HR Wallingford
Working with water

Incorporating drought risk modelling as a planning tool for climate change adaptation measures in Saint Kitts and Nevis

Implementation plan

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25 January 2022

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Contents

1 Introduction 5
1.1 Project summary 5
1.2 About this plan 5
2 Project Management set up 5
3 Development methodology outline 7
3.1 Project scope 7
3.2 Method outline 8
4 Project outputs, activities and deliverables 9
4.1 Overview of the implementation process 9
4.2 Detailed activities 10
4.2.1 Mandatory output: Development of implementation planning and related communication documents (Month 1) 10
4.2.2 Output 1: Map Stakeholders and establish a stakeholder working group (Month 1) 10
4.2.3 Output 2: Assess drought risk and water resources in Saint Kitts and in Nevis (Month 2 to 3) 11
4.2.4 Output 3: Benchmark, design and implement a drought prediction model in Saint Kitts and in Nevis (Month 4 to 6) 13
4.2.5 Output 4: Train administrators and users of Saints Kitts and Nevis to the drought prediction model (Month 7 to 12) 14
4.2.6 Progress reporting 15
5 Work schedule 15
6 Stakeholder management process 18
6.1 Considerations 18
6.2 Approach to stakeholder management 18
7 Gender analysis process 19
7.1 Introduction 19
7.2 Gender assessment 20
7.2.1 Impacts of drought 21
7.2.2 Action Plan to address potential gender participation gaps and identify entry points 22
8 Change management process 22
8.1 Changes in scope of work 22
8.2 Changes to technical approach 22
9 Communications management 23
9.1 Communication requirements for the project 23
10 Quality management process 24
10.1 Quality management 24
10.2 Continual improvement for our projects, and recording corrective actions 24
11 Risk management 24

Tables

Table 5.1: Work schedule 16

Table 5.2: Level of effort breakdown per output 17
Table 9.1: Project communication plan 23
Table 11.1: Project risks, assumptions and risk reduction measures 25

Figures

Figure 2.1: Project delivery team 7
Figure 3.1: Schematic showing the main components of a drought prediction system 8
Figure 4.1: Project implementation steps 9
Figure 6.1: Stakeholder management process 18
Figure 6.2: Stakeholder engagement approaches 19

1 Introduction

1.1 Project summary

In an effort to address the impacts of climate change and climate variability in a sustainable way, access to critical information within the water sector is vital. Drought prediction models can identify areas most susceptible to water supply variability and shortages and when shortages might occur, and therefore facilitate early action to manage risks. In doing so, this will increase resilience in the water sector to improve agricultural use of water resources and therefore ensure food security and water usage including from the domestic sector and the tourism sector in Saint Kitts and Nevis.

The overall objective is to incorporate drought risks modelling as a planning tool for climate change adaptation measures in Saint Kitts and Nevis. The main outputs include:

1. Map stakeholders and establish a stakeholder working group;
2. Assess drought risk and water resources in Saint Kitts and in Nevis;
3. Benchmark, design and implement a drought prediction model in Saint Kitts and in Nevis;
4. Train administrators and users of Saint Kitts and Nevis to the drought prediction model.

The Project outcomes respond directly to SDG 13 ‘Taking early action to combat climate change and its impacts’ by providing a system that will support planning and decision-making for the sustainable management and conservation of water resources in Saint Kitts and Nevis. The Project will also contribute to SDG 1 (End poverty), SDG 2 (Food security) and SDG 6 (Availability and sustainable management of water) as the drought prediction model will improve agricultural and use of water resources, improve food security and increase the income of rural communities.

1.2 About this plan

Project planning occurs broadly at two levels: policy and delivery. At the policy level, a series of plans set out the principles of how each aspect of the work will be managed. These plans include documents such as the risk management plan, quality management plan and benefit management plan. These plans set out procedures and processes for each management aspect and further list preferred techniques including document templates and defined responsibilities.

At the delivery level this implementation plan serves as the focal point for the project, and documents how the project will be delivered and managed. It includes the listing of controls that are in place for the project (e.g. communication processes, issue escalation processes) and also the organisational processes that are likely to influence how the project will be delivered. At the delivery level, the implementation plan answers questions such as: Why is the project needed? What are the objectives, scope and deliverables? How will the project be delivered, controlled and managed? How much budget is available? Who is responsible for what? When are the key milestones due? Where will the work be performed?

2 Project Management set up

HR Wallingford uses a bespoke project management system, which covers all our project management processes and supporting systems. It is part of our quality, safety and environment management system. These processes are used from the initial identification of an opportunity through to the delivery of bids and projects. These procedures ensure that project managers keep track of the contract, correspondence,

project plan, resourcing schedule, quality monitoring and risk mitigation measures using a structured and traceable method.

HR Wallingford requires all staff to be familiar with our project management procedures, and is rolling out a revised in-house training package. Staff are assisted in their use of the project management system by resources such as a User Manual, an online toolbox of standard templates and forms, and an on-line user forum with updated frequently asked questions.

To reflect our commitment to maintain the standard of our project management, HR Wallingford also has a corporate Key Performance Indicator (KPI) of having 10% of our staff certified in project management. We therefore have an active programme of project management certification through the APM Project Management Qualification training course. APMP is adopted as standard training for project professionals in leading organisations such as Siemens, Network Rail and BAA. HR Wallingford currently has over 20 APMP Level D certified Project Managers.

Our project management team for this project has the skills and expertise to support planning, managing and resourcing each activity, to ensure the project is delivered to time, quality and budget. Our project manager has been accredited by the Association of Project Management Professional (APMP) qualification, which covers 37 knowledge areas (PRINCE2 covers 12) and is the equivalent of the International Project Management Association (IPMA) Level D.

Role definitions:

- Project Director (Nigel Walmsley): The prime responsibility of the Project Director (PD) is the ownership of the business case and its continuing viability, culminating the measurement of the realised benefits at some point in the Operation's phase of the project lifecycle. The PD should liaise with the client on key issues relating to the definition of deliverables, contractual matters and any concerns that arise over the management or running of the project. Maintain oversight on project progress and financial performance, including the need for variations where appropriate. Provide support and mentoring to the Project Manager and other members of the project team as needed.
- Team Leader (Andrew Ball): Accountable for delivering a product that will achieve the project benefits. The Team Leader (TL) is responsible for accepting the project deliverables, as well as approving any changes that have an impact on any of the project's defined objectives. The TL must ensure the motivation of the team, use interpersonal and influencing skills, with effective communication being one of the most important skills.
- Project Manager (Gina Tsarouchi): Responsible for defining and planning the project and be competent in a range of project management tools and techniques. The Project Manager will: Manage the project in accordance with the project management procedures; Agree resource allocation with the relevant Group Managers; Ensure internal co-ordination of all project activities; Assign the tasks required to complete the project to Task Managers (for small projects this may include the management of those tasks); Cary out day-to-day liaison with the client's representative; Ensure successful delivery of the tasks to time and to budget; Ensure that all work complies with the quality management procedures and that the necessary checking has been assigned to a competent individual and completed to a satisfactory standard.
- Team Members (Figure 2.1): These are responsible for creating the deliverables. They will be heavily involved in the identification of risks and estimation and sequencing of project activities. Regular status updates from the team are crucial if corrective action is to be taken in an informed and timely manner.
- Project Support: They assist with report production; project support; project administration including document control. Ensure that report preparation complies with the relevant quality management procedures and that deliverables comply with Company standards.
- Users (stakeholders from Saint Kitts and Nevis): The users defined the need for the project and will provide the necessary input to the specified requirements and acceptance criteria.

- Client (CTCN): The client provides resources for the project, assures that the project is being managed correctly, may be involved in the resolution of project issues. CTCN is also responsible for accepting the project deliverables, as well as approving any changes that have an impact on any of the project's defined objectives.

The below Figure shows the structure of the project team.

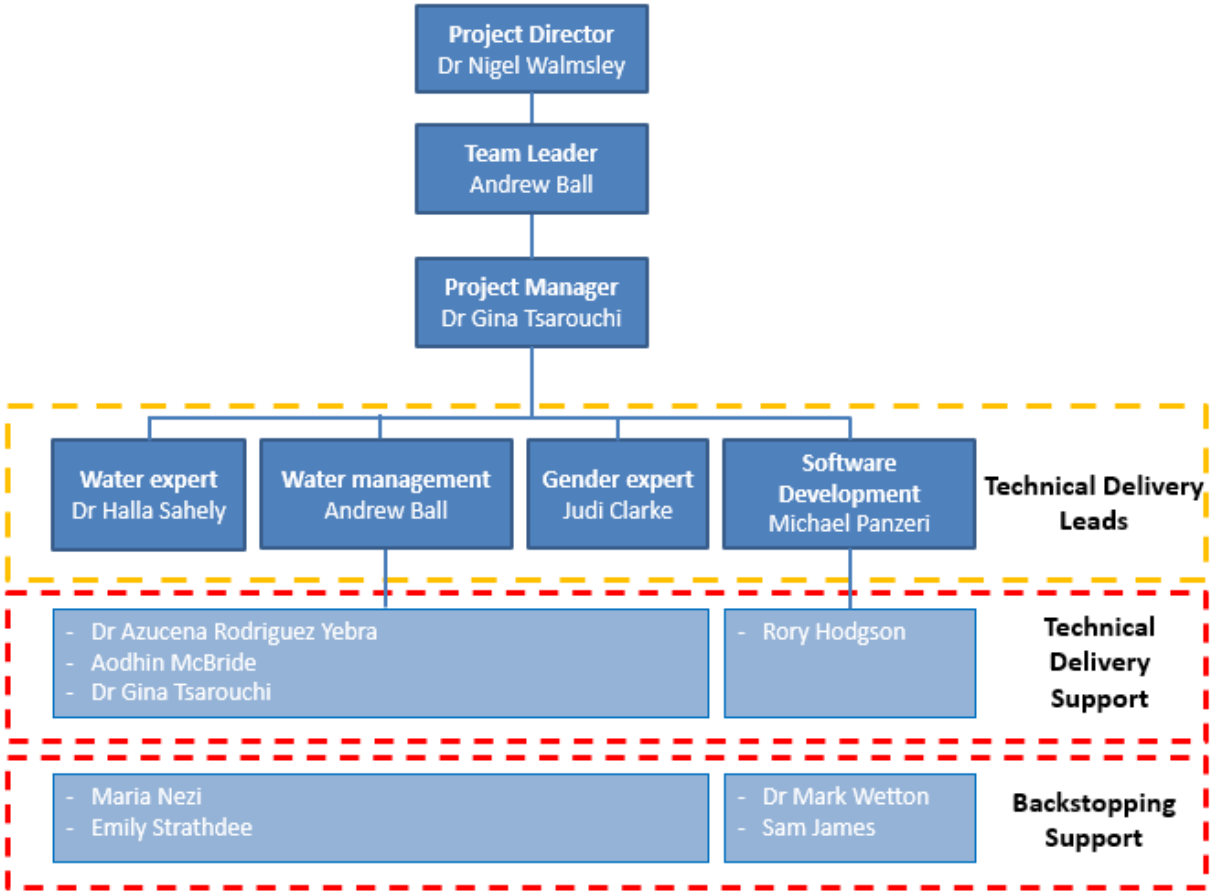

Figure 2.1: Project delivery team

3 Development methodology outline

3.1 Project scope

Project Outcome:

Increase resilience in the water sector to improve agricultural and use of water resources and therefore ensure food security in Saint Kitts and Nevis.

Project Objective:

Incorporate drought risks modelling as a planning tool for climate change adaptation measures.

3.2 Method outline

Development of a drought forecasting system

We will develop an integrated modelling system that will combine: Earth Observations (EO), climate forecasting, hydrological data and hydrological modelling.

Climate forecasts (monthly-to-seasonal timescales) will be used to drive a hydrological model, whose outputs combined with EO datasets will be translated to indicators of water stress such as commonly used indicators of drought (e.g. Standardized Precipitation Index). The system will generate monthly forecasts of water stress. The system will be calibrated against historical data.

The schematic below (Figure 4.1) summarises our understanding of the key elements of the forecasting system.

- There will be a conceptual model (1), which describes the key processes on Saint Kitts and Nevis and this will inform **a groundwater assessment tool**.
- This groundwater assessment tool (2) will be interfaced via a **web-portal** (6).
- The web-portal will allow users to **update data** (primarily (3) groundwater information from the boreholes on the islands) and (4) weather data and (5), land use and demand forecasts.
- The groundwater assessment tool will be run from the web-portal.
- On completion of each run the web-portal will produce a range of **user-friendly outputs** to provide insight for users (7).

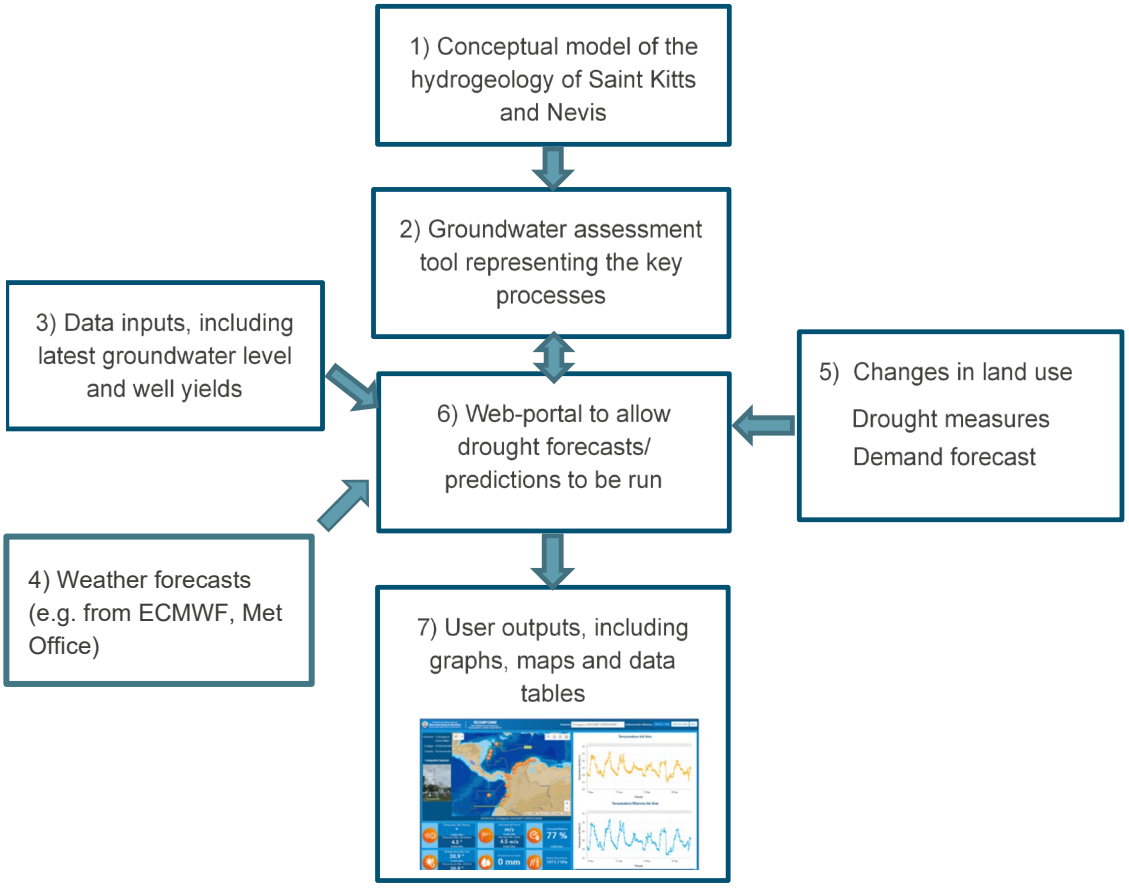

Figure 3.1: Schematic showing the main components of a drought prediction system

Source: HR Wallingford, 2021

Software development, integration and testing

The project will develop a user-friendly drought forecasting system that will be used to integrate multiple data sets and a series of models and services. Beneficiaries will be able to use the tool to support decision-making and capacity building activities will encourage the development of a support network that can maintain it, ensuring the tool's sustainability. The platform will be designed to assimilate various data sources including EO information, climate, and ground-based observations (e.g. data from rainfall gauges).

4 Project outputs, activities and deliverables

4.1 Overview of the implementation process

A schematic of the project implementation steps is shown in Figure 4.1. Our approach to project implementation is given in Section 4.1 and more detailed descriptions of specific tasks under each of the four Activities given in Section 4.2.

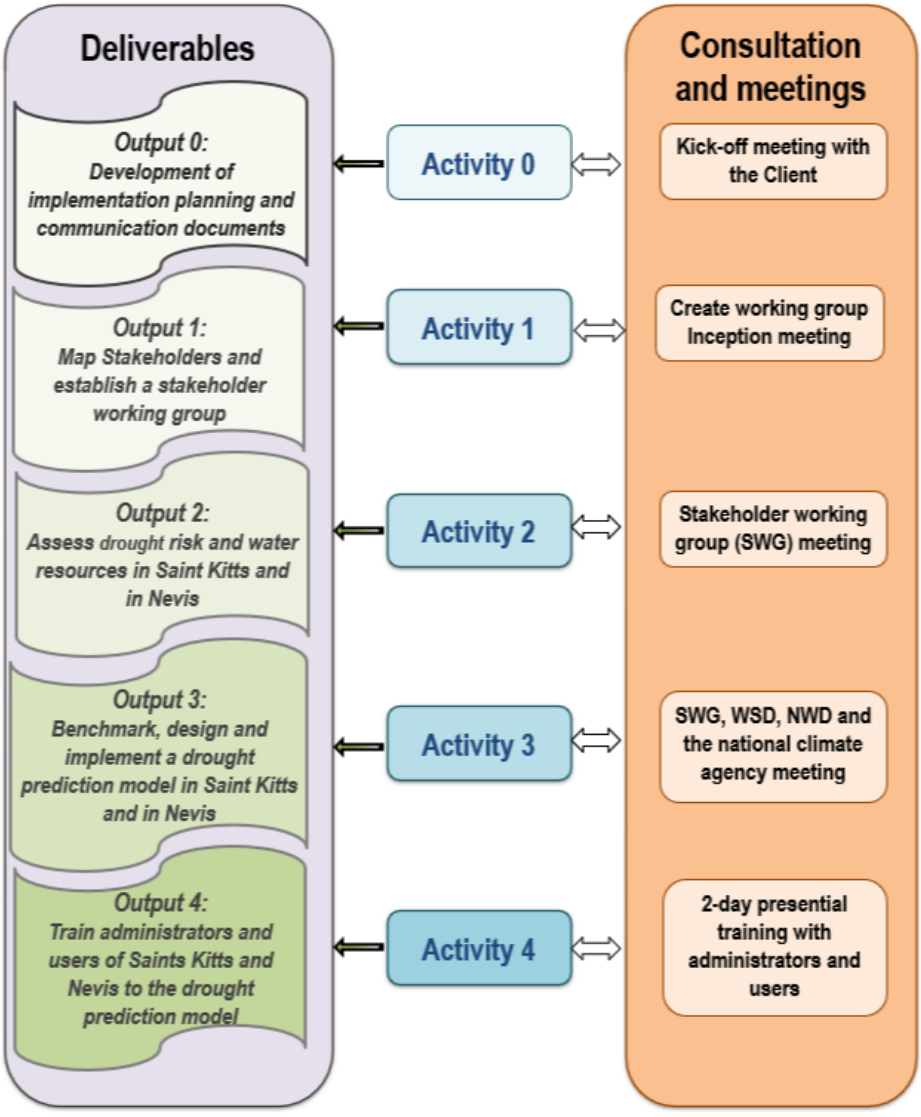

Figure 4.1: Project implementation steps

4.2 Detailed activities

4.2.1 Mandatory output: Development of implementation planning and related communication documents (Month 1)

Activity i: A detailed implementation plan

The implementation plan presented in this proposal will be discussed and reviewed at a Kick-off meeting with the Client and an updated detailed implementation plan for all activities, deliverables, outputs, deadlines, and responsible persons/organisations produced.

Box 5.1: Approach to gender mainstreaming

The approach to gender mainstreaming throughout the project will follow CTCN's 3-step process:

- Step 1: Conduct a gender analysis (or assessment) at the start of the project;
- Step 2: Develop an action plan; and,
- Step 3: Monitor and evaluate.

Steps 1 and 2 will be completed as part of the first main activity – the preparation of an Implementation Plan (Activity i). Step 3 will be incorporated into the project implementation process, i.e. each project activity will be assessed for its alignment to gender mainstreaming principles. Rather than developing a separate monitoring and evaluation plan for gender mainstreaming, gender-based indicators will be included in the project's overall monitoring and evaluation plan (Activity ii).

Activity ii: Monitoring and evaluation plan

Based on the implementation plan, a monitoring and evaluation (M&E) plan will be developed to evaluate the timeliness and appropriateness of implementation (using the Client's template). The indicators selected in the monitoring and evaluation plan will include both process indicators and output indicators aligned to the technical assistance services. The M&E plan will be the basis for completing the CTCN Closure and Data Collection Report at the end of the assignment and, in doing so, will include consideration of gender-specific data and information.

Activity iii &iv: Impact Statement and Project Closure Report

An impact statement will be prepared at the start of the assignment and updated at the end of the project together with a Project closure report based on the Client's template, which will include lessons learned.

Deliverables

- D.0.1: Detailed implementation plan;
- D.0.2: Monitoring and evaluation plan;
- D.0.3: Impact Statement (initial and final version);
- D.0.4: Technical Assistance Closure Report.

4.2.2 Output 1: Map Stakeholders and establish a stakeholder working group (Month 1)

Activity 1.1: Map Stakeholders

Relevant stakeholders among government institutions at national and community levels, professionals in the agriculture and tourism sectors, experts in water management and use, in climatology, meteorology, early warning services, representatives of farmers, as well as women and youth for the two islands of Saint Kitts and Nevis. HR Wallingford carried out a similar stakeholder mapping in 2021 as part of the Vulnerability Assessment and Water Utility Adaptation Planning project (CCCCC-funded) and this, together with support by the National Designated Entity (NDE) and the National Designated Agency (NDA), will enable a final

group of relevant stakeholders to be quickly assembled and presented in a report in which each actor will be linked to its sector of expertise and include individual contacts and details.

Activity 1.2: Establish a stakeholder working group

Based on the stakeholder mapping, a more streamlined Stakeholder Working Group (up to 10 persons) will be agreed and formalised, taking account of gender balance and an adequate representation of vulnerable groups. It is important that the Stakeholder Working Group can provide a technical overview and high-level guidance at each stage of assignment whilst members of the restrictive working group should have the capacity to make sound decisions on some key aspects of the assignment such as the collection of climate and meteorological data needed for the vulnerability study (Output 2), the definition of the drought prediction model (Output 3), and the training of the official representatives of Saint Kitts and Nevis to the drought prediction system (Output 4).

The composition of the stakeholder working group will be summarised in a report, disaggregated by gender, and will likely include those identified in the Response Plan and may consider others such as the Saint Kitts National Emergency Management Agency (NEMA), the Nevis Disaster Management Department and important water use sectors such as agriculture and tourism. It may also be beneficial for regional organisations such as CIMH, CARPHA or others to be engaged in a technical support role within the wider stakeholder grouping if necessary. We will be guided by the Client on the final selection.

Activity 1.3: Conduct an inception meeting

Once the stakeholder working group is in place, a 2 hour on-line inception meeting will be held with the Stakeholder Working Group and Team Leader, and other members of our team. The inception meeting will introduce the team of experts, the goals, milestones, anticipated deliverables, and be used to fully understand the role of the stakeholder working group, particularly at key decision points within the assignment. The results of the inception meeting will be captured in the implementation plan (see Mandatory Outputs).

Output 1 Deliverables

- D 1.1: Report on stakeholder mapping;
- D 1.2: Detailed description of the stakeholder working group;
- D 1.3: Minute of the inception meeting.

4.2.3 Output 2: Assess drought risk and water resources in Saint Kitts and in Nevis (Month 2 to 3)

Activity 2.1: Assess drought risk in Saint Kitts and in Nevis and generate GIS risks maps for Saint Kitts and for Nevis.

The drought risk assessment will provide clarification on, among other things, risk identification, risk analysis and risk evaluation. This will include a conceptual model report.

Activity 2.2: Map the total water resources including the groundwater

As mentioned in Section 4 in our Approach and Methodology, we will develop an assessment of the total water resources, including groundwater. This assessment will include a review of previous work, the use of expert judgment to complete any gaps, the development of a water balance for each aquifer, and an assessment of key risks (such as saline intrusion). Maps will be produced of these key features.

We propose to review the existing data, but after discussions with contractors and based on our expertise, the key uncertainties are likely to be the hydrogeology of the aquifers, rather than their geometry, so our focus would be on gathering data on water levels and hydraulic performance and water quality of the

boreholes, rather than resistivity logging. If we felt that resistivity logging would be of benefit then we would propose this as a later study to enhance the drought prediction model we develop.

Activity 2.3: Estimate the water balance in Saint Kitts as well as in Nevis

Once the scoping report has been completed, we will undertake a water balance for each catchment or aquifer unit. The approach may involve the development of a series of lumped parameter models, suitable for the Caribbean. These models will represent the main hydrological processes (rainfall, recharge, runoff, storage) and be combined into an overall assessment. Water balance estimations can be a complicated task. This normally relates to the difficulty in obtaining ground measurements (e.g. changes in groundwater storage). Depending on the data available or the data obtained from the previous steps or previous studies, approximations can be obtained with earth observation data and relatively simple models, such as the one used in one of our previous studies (see Section 3.1, Project Reference 7). This approach (the Water Accounting Plus (WA+) framework can be used to estimate abstraction and recharge based on gridded rainfall and actual evapotranspiration. If more data is available, more complex models to estimate recharge can be developed (e.g. ZOODRM[1]), which will feed the water balance calculation and subsequently the groundwater model proposed for the project.

Findings from the (current) water balances for both Saint Kitts and Nevis will be described in a clear, concise and visual report.

Activity 2.4: Identify water conservation measures and recommend technologies to save water in the high consuming water sectors for Saints Kitts as well as in Nevis.

Based on the consumption data analysed in the activity 2.3, we will provide recommendations on water conservation measures and technologies that could be used to save water in the high consuming sectors. We will also draw on findings from the Water Sector Adaptation Plan HR Wallingford prepared for Saint Kitts and Nevis in 2021. The measures will be presented in action/technology fact sheets, that will include the sector of activity concerned, title of the measure, short description of the measures, as well as its implementation, operation and maintenance costs, and possible sources of financing. Each action sheet will provide information about the impact that each action could have on the vulnerability identified in Activity 2.1, as well as an entity responsible for its implementation, if it is a mitigation / adaptation or mix action, some monitoring and evaluation indicators, the time horizon for the implementation of the action, amongst other information.

Activity 2.5: Organize a meeting with the stakeholder working group (SWG) to summarize the results of output 2

A half day meeting will be organized to present the results of the output 2 to the stakeholder working group. The meeting will be held virtually. Minutes of the stakeholder working group meeting will be prepared including a summary of the discussions held.

Output 2 Deliverables

- D 2.1: Saint Kitts and Nevis drought assessment;
- D 2.2: Detailed report on aquifers in Saint Kitts and Nevis;
- D 2.3: Report on the water balance in Saint Kitts and Nevis;
- D 2.4: Report on water conservation measures and technologies recommended to save water;
- D 2.5: Minute of the stakeholder working group meeting and summary of the discussions held.

[1] http://pureportal.org/modelCodes/1502

4.2.4 Output 3: Benchmark, design and implement a drought prediction model in Saint Kitts and in Nevis (Month 4 to 6)

Activity 3.1: Benchmark and select the most suitable drought prediction model for Saint Kitts and Nevis

A range of drought prediction models will be consider including statistical, dynamical, and hybrid methods including a number that that have been proposed or implemented in the Caribbean region. We are fully aware of the strengths and weaknesses of alternative technical solutions and a SWOT analysis of the various approaches and models will form part of the benchmarking process, ensuring this is specific to the context in Saint Kitts and Nevis.

Each model will be described in a fact sheet providing fundamental information such as if the model is based on a, on historical records or climate forecast or a mix of both, the name and characteristics of the model, data required, indicators defined, forecast generated, prediction obtained, the relevancy of the system to predict Meteorological, Agricultural, Hydrological drought, time horizon of the forecast, amongst other information.

Based on the on the results of the drought assessment (activity 2.1), as well as the quantity and quality of climate and water data available in Saint Kitts and Nevis, we will rank and prioritize the existing technologies and select the one(s) that would be most suitable to Saint Kitts and to Nevis. The prioritization criteria for the selection of the best model will be defined and explained in a report, and a matrix of the benchmarking results made.

Activity 3.2: Organize a meeting with the SWG, Saint Kitts Water Services Department (WSD), The Nevis Water Department (NWD) and the to discuss the characteristics of the drought prediction model

A half day virtual meeting with the SWG, in presence of the relevant representatives Saint Kitts Water Services Department (WSD), The Nevis Water Department (NWD) and any other relevant stakeholders will be held to discuss and present the results of the activity 3.1. At the end of the meeting, it is expected that consensus will be achieved on the model to be developed and used to predict drought in Saint Kitts and in Nevis. In doing so, it will also be essential that relevant agencies provide authorisations to support the effective development and implementation of the drought prediction models.

Activity 3.3: Design the architecture of the drought prediction model for Saints Kitts and Nevis

Once the modelling approach most suitable for Saint Kitts and Nevis has been approved, this activity will develop and design the architecture and components of the system including (see also Section 4.2):

- Access to data;
- Data analysis and treatment;
- Generation of regular forecast bulletin (the frequency will need to be defined);
- Implementation of early drought warnings;
- Communication channels (how would the information be released, who will access it);
- Other relevant criteria.

The design of this system will be detailed in a report along with an expected implementation plan. The implementation plan will describe the resources required for the development and implementation of the drought prediction model, a timeline and the entities and person responsible at each step in the process.

As part of the design, we will propose a framework for the use of the drought prediction model which will clarify the roles and responsibilities of the different agencies involved, the rights of the administrators and other users, the cost of the maintenance and operation of the system as well as which agency should be in

charge of budgeting these costs, as well as any other relevant operational aspects that will ease the efficient use of the tool in the short-, medium- and long-term perspective.

Activity 3.4: Organize a meeting with SWG, Saint Kitts Water Services Department (WSD), The Nevis Water Department (NWD) and the national climate agency to present the drought prediction model and the implementation plan

A one day meeting will be organised to present the design of the drought prediction model and the expected implementation plan. Feedback from the participants will be taken into account before the final design and implementation plan is endorsed. In particular, discussions will be held on the need to connect the drought prediction model to the existing databases of Saint Kitts Water Services Department (WSD) and The Nevis Water Department (NWD) and the necessary protocols for accessing and using this data when creating the drought prediction model.

Activity 3.5: Implement the drought prediction model in Saints Kitts and Nevis

The online, interconnected drought prediction model for Saint Kitts and Nevis will be developed and implemented in accordance with the approved design and implementation plan. The aim will be for the drought prediction model to be automatically updated with the most recent data collected and provide on-time information on a range of parameters (e.g. the level of the aquifer/groundwater, implications for deployable output, water demand/consumption, implications for meeting demand, drought indicators etc.) to deliver the relevant early drought warnings that will lead to a sustainable risk management.

We aim to complete initial implementation of the drought prediction model during Month 6. During Months 7-12 (see also Output 4 below) users and administrators will be trained in the drought prediction system and be able to test and effectively use the system independently, before taking full ownership and responsibility of the planning tool.

Output 3 Deliverables

- D 3.1: Benchmarking of drought selection models suitable for Saint Kitts and Nevis;
- D 3.2: Minutes of the meeting and selection of the drought selection model to be deployed;
- D 3.3: Design of the drought prediction model, implementing plan and an operational framework;
- D 3.4: Minutes of the meeting, design of the drought and framework endorsed by the country;
- D 3.5: Drought prediction model deployed and functioning.

4.2.5 Output 4: Train administrators and users of Saints Kitts and Nevis to the drought prediction model (Month 7 to 12)

Activity 4.1: Develop a manual of use for the administrators of the drought prediction model

A Procedural Guide will be prepared for system administrators, explaining how to use the drought prediction model, and how to ensure a satisfactory operation and maintenance of the model. These guides will explain the cost of maintenance (where relevant), the frequency of maintenance required, as well as guidance on how the data should be updated, how and when to create new categories of data, how the model works, details of the system architecture, how to fix system bugs, and any other aspect that may be necessary to the system administrators. The guide will be explained during a workshop (activity 4.3) and can be revised up to 3 times to incorporate user recommendations. The guide will be delivered in English and any translation into other languages will be the responsibility of the Client.

Activity 4.2: Develop a manual of use for the users of the drought prediction model

An operation and maintenance manual will be developed for users of the drought prediction model in Month 7. The manual will guide users on why, when and how the drought prediction model can be used, highlight data sources required and used, how to analyse the data received and under what circumstances.

It will also describe the functions and functionalities of the model, how to proceed to access specific types of information that may be necessary for users in order to select adaptation actions, identify the vulnerable zones to drought, their evolution, how to download reports, how to report actions implemented in the model, and all other criteria that may be necessary for users. The manual will be presented and explained during a 2 day workshop (see activity 4.4 below) with an opportunity for users to provide comment and suggestions to improve the manual after the training (Month 7), after initial use of the system (Month 9), and once more before finalisation of the manual (Month 11). The manual will be delivered in English and any translation into other languages will be the responsibility of the Client.

Activity 4.3: Train administrators and users to the drought prediction model and test the model

A 2-day training workshop for administrators and users of the drought prediction model will be organised in Month 7. We expect the Client to organise the workshop with technical help and support from ourselves. The training will be delivered by the Team Leader in conjunction with the IT Expert and local Water Engineer. The training will explain the concept and architecture of the system, the functionalities of the system and how to use each function, including the roles and responsibilities of different stakeholders to successfully operate the planning tool. We anticipate no more than 25 participants (administrators, users and other experts) and each will receive a copy of the detailed manuals and procedural guidelines at least 1 week in advance of the event. In addition to the training on the application and use of the planning tool, there will be a dedicated session to discuss maintenance requirements, future potential updates and software requirements required to ensure long-term efficient and sustainable use of the drought prediction model.

Following the training, for the remainder of the project, the administrators and users will be encouraged to test the drought prediction model. Our Team will be available to respond to questions and queries, to solve bugs and provide explanations and advice to the end of the assignment in Month 12. The objective of this testing period will be to ensure users and administrators can take full ownership and responsibility of the planning tool and are able to effectively use the system independently once the assignment is closed.

Output 4 Deliverables

- D 4.1: Manual for administrators;
- D 4.2: Manual for users;
- D 4.3: Minutes of the training, materials used.

4.2.6 Progress reporting

In addition to the specified deliverables, we recommend that bi-monthly progress reports are prepared following completion of the inception phase. Following submission of the bi-monthly progress reports, catch-up calls with the client can be organised on an ‘as needed’ basis.

Each progress report will include activities undertaken during the month, planned activities for the following month and any deviation of progress against the agreed work plan. A summary of the finances in terms of invoices submitted, paid and remaining will also be included. The bi-monthly progress reports will ensure any issues or challenges are flagged and highlighted to the client at the earliest possible stage.

5 Work schedule

Our proposed work schedule for the project activities and deliverables is given in Table 5.1 and the % level of effort breakdown per output is given in Table 5.2.

Table 5.1: Work schedule

Activities / Deliverables	Month 1	2	3	4	5	6	7	8	9	10	11	12
Mandatory output: Development of implementation planning and related communication documents												
D.0.1: Detailed implementation plan	■											
D.0.2: Monitoring and evaluation plan.	■											
D.0.2: Impact Statement (initial and final version).	■									■		
D.0.4: Technical Assistance Closure Report										■		
Output 1: Map Stakeholders and establish a stakeholder working group												
D 1.1: Report on stakeholder mapping	■											
D 1.2: Detailed description of the stakeholder working group	■											
D 1.3: Minute of the inception meeting	■											
Output 2: Assess drought risk and water resources in Saint Kitts and in Nevis												
D 2.1: Saint Kitts and Nevis drought assessment		■										
D 2.2: Map of total water resources including groundwater		■										
D 2.3: Report on the water balance		■										
D 2.4: Report on water conservation measures/technologies			■									
D 2.5: Minute of the stakeholder working group meeting			■									
Output 3: Benchmark, design and implement a drought prediction model in Saint Kitts and in Nevis												
D 3.1: Benchmarking of drought prediction models				■								
D 3.2: Minute of the meeting and selection of the model				■								
D 3.3: Design drought prediction model, plan & framework					■							
D 3.4: Minute of the meeting, on the design and framework					■							
D 3.5: Drought prediction model deployed and functioning						■						
Output 4: Train administrators and users of Saints Kitts and Nevis to the drought prediction model												
D 4.1: Manual for administrators							■					
D 4.2: Manual for users							■					
D 4.3: Minutes of the training, materials used							■					■

Table 5.2: Level of effort breakdown per output

Outputs	Activities	Level of effort (% of total)
Mandatory output: Develop communication documents and implementation work plan	Activity i: Develop detailed Implementation Plan Activity ii Develop a monitoring and evaluation plan Activity iii: Impact Statement of the CTCN technical assistance prepared at the start and updated at the end of the CTCN technical assistance Activity iv: A Technical Assistance Closure report Travel and per diem costs	**10%**
Output 1: Map Stakeholders and establish a stakeholder working group	Activity 1.1: Map Stakeholders Activity 1.2: Establish a stakeholder working group Activity 1.3: Conduct an inception meeting	**7%**
Output 2: Assess drought risk and water resources in Saint Kitts and in Nevis	Activity 2.1: Assess drought risk in Saint Kitts and in Nevis and generate GIS risks maps for Saint Kitts and for Nevis Activity 2.2: Map the total water resources including the groundwater Activity 2.3: Estimate the water balance in Saint Kitts as well as in Nevis Activity 2.4: Identify water conservation measures and recommend technologies to save water in the high consuming water sectors for Saints Kitts as well as in Nevis Activity 2.5: Organize a meeting with the stakeholder working group (SWG) to summarize the results of output 2	**24%**
Output 3: Benchmark, design and implement a drought prediction model in Saint Kitts and in Nevis	Activity 3.1: Benchmark and select the most suitable drought prediction model for Saint Kitts Activity 3.2: Organize a meeting with the SWG, St. Kitts Water Services Department (WSD), The Nevis Water Department (NWD) and the to discuss the characteristics of the drought prediction model Activity 3.3: Design the architecture of the drought prediction model for Saints Kitts and Nevis Activity 3.4: Organize a meeting with SWG, St. Kitts Water Services Department (WSD), The Nevis Water Department (NWD) and the national climate agency to present the drought prediction model and the implementation plan. Activity 3.5: Implement the drought prediction model in Saints Kitts and Nevis Travel and per diem costs	**36%**
Output 4: Train administrators and users of Saints Kitts and Nevis to the drought prediction model	Activity 4.1: Develop a manual of use for the administrators of the drought prediction model Activity 4.2: Develop a manual of use for the users of the drought prediction model Activity 4.3: Train administrators and users to the drought prediction model and test the model Travel and per diem costs	**23%**
TOTAL		**100%**

6 Stakeholder management process

6.1 Considerations

Projects can encounter problems where there are multiple stakeholders and/or project steering groups. Although managing stakeholders should be planned at the bid stage and start of a project, it is actually a dynamic and iterative process that requires excellent communication skills and a great deal of adaptability, as well as careful planning. It can be very challenging but also highly rewarding. When done well, stakeholder engagement should enable you to maximise the benefits from your project. To carry out the project successfully we will:

- Identify and assess the needs and expectations of our stakeholders at the outset;
- Make sure that roles of key individuals are clearly defined;
- Implement the agreed plan, but also be open to the prospect of having to deal with the unexpected;
- Have an auditable system for filtering/ prioritising feedback and keeping a record of responses;
- Include potential issues/problems in the project risk assessment and identify mitigation actions;
- Use specialists in stakeholder engagement and facilitation.

6.2 Approach to stakeholder management

Stakeholders are individuals or groups with an interest in the project because they are involved in the work or affected by the outcome. Stakeholder management is important for this project as stakeholders ultimately determine the success or otherwise of the project by accepting or rejecting the project outputs. The approach to stakeholder management that will be implemented throughout this project is set out in Figure 6.1. This involves:

- Stakeholder identification through research, brainstorming and discussion between the project team;
- Stakeholder assessment to understand their needs or most important goals, their levels of interest and influence and how best to engage them;
- Planning communications by identifying who will communicate what, how and when;
- Engaging stakeholders throughout the project.

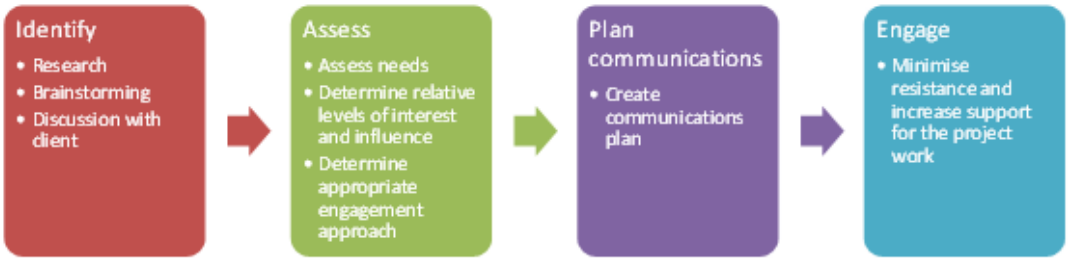

Figure 6.1: Stakeholder management process

The stakeholder assessment process aims to understand the needs and expectations of stakeholders as well as their relative levels of interest and influence in order to determine an appropriate engagement approach. Interest level indicates how much the project will affect them. Influence indicates how much their actions or decisions can affect the success of the project. This analysis is used to determine an appropriate engagement approach for each stakeholder, as shown in Figure 6.2.

The engagement approaches are[2]:

- Partnership: Shared accountability and responsibility. Two-way engagement joint learning, decision making and actions.
- Participation: Part of the team, engaged in delivering tasks or with responsibility for a particular area/activity. Two-way engagement within limits of responsibility. In this project, this approach relates to the stakeholders who will attend the workshops.
- Consultation: Involved, but not responsible and not necessarily able to influence outside of consultation boundaries. Limited two-way engagement: organisation asks questions, stakeholders answer. In this project, this approach relates to the stakeholders who will not attend the workshops but who may be able to provide information or ideas.
- Push communications: One-way engagement. The project team may broadcast information to all stakeholders or target particular stakeholder groups using various channels e.g. email, letter.
- Pull communications: One-way engagement. Information is made available, and stakeholders choose whether to engage with it e.g. web-pages, blogs, press releases.

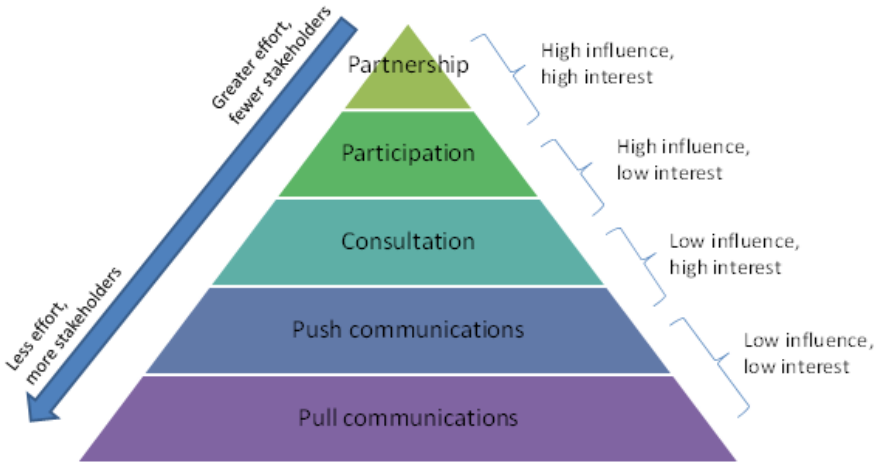

Figure 6.2: Stakeholder engagement approaches

Source: Based on https://www.stakeholdermap.com/stakeholder-engagement.html

7 Gender analysis process

7.1 Introduction

The project's outputs must be gender-responsive, in that they must take into consideration, the differential needs and circumstances of men/boys and women/girls. This Gender analysis will assist the Team in incorporating a gender perspective into the development of the drought prediction tool through taking account of the different needs, characteristics and behaviours of the affected groups.

In light of this purpose, the analysis will identify:

[2] Source: https://www.stakeholdermap.com/stakeholder-engagement.html

- Potential risks and differential effects from drought; and differential capacities for drought management where relevant;
- Potential gender participation gaps and entry points which may affect key outputs and outcomes; and
- Potential priority intervention areas (remedial action), as determined by key inequalities among genders where applicable, focusing on women and men and girls and boys, noting international or regional good practices to address these areas. These intervention areas will be confirmed and strengthened by the Stakeholder Working Group once established.

Desk review was the sole mode of information and data collection for this gender analysis. The analysis will be updated with stakeholder input after the Inception meeting in January 2022. Key documents from the Government of St. Kitts and Nevis were reviewed, as well as relevant regional and international literature on incorporating gender into drought management.

A National Gender Policy for St. Kitts and Nevis was completed this year (2021) to address the many social issues that were highlighted in the Gender Equality Study that was done in 2014. The new policy, once implemented, is expected to address those matters including men and women's biological and culturally constructed differences and bring equity to various solutions to ensure development benefits all.

National Report on Progress in the Application of the Montevideo Strategy for Implementation of the Regional Gender Agenda within the Sustainable Development Framework by 2030 highlighted the following for St. Kitts and Nevis:

- Much has been achieved in the area of public awareness and education with regard to the prevention of violence against women; gender sensitisation, gender equality and the formal recognition of the contribution of women to society.
- 'Gender mainstreaming' is a strategy embraced by the Government, and is an important initiative that promotes gender equality within institutions when planning actions such as policies and programmes. The implications and interests of men and women are considered in order to address unequal social structures. 116 focal points across St. Kitts and Nevis in the private and public sectors, and civil society have been trained in gender sensitization and this continues to be delivered through the Departments of Gender Affairs on St. Kitts and Nevis.

Prior to the Gender Policy, gender mainstreaming efforts in St. Kitts and Nevis were mainly shaped by efforts to reduce poverty; and in particular, through the National Social Protection Strategy and Action Plan (2013-2017). The purpose of the Strategy is to establish the main priorities for Social Protection policy making and reform over the next five years (2013-2017); and to guide the establishment of a sustainable, comprehensive and integrated Social Protection system for the Government of St. Kitts and Nevis. This encompasses the strengthening and integration of a wide range of policies and programmes across the social sector including social safety nets, social welfare services, social insurance and labour market policies.

By addressing multidimensional vulnerabilities in an integrated and interconnected way, gains achieved through social protection can be enhanced by the Gender Policy.

7.2 Gender assessment

The percentage of women who live in poverty in St. Kitts is a little higher than that of poor men, corresponding to the gender ratio of the population. However, although men have a slightly higher likelihood of being employed generally, women within the poorest socio-economic quintile have a higher employment rate than men, which is unlike the pattern observed in Nevis and other OECS territories.

Additionally, it is well recognised that, in St. Kitts and Nevis, women are bearing the burden of raising families single-handedly; and women are also more likely to be indigent despite the fact that more women than men are graduating from schools, colleges and universities.

7.2.1 Impacts of drought

Freshwater resources are already limited on St Kitts and Nevis and climate change projections indicate more substantial increases for drought during the dry season, especially considering long-term trends. From a climatological perspective, the island of Nevis is the one most affected by drought. When drought occurs in Nevis, it generally lasts for 2 to 3 months. Periods of drought have occurred within the COVID-19 pandemic, and the need for handwashing and improved hygiene has significantly increased the need for, and use of water.

Specific impacts from drought identified in the TNC include:

- Water shortages and rationing;
- Costs associated with maintenance of silted up water and wastewater systems due to low flows;
- Increased water Storage domestically (black tanks and barrels) which may lead to increased waterborne illnesses and vectors;
- Declines in sanitation and hygiene -impacting overall health;
- Mental health issues related to trauma of extreme events and loss of social cohesion;
- Loss of forest cover and decline in infiltration rates, which impact aquifer recharge potential and water supply;
- High vulnerability and risk of economic losses of rainfed systems (90% of all farms in St Kitts and Nevis, Hutchinson 2017);
- Increased costs associated with irrigation and soil moisture retention. Indirect impacts on the cost of mulch grass species;
- Possible declining productivity and yields of crops that require higher moisture – according to Oderson et al (2015) most tropical crops cannot manage more than two 7-day dry-spells during the 3-4 month growing season;
- Nevis is particularly vulnerable to low and unreliable rainfall and extended periods of drought – limiting food security on that island and increasing reliance on imported food.

Stakeholders consulted in the preparation of the country's Third National Communication (TNC) to the UNFCCC identified migrants, the elderly, youth, single mothers, women and those in the informal sector as the most vulnerable to climate change.

St. Kitts and Nevis has a high number of female-headed households, many of whom are poor. If there is limited or lack of water supply, the burden on such women to care for their households is significant and can affect sanitation, health and hygiene and nutrition. This social aspect of drought can lead to disaster for many households, and is rarely quantified and poorly understood.

St. Kitts and Nevis has publicly declared its commitment towards gender sensitivity as it relates to climate change. At the UNESCO Climate Change conference in 2011, Minister of Education and Information, Honourable Nigel Carty, said: "*Women are more vulnerable from a socioeconomic standpoint and are going to be most hard hit by the effects of climate change when [it does] impact us, and therefore we have catered for special treatment in relation to the analysis of gender-based vulnerability," the Minister said. "We must take into account all of those factors which predispose women in particular, and of course any other (group), where there may be those vulnerabilities, to see how we can make sure that the policies we put in place address … those issues that affect people."*

The Caribbean Water Initiative (CARIWIN) project, (2006-2012) identified that when it comes to the domain of water, there are very segregated roles for women, men, and children. During times of water scarcity or drought, when water must be accessed from community faucets, water trucks, irrigation ditches, rivers and

wells, women's responsibilities in sourcing and allocating water for domestic use tend to be significantly increased.

Impacts of drought will also be felt by farmers. Assessments conducted by the UNFAO reveal that female participation in the Caribbean rural economy is low since, Compared to men, women are generally less equipped to face the challenge of transitioning from subsistence farming to commercial agricultural production.

7.2.2 Action Plan to address potential gender participation gaps and identify entry points

An Action Plan will be developed in early January, to recommend how to actively engage women and men, boys and girls as participants in the planning processes for the development of the drought prediction tool. This will facilitate an assessment of their capacity and perceptions of drought risks and ensure that their perspectives are considered in the design of the drought-risk planning tool. Feedback in the development and testing phase will also give a preliminary understanding of how the tool and other outputs from the project affect women and men differently.

8 Change management process

8.1 Changes in scope of work

All requests for changes to the technical scope or duration of a project must be checked against the project scope in the contract. If this check indicates that the scope needs to be modified and/or additional work is required then the **Project Manager** should:

- Discuss the required change with the **Team Leader**;
- Discuss any changes and additional work required with the client;
- Ensure discussion and agreement with the TA proponent and the Chair of the Stakeholder Working Group;
- Use a Contract Variation Order (CVO) (or equivalent as set out in the Contract) to agree/confirm variations with the client where changes require identifiable additional work. It is essential that any change in scope is formally recorded so that additional (or lesser) cost or time can be allocated.

8.2 Changes to technical approach

We may make changes to the technical approach as the project proceeds. In such occasions:

- The **Team Leader** should discuss the change with **Project Director** and the **Project Manager**;
- If the change is to be implemented, the **Team Leader** must discuss its consequences with the **Project Manager**, and inform all appropriate staff;
- If the change has an impact on the overall timing or technical output of the project then the **Team Leader** must discuss it with the client;
- The **Team Leader** should discuss changes required by the client with the **Project Manager**;
- If a change could have a significant negative commercial impact for HR Wallingford, the **Responsible Director** should be informed and they will assess whether additional actions should be taken (e.g. advise our insurers or help manage any aspect of client or public relations).

All changes to the project are recorded in a Change Management Plan section of the implementation plan, together with comments on the likely impacts / mitigations.

9 Communications management

9.1 Communication requirements for the project

Table 8.1 includes details on the frequency of disseminating information relevant to the project, lists the project team members that need to receive or send information, the media best suited for the exchange of information and the purpose of communicating the information.

Table 9.1: Project communication plan

Communication Type	Description	Frequency	Format	Participants/ Distribution	Deliverable	Owner
Weekly catch-up	Weekly meeting for the technical delivery team	weekly	Microsoft Teams call	Nigel Walmsley Andy Ball Halla Sahely Judi Clarke Azucena Rodriguez Gina Tsarouchi	Actions (email)	Gina Tsarouchi
Stakeholder working group (SWG) meeting	To discuss progress to date and get feedback	As per work schedule	Microsoft Teams call / in person	Delivery team, SWG, CTCN	Minutes with actions	Andrew Ball
Technical team calls	To resolve technical matters and progress with the technical delivery of the project	As required (at least biweekly)	Microsoft Teams call	Technical team	Actions (email)	Technical leads
M&E calls	To discuss progress on M&E indicators	As required (at every 4 weeks)	Microsoft Teams call	Delivery team	Actions (email)	Gina Tsarouchi
Bi-monthly progress reports	To provide the CTCN with an update on all project aspects (technical delivery, M&E, sustainability, issues, risks)	Bi-monthly following the inception phase	Report	Delivery team, CTCN	Report	Andrew Ball
Bi-monthly progress calls	To provide an update on all project aspects (technical delivery, M&E, sustainability, issues, risks)	Bi-monthly following the inception phase	Microsoft Teams call	Delivery team, CTCN, Chair of the SWG	Actions (email)	Andrew Ball
Publicity items: website articles, blogs, press releases, sound bites.	For information and awareness raising	Ad hoc as needed/as appropriate	Website, twitter, LinkedIn, community meetings, conference, media	Delivery team, CTCN	Ad hoc as needed/as appropriate	Delivery team

10 Quality management process

A process of continual development and improvement is inherent in the HR Wallingford quality assurance management systems. This is implemented as an ongoing process based on the 'Plan, Do, Check, Act' cycle, details of which are provided below. This process will continue to drive improvements in quality assurance on work delivered to the Environment Agency as a Collaborative Delivery Team (CDT) partner through the Collaborative Delivery Framework.

Plan - We identify all quality, health & safety, and environmental aspects of our activities, products and services. We also identify any legal requirements that we have to comply with. Management sets out a Quality, Health, Safety and Environment (QHSE) policy and sets targets for improvements that are related to compliance with legal requirements and to our performance.

Do - We implement our improvement plans and work and conform to our own procedures and instructions. In areas where we already comply with legal requirements, we make sure that this remains the case. All activities aimed at maintaining the present level can be seen as assurance measures which are illustrated by the orange wedge in the diagram above.

Check - We monitor the performance we achieve with our QHSE Management System. Monitoring is directed both at our means of assurance and to our improvement plans.

Act - Management evaluates in a management review all results of the previous year and sets direction and new objectives for the coming period. In this stage, management also looks at legislation and new developments in our undertaking that are relevant to our QHSE Management System and which might require additional actions for improvement. This stage results in new objectives and areas for improvement which leads back to the Plan stage again.

10.1 Quality management

HR Wallingford uses a quality management system to help us to meet our business objectives and to ensure that we continually improve our ability to deliver solutions that match our clients' requirements in an efficient, accurate and timely way. Our quality management systems are certified to ISO 9001: 2008 and ISO 9001: 2015 respectively.

10.2 Continual improvement for our projects, and recording corrective actions

We look for continual improvement in our project management. We have developed Quality Track (QTrac) to log issues, improve compliance and support continual improvement.

The issues we identify may require action to correct failings in existing processes and/or procedures. These are usually corrective action requests where the cause of the issue is addressed or corrections where we need to fix a problem or issue.

When we anticipate that changes are needed to prevent problems developing in the future, we can take preventative action. Often though we simply need to propose improvements to the way we do things; these issues are termed suggestions for improvement.

11 Risk management

Our standard practice is to identify and discuss risks at project inception and monitor these throughout the project, thus helping us to anticipate and avoid unexpected issues and avoidable delays. Table 10.1

summarises identified risks and assumptions and proposes measures which can contribute to reducing negative impacts, and these will be revisited and discussed during the inception phase.

Table 11.1: Project risks, assumptions and risk reduction measures

Risks and Assumptions	Risk reduction measures
Inputs to outputs	
Stakeholder expectations beyond the scope of the assignment	■ Clearly communicate with stakeholders what the project will and will not be able to achieve and ensure the case for the final design and implementation of the drought prediction system is fully evidenced; ■ Take on board stakeholder expectations and concerns at the outset and appropriately manage expectations in the early in the project, with assistance from the Client.
Time allocated to the deployment of the drought prediction model is tight (Month 6)	■ Maximise the use of readily available existing information to initiate deployment of the drought prediction model; ■ Use the remaining period (Months 7-12) to familiarise administrators and users with the basics of the system whilst also refining and enhancing the system where necessary.
Lack of data and information	■ Identify information sources during inception phase to allow early action on collating and analysing available data; ■ Utilise one-on-one communication with stakeholders to verify data availability and to source specific pieces of information, where this is known to be available; ■ Maximise synergies with other projects and initiatives where relevant data are being collected and collated.
Stakeholders unfamiliar with drought risk modelling approaches	■ Ensure methodologies, approaches and terminology are clearly defined in all stakeholder workshops and written materials; ■ Clearly articulate the pros and cons of alternative modelling approaches, and ensure these are linked to data availability and how they support decision making.
Stakeholders are not available to participate in workshops	■ Plan well ahead (e.g. min 2 weeks in advance) and avoid holiday periods etc; ■ Ensure stakeholders are included in the review of project deliverables and outputs if they are not able to attend workshops.
Scope of works creeps or shifts as project progresses	■ Record changes in scope which can be accommodated and note those which cannot be accommodated as potential areas for future work.
Interruption to work schedule due to natural hazards and/or COVID-19	■ Changes to schedule discussed and agreed with the Client as appropriate; ■ Be conservative and assume COVID-19 restrictions will remain in place (e.g. for travel, quarantine, etc.) and plan accordingly.
Lengthy review and comment on draft deliverables leads to work plan slippage	■ Agree timeframes in advance. ■ Issue draft deliverables under the proviso that if nothing is received within the allowable timeframe then it is assumed the deliverable has been accepted and endorsed.
Outputs to outcomes	
Stakeholders struggle with drought prediction tool and it is not adopted	■ Ensure stakeholders have ample opportunity to shape the tool as it is developed to secure buy-in.
Drought prediction tool is developed but does not attract follow-up action and investment	■ Identify follow-up support action and maintenance requirements necessary to sustain the system, in consultation with administrators and users; ■ Administrators and users (and the Client) to ensure measures are in place to sustain the drought prediction model outputs (e.g. operation and maintenance budgets, mainstreaming of the planning tool, further capacity development and support).

HR Wallingford
Working with water

HR Wallingford is an independent engineering and environmental hydraulics organisation. We deliver practical solutions to the complex water-related challenges faced by our international clients. A dynamic research programme underpins all that we do and keeps us at the leading edge. Our unique mix of know-how, assets and facilities includes state of the art physical modelling laboratories, a full range of numerical modelling tools and, above all, enthusiastic people with world-renowned skills and expertise.

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