement in the BMA, as climate change adaptation requires cross-cutting coordination with departments.

Collaboration with the City of Yokohama provided an extra opportunity for the BMA to exchange views and experiences to overcome urban challenges including negative impacts of climate change. Continuous communications have enabled to update their knowledge, and common understanding toward the global issue.

The Master Plan has served as an effective tool to show a direction for BMA's investment on adaptation related infrastructure. While efforts are still underway and challenges remain, the BMA is expected to continue and accelerate its adaptation actions.

## Singapore

### Holistic Approach to Flood Protection, Case Study on Orchard Road

#### Description

Over the years, PUB, Singapore's National Water Agency, has made significant progress to reduce the flood prone areas in Singapore, from 3200 ha in 1970s to 29 ha today.

#### Source-Pathway-Receptor Approach

With climate change, Singapore may experience more intense rainfall events more frequently. There is a limit to how wide drains can be as land is scarce in Singapore. To minimise flood events, PUB has adopted a multi-pronged approach that covers the entire drainage system, from 'source' (where stormwater runoff is generated), to 'pathway' (drains and canals through which stormwater is conveyed), to 'receptor' (where floodwaters may flow to and affect infrastructure). This would build flexibility and adaptability into the entire drainage system.

#### Case Study

In 2010 and 2011, Orchard Road was subject to intense rains that caused flash floods, as the Stamford Canal, which stretches 4.7km under Orchard Road shopping belt from Tanglin to Marina Reservoir, could not cope with the heavy rain. Taking a holistic stormwater management approach, the Stamford Diversion Canal (SDC) and Stamford Detention Tank (SDT) were identified as important, long-term measures which work together as a system to alleviate floods in the Orchard Road belt.

#### Stamford Diversion Canal (SDC)

The 2km SDC runs underneath Tanglin Road to Grange Road, and connects to the Singapore River. The SDC will divert stormwater from the upstream of Stamford Catchment (such as Holland Road and Napier Road areas) into the Singapore River, through two underground tunnels of 4.5m diameter and drains (6m to 14m wide box culverts), which

eventually leads to Marina Reservoir. Previously, stormwater from these areas was channelled directly into Stamford Canal. The SDC will now be able to relieve Stamford Canal of a portion of stormwater.

#### Stamford Detention Tank (SDT)

The SDT sits beneath the Singapore Botanic Garden's Tyersall Learning Forest's coach park and the National Orchid Nursery. Although the underground tank is as large as a football field, its facility building on the surface only takes up a fifth of this area, freeing up space for the coach park and nursery.

The SDT is designed to temporarily store stormwater from the drains in Holland Road during a heavy rainfall. The excess stormwater will flow from the drains into a weir chamber where a pair of inlet pipes will then channel the water into the SDT by gravity. After the rain subsides, and water levels in the Holland Road drains fall, the water stored in SDT will then be pumped back into these drains which leads to SDC. The SDT can hold up to 38,000m<sup>3</sup> or 15 Olympic sized swimming pools of stormwater which can be emptied in four hours to prepare the tank for the next heavy rainfall.



Photo of Stamford Detention Tank

## Timeline

### June 2010, June 2011, December 2011

Heavy rains occurred over the Stamford catchment area leading to flash floods in Orchard Road.

### 2012/2013

Implemented short term measures such as:

- i. Raising roads from Orange Grove Road to Cairnhill Road by an average 30cm;
- ii. Introducing a lining to smoothen the walls of Stamford Canal to channel stormwater more quickly; and
- iii. Working with building owners along Orchard Road to install flood protection measures such as flood barriers.

### 2013/2014

Construction works on SDT and SDC commences.

### 2018

Construction works completed and both SDT and SDC became operational.

## Status of Implementation/progress

Construction works for SDT and SDC commenced in 2013 and 2014 respectively, and both became operational in 2018.

## Lessons learned

Both the SDC and SDT were complex infrastructural projects conducted in a densely built up area. During the whole construction phase, engineers were mindful to minimise inconvenience to the residents and businesses. For example, the shallow tunneling for SDC were challenging tasks with little room for error as some areas of SDC were a mere 4 metres underground. Engineers took extra precautions by monitoring the ground condition 24/7 during such works. The use of skilled expertise also ensured that the tunneling underground was executed smoothly.

Overview of flood protection measures for orchard road

