Climate change adaptation and resilience in the Caribbean
Water security and disaster risk reduction
Climate change and resilience

HR Wallingford is an independent, specialist consultancy and research organisation. We deliver practical solutions to the complex development challenges faced by our international clients, specialising in climate, water, agriculture, infrastructure development and disaster risk reduction.

In the Caribbean, there is a demand for significant investment in water, energy, agriculture and transport infrastructure. From small-scale development interventions to major infrastructure projects, investments are made in the context of uncertainty related to future climate change and growing demands on natural resources. Our approach to managing future risks is focused on promoting climate resilience. Resilient communities are capable of mitigating the impacts of, and bouncing back from 'climate shocks', such as floods, droughts and slower onset sea level rise. They actively prepare for economic, social and environmental change.

Resilient infrastructure is designed to resist climate hazards, to provide a reliable level of service and a return on investment, whatever the future holds. In both cases ‘systems’ can endure shocks and stresses and recover to deliver their long term objectives.

We provide climate resilience and adaptation guidelines for Government ministries; tools to identify risks and screen investment decisions; national-, basin- and community-scale risk assessments; early warning systems for floods, droughts and cyclones and detailed flood risk and engineering studies. We offer capacity building and training courses in these areas, which are underpinned by more than 60 years of engineering research in the water environment. This includes capacity development at all levels – from policy makers to technical professionals and community-based organisations - on a range of subjects including resilience building, risk assessment, climate change adaptation, water resources management, water and wastewater services, flood risk management, urban drainage and coastal zone management. Some of our recent and on-going projects underpinning climate resilient development in the Caribbean are summarised below. The projects were delivered through strategic partnerships with CARICOM Regional Organisations, National Governments, Water Services Departments, Water and Waste Water Companies, Water Resource Management Authorities, Inter-Governmental Organisations, Donors and IFIs.
Integration of climate resilience in the Caribbean water sector

**Client:** Caribbean Development Bank (CDB)

**Location:** Caribbean region with case studies in Grenada, Saint Kitts and Nevis, Antigua and Barbuda and Dominica

We assessed climate risks and developed investment plans for the water sector in four Caribbean Small Island Developing States (SIDS); Saint Kitts and Nevis, Grenada, Antigua and Barbuda and Dominica. Climate risk and vulnerability assessments were completed for each island using a participatory approach and addressing: water services and water resources; reviews of policies and plans related to the water sector; development of sector wide investment plans setting out the short, medium and long term investments required to support the resilience of the sector to climate related risks.

We engaged with 17 of CDB’s borrowing member countries from across the Caribbean region to develop tools and guidance to upscale the approaches developed for the case study countries across the region.

This included a Water Sector Resilience (WSR) index tool, training manual and accompanying tools and guidance to strengthen national capacity for risk assessment and investment planning. The WSR index tool and guidance was disseminated through a regional training of trainers event which brought together water sector professionals and practitioners from all the CDB borrowing member countries.

Climate risk and vulnerability assessment

**Client:** Water and Sewerage Company (WASCO)

**Location:** Saint Lucia

HR Wallingford supported WASCO in producing a Climate Risk and Vulnerability Assessment (CRVA) and preparing an Adaptation Plan of Action (APA) for Saint Lucia. The overarching aim of the work was to increase the reliability and resilience of WASCO’s capability to achieve its goal ‘the reliable provision of good quality water and wastewater services to its customers’.

WASCO led the preparation of the CRVA and APA with the active participation of key stakeholders. The CRVA formed the evidence base to prepare the adaptation plan of action (APA). At the end of the consultancy project, the CRVA and APA documents became living documents to be elaborated and updated on a regular basis by WASCO’s staff, its management and key stakeholders.

Climate vulnerability assessment

- **Antigua road project**

**Client:** Consultant

**Location:** Antigua

A Climate Vulnerability Assessment (CVA) was carried out for proposed infrastructural road works in Antigua. The CVA identified and evaluated the effects of climate variability and projected climate change on the areas and communities where the roads were situated, assessed the vulnerability of proposed works and identified options to increase resilience. The CVA provided both qualitative and quantitative evidence that can be used for the financial and economic assessment of the various options under consideration for upgrading the roads.
Regional strategic action plan for water governance and climate resilience

Client: Caribbean Development Bank (CDB)
Location: Caribbean region

A senior expert from HR Wallingford supported the development of a Regional Strategic Action Plan (RSAP) for Water Governance and Climate Resilience in the Caribbean. The RSAP aimed to strengthen water governance arrangements, address climate challenges and increase levels of investment. The process involved consultation and engagement with ministerial and senior representatives of Caribbean countries, Water Utility companies, development partners and regional organisations. The preparation of the RSAP formed the centre-piece of the Caribbean session at the 8th World Water Forum (8WWF) held in Brazil in 2018.

Green Climate Fund proposals

Client: Caribbean Development Bank (CDB)

Location: Caribbean region and The Bahamas

A Green Climate Fund (GCF) facility was established in 2018 to help countries in the region access the Fund. HR Wallingford prepared a number of GCF concept notes to support CDB’s growing support to the water sector. GCF concept notes provide early, outline proposals and experience has shown that it leads to better full proposals. They also provide an early opportunity to start dialogue with the GCF Secretariat and receive valuable feedback and guidance. Two concept notes were prepared: firstly for a Regional project and secondly for The Bahamas. Indicative costs of the proposals were US$ 40-50 million each and the components and outputs included: climate-resilient water governance; climate-resilient water resources management; climate informed decision support; building climate resilience in the provision of water services; and integrated climate resilient capacity building, education and information communication.

Climate impacts on achievement of the Sustainable Development Goals (SDGs)

Client: Climate and Development Knowledge Network
Location: Caribbean region

This project provided an in-depth analysis of the major impacts of climate change and climate variability (including temperature, water, extreme weather events, sea level rises, ocean acidification, etc.) on the achievement of the SDGs in three world regions including Latin America and the Caribbean between 2015 and 2030. The study considered the impacts of high ambition and low ambition climate change agreements and projections. It also included deep dive country specific analysis of the impacts of climate change on SDG1 (End Poverty), SDG5 (Gender equality); SDG6 (Water) and SDG7 (Energy) in Jamaica and Dominica. The study helped to improve the awareness of the impacts of climate change, and the 2015 Climate Change Agreement, on the achievement of the SDGs across a range of stakeholders.

Caribbean flood hazard mapping and rainfall intensity-duration-frequency curves

Client: CARCOM/CROSSQ
Location: The Bahamas, The Cayman Islands, Montserrat, Saint Vincent, Trinidad and Tobago and Guyana

Specialists from HR Wallingford worked with the Caribbean Institute of Meteorology and Hydrology (CIMH) to prepare rainfall intensity-duration-frequency curves and national flood hazard maps for several islands in the Caribbean and the coastal zone of Guyana. The outputs were used in the provision of greater uniformity in building design across the region.
Climate proofing water investment in the Caribbean

Client: Climate and Development Knowledge Network
Location: Caribbean region

Building on the CARICOM Regional Framework for Achieving Development Resilient to Climate Change, this project undertook a situational analysis of past financing flows and assessed opportunities for accessing Climate Finance in the Caribbean water sector. The project was led by HR Wallingford on behalf of the Global Water Partnership Caribbean (GWP-C) and CARICOM Caribbean Climate Change Centre (CCCCC).

A regional Framework for Investment document was prepared to serve as a reference document to provide a coordinated regional approach for planning, financing and progressing work on water and climate in the region. The document provided outlines for critical water and climate resilience programmes/projects organised into six thematic areas related to droughts, floods, infrastructure, agriculture, IWRM and the environment. We worked alongside a wide range of key stakeholders including CARICOM Regional Organisation, regional agencies and professional bodies working on water management and use and national technical specialists.

Science for Humanitarian Emergencies and Resilience (SHEAR)

Client: UK Department for International Development (DFID)
Location: Caribbean region

The SHEAR programme provided investment in research to bring forward the next generation of more systematic, transparent and comprehensive risk information and early warning systems for humanitarian and development purposes. The programme focussed on weather-related risks, and how these are integrated with other vulnerabilities and stresses to generate humanitarian emergencies and damage.

Climate proofing water supply in Saint Vincent

Client: Climate and Development Knowledge Network
Locations: Saint Vincent and the Grenadines

The project assisted the Central Water and Sewerage Authority (CWSA) in delivering safe and sustainable water supply services to communities in the Sandy Bay area of Saint Vincent. We assessed the climate risks to the water supply at Sandy Bay in Saint Vincent and developed options to enhance the climate resilience of the system and the communities it served. Economic analysis of costs and benefits of the climate proofing and adaptation measures were assessed before being prioritised. Ultimately, the project delivered a Project Appraisal Document to allow CWSA to access funding for a the water service improvement project. It also provide capacity development to CWSA in the analysis of climate risks, economic appraisal approaches for climate resilience and the preparation of funding proposals. Lessons learned and outputs from the project were also transposed into capacity development materials for wider regional dissemination.
Strategic framework for WASH climate resilient development

Client: Global Water Partnership and UNICEF
Location: Caribbean region / Global

HR Wallingford, in collaboration with ODI, worked with UNICEF and the Global Water Partnership (GWP) to develop a Strategic Framework for WASH Climate Resilient Development. Phase I produced the Strategic Framework which is targeted at WASH sector practitioners, advances thinking around WASH and climate variability and change, and has an emphasis on climate resilient development. Phase II produced further supporting materials to support implementation and roll out of the Strategic Framework by national teams and practitioners. This included risk assessment guidance, technical briefs, learning modules and a training workshop package. The materials are practical and easy to use tools that are flexible enough to be used and adapted to in many different country contexts. The deliverables are being used by UNICEF country offices and are also used to support national training programmes on WASH Climate Resilient Development.

Water security indicator toolkit

Client: Internally funded research by HR Wallingford
Location: Caribbean region / Global

Through internally funded research, HR Wallingford has developed a Water Security Indicator Toolbox for use in climate screening studies and assessments. The toolkit can be applied at national, catchment and local levels to produce a series of hydrological/water resource indices that summarise baseline conditions and climate change impacts on indices such as specific precipitation, evapotranspiration, run-off, soil moisture, and groundwater recharge. The Toolkit is particularly useful for looking at drought indices for both short- and long-term droughts. The toolkit brings together:

- the latest available climate change projections and data sets (CIMP5);
- development of tools to process CMIP5 datasets;
- input/output algorithms to link climate datasets to a gridded water balance/recharge model;
- transient water availability simulations;
- generation of hydrological indices;
- visualisation of results.
### Water supplement to the UNFCCC’s NAP technical guidelines

**Client:** UNFCCC/Global Water Partnership  
**Location:** Caribbean region / Global

The United Nations Framework Convention on Climate Change (UNFCCC) National Adaptation Plan (NAP) process is building resilience to climate change and integrating climate change adaptation into all levels of decision making. Following the release of the main NAP technical guidelines, HR Wallingford led the development of a water supplement to specifically address the unique characteristics of water within national adaptation planning processes. Aimed at national and sectoral planners (water resources and others), the water supplement supports the integration of water in the NAP process to reinforce implementation of the Paris Agreement and to reinforce achievement of the Sustainable Development Goals (SDGs). The NAP Water Supplement aims to support countries to:

- incorporate water-related adaptation needs and opportunities in the formulation and implementation of NAPs;  
- enhance the integration of water-related adaptation in development policies, programmes and plans;  
- strengthen the resilience of economies, livelihoods, and natural ecosystems by reducing water-related climate vulnerabilities, and building adaptive and transformative capacities.

### A sourcebook for the Caribbean water sector

**Client:** Climate and Development Knowledge Network  
**Location:** Caribbean region

High-level commitments and aspirations in the Caribbean were supported to increase investment in water security and climate resilient development. This was achieved through the development of a Caribbean-specific sourcebook to support the integration of climate resilience. The sourcebook assists water sector professionals and practitioners to mainstream climate resilient approaches through the implementation of better water policies, strategies, programmes and water related adaptation actions. Updates to the CCORAL risk assessment toolkit were also undertaken to strengthen its applicability to, and application by, water sector professionals.

### South-South Learning Exchange

**Client:** Climate and Development Knowledge Network  
**Location:** Trinidad and Tobago

Climate and Development Knowledge Network (CDKN) sought to promote south-south knowledge transfer and exchange on water security and climate resilience development between Africa and the Caribbean. HR Wallingford designed and facilitated the knowledge exchange workshop which brought together regional around 40 specialists from Africa and the Caribbean. The outcomes of the exchange were used to generate knowledge briefs and lessons learned products that were disseminated more widely in each region, as well as an action plan for continued south-south learning between the two regions.
IWRM learning review

**Client:** Global Water Partnership (GWP)

**Location:** Caribbean region with case studies in Trinidad and Tobago, Barbados, Grenada and Guyana

An international team led HR Wallingford conducted a learning review for GWP’s Regional Water Partnership (RWP) in the Caribbean. The GWP has established a system of learning reviews for the Regional Water Partnerships to provide a mechanism to help strengthen GWP’s overall impact, assure quality and protect the GWP brand name. All with a spirit of transparency and accountability to the partners and other stakeholders of the GWP network. The review provided a system of self-improvement for the individual RWP and GWP as a whole. We identified sources of documentation for analysis, identified key partners, donors, regional and country stakeholders to engage with and led missions to Trinidad and Tobago, Barbados, Grenada and Guyana.

Infrastructure rehabilitation project - surge and wave modelling

**Client:** Consultant

**Location:** The Bahamas

Hurricane Floyd (in 1999) was one of several hurricanes which caused infrastructure damage throughout The Bahamas. Following initial site investigations by HR Wallingford specialists, the client identified about a dozen sites which required wave and surge data for rebuilding design. We set-up and carried out surge and wave modelling covering the whole of the Bahamas and validated this against Hurricane Floyd. Site specific wave predictions for hurricane and storm conditions were also made to investigate worst cases scenarios, return periods and distributions of the highest wave heights. Additional model studies explored alternative site-specific infrastructure options and their impacts on surge and wave conditions in adjacent locations.

Guyana coast - sea defence strategy

**Client:** Ministry of Agriculture

**Location:** Guyana

HR Wallingford, in association with the Ministry of Agriculture of Guyana, provided recommendations for the future sea defence policy of Guyana. This was based on a visit to the country, a literature review of reports on the subject and detailed evaluation of historical maps and charts from the 1780s to the 1970s. The study challenged a previous recommendation (by others) that extensive and costly new concrete sea-defences were required. Instead, HR Wallingford recommended:

- developing the resources of the government’s Hydraulics Division such that it could rehabilitate sea defences gradually in response to actual erosion;
- using the existing form of embankments;
- enhancing survey capacity of the Hydraulics Division;
- increasing the frequency of harmonised onshore and nearshore surveys;
- reintroduction of natural vegetation into regions of prior erosion.

Although this project was completed in the 1980’s, this approach echoed HR Wallingford’s forward thinking and ethos to maximise natural flood defences and to build national capacity to ensure long-term sustainability of defences.
HR Wallingford has a 60 year track record of achievement in applied research and specialist consultancy – key to our success is our expert staff, with world renowned skills and expertise.

**Our team**

**Dr Nigel Walmsley**
Dr Nigel Walmsley is a Technical Director at HR Wallingford with over 20 years’ experience, including substantial periods based overseas in Africa, Asia, Pacific, and elsewhere. He specialises in integrated water resource management, including climate change aspects, and has led and coordinated a range of specialist international consultancy and research projects / programmes.

**Darren Lumbroso**
Darren Lumbroso has over 20 years’ experience undertaking hydrological, hydraulic and water resources and flood risk management projects in over 30 countries, including Thailand. He has managed a number of projects on flood event management that are directly related to the benefits that are derived from improved flood warning and also on emergency management of floods.

**George Woolhouse**
George Woolhouse is a hydrologist specialising in water security and climate resilience. George has led and contributed to a wide range of projects for international development organisations including the development of guidance for developing countries on the incorporation of climate change in water resources and planning and climate risks management.

**Jemima Kennedy**
Jemima Kennedy has 11 years’ experience in the areas of water resources, water quality, Water, Sanitation and Hygiene (WASH), and climate resilience. She was lead author on the Global Water Partnership and UNICEF WASH Strategic Framework and two Technical Briefs, designed to help strengthen the resilience of WASH services to climate variability and change.

**Dr Gina Tsarouchi**
Gina’s PhD in Hydrology focused on modelling the hydrological response of watersheds to land-use and climate change in the Ganges River Basin of India. Gina’s main areas of expertise are in land surface modelling, climate change and hydrological modelling. She has analysed Climate Change impacts on the achievement of the Sustainable Development Goals (CDKN).

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