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The United Nations Environment Programme (UNEP) on behalf of the Climate Technology Centre and Network (CTCN)

Inception Report

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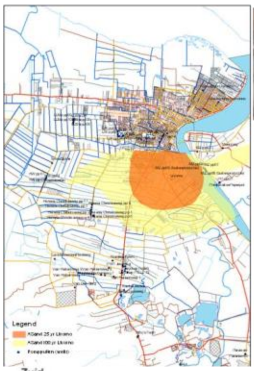

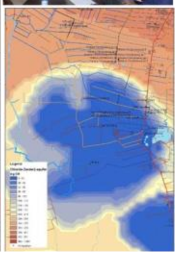

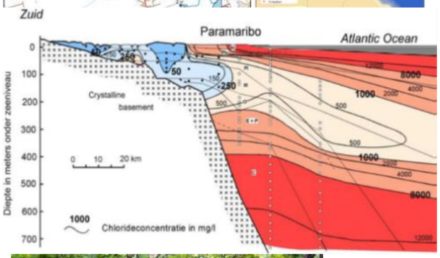

Consultancy services for

Enhance the resilience of Suriname´s water supply system by modelling drought risks and developing a roadmap of prioritized alternatives for aquifer recharge

Acronym: ***ARADIS***

Climate Technology Centre and Network (CTCN)

RFP Number: 3100006085
Biruk KIBRET

ILACO

In association with

Royal HaskoningDHV

ACACIAWATER

Project title:	Enhance the resilience of Suriname´s water supply system by modelling drought risks and developing a roadmap of prioritized alternatives for aquifer recharge. Aquifer Recharge Against Droughts in Suriname (ARADIS)
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Contents

List of Figures

List of Table

1 Project outline

This report contains implementation plan for research into the possibilities of managed aquifer recharge as a strategy to combat drought in Suriname. The project is funded by the United Nations Environmental Program (UNEP) and supervised by the Climate Technology Centre and Network (CTCN), the working arm of the United Nations Framework Convention on Climate Change (UNFCCC). In Suriname, the project is managed by the Ministry of Spatial Planning and Environment (MROM), hereafter named the client.

The full title of the project is “Enhance the resilience of Suriname´s Water Supply System by Modelling Drought Risks and Developing a Roadmap of Prioritized Alternatives for Aquifer Recharge”. This long title describes the objective of the project well. For practical purposes the title is shortened to “Aquifer Recharge Against Droughts In Suriname” with the acronym ARADIS.

The project has been awarded to a consortium consisting of the engineering firm ILACO from Suriname, as leading partner, and the firms Acacia Water and RHDHV from the Netherlands. Apart from MROM, as the client, the project deliverables will be reviewed at critical moments by a Stakeholder Working Group (SWG), which is formed during the inception phase.

The present report is the implementation or inception report and provides an outline of the methodology, deliverables and planning of the project. The draft implementation report will be reviewed by the SWG. Based on this review the inception report will be finalized.

The project is carried out in three phases or three outputs according to the terms of reference (CTCN, 2023; UN, 2024):

1. The inception phase: writing inception report, gender report and review by SWG
2. The analytical phase: mapping droughts risks, water demands, MAR potential and site selection by SWG for the pilot MAR
3. The design phase: conceptual designing of a pilot MAR and review and workshops by SWG and other stakeholders

2 Rationale of the project

Suriname has a humid tropical climate. Annual precipitation ranges from 1700 along the northwestern coast tot 2700 in the center of the country. Seasonal variation in rainfall is controlled by the northward and southward displacement position of the Intertropical Convergence Zone (ITCZ) and results in two dry and two wet seasons in Suriname, namely:

1. The short rainy season (early December to late January);
2. The short dry season (early February to mid-April);
3. The long rainy season (mid-April to mid-August); and
4. The long dry season (mid-August to early December).

There are also interannual variations related to the El Niño-Southern Oscillation (ENSO) cycle. During so called El Nino years the long dry season can increase both in intensity and duration. An El Niño episode occurs every 2-7 years and has large impacts on the water levels, soil moisture, river discharge, water quality and consequently water supply, agriculture, ecosystems and other water dependent functions. Recently Suriname experienced an El Niño drought starting in 2023 and lasting far into 2024. Climate change scenarios indicate yearly rainfall will decrease in future, though intensity of rainfall events during the rainy seasons will increase causing more frequent flooding in urban areas. On the other hand, El Niño droughts are expected to increase in severity and duration causing decreasing runoff of rivers and creeks, lowering of water levels and salinization of both groundwater and surface water.

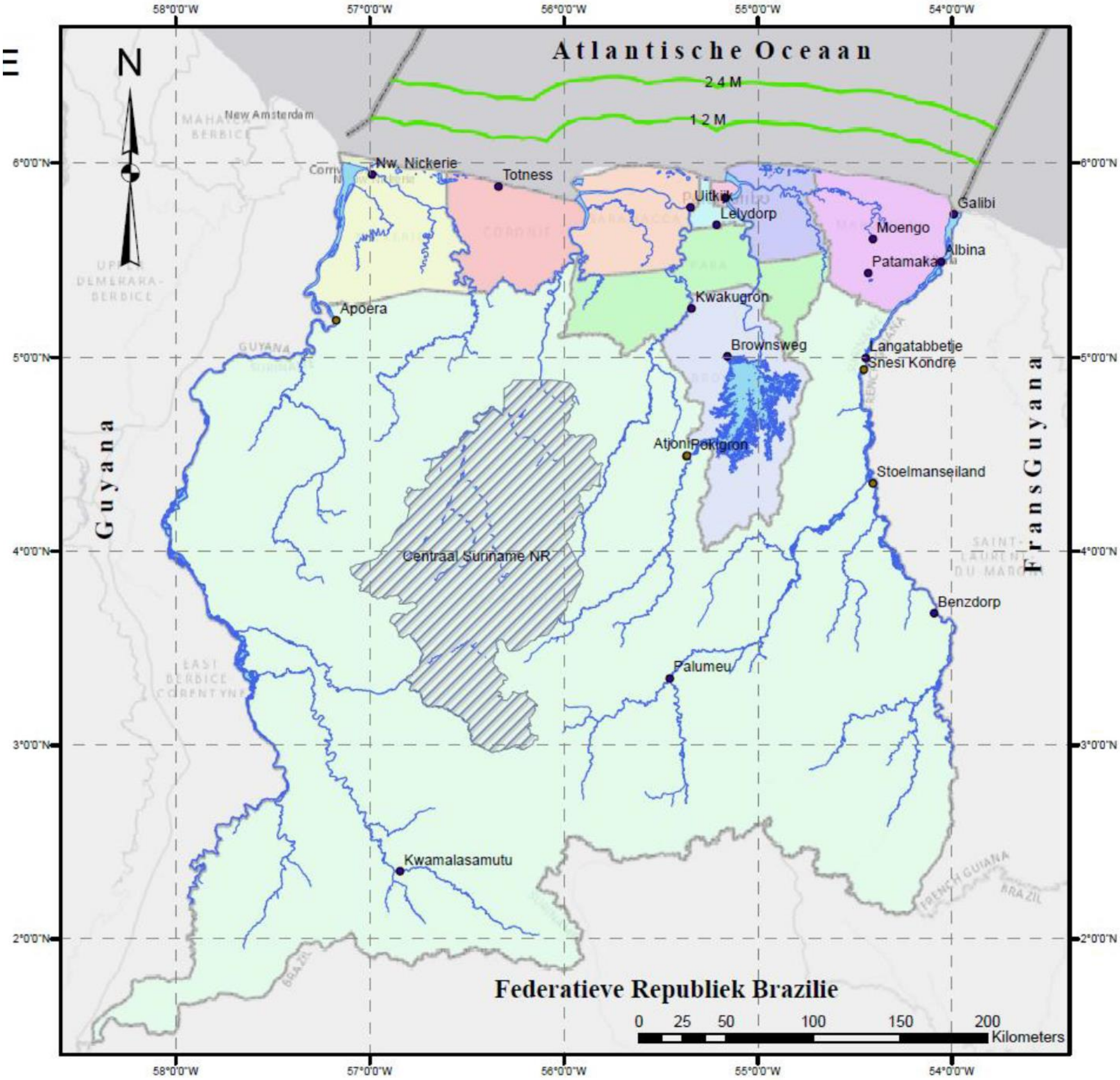


Figure 1. Republic of Suriname. Six northern districts (Nickerie, Coronie, Saramacca, Paramaribo, Wanica, Para, Commewijne and Marowijne) are encompassing the coastal zone of Suriname, the target area of ARADIS (from Gov. of Suriname, 2021).

Problems are expected for the future water supply of various sectors. As far as drinking and industrial water supply is concerned groundwater is by far the most important source. This resource is already overexploited in some areas (HACAS, 2016; TAUW, 2011; Genivar & ILACO, 2011; Groen, 2022), a problem which will be exacerbated by climate change. One of the strategies to cope with these developments is managed aquifer recharge (MAR). Though applied in many countries in various forms, MAR is still a new and unexplored strategy in Suriname.

Managed aquifer recharge (MAR) is defined as the purposeful recharge of water to aquifers for subsequent recovery or environmental benefit (Dillon et al, 2009, Ward & Dillon, 2009). MAR may be applied for various reasons:

1. Underground storage for reuse during periods of water shortage or droughts (water supply for domestic, industrial use and irrigation)
2. Underground storage to prevent or control flooding (urban and agricultural land)
3. Underground storage and passage to improve water quality and reuse (filtering, removal of pathogens, chemical breakdown and adsorption)
4. Underground storage to rehabilitate and control hydrological and environmental conditions (restore base flows and groundwater levels; mitigate salinization pollution and land subsidence)

There is a large variety of MAR techniques which can be categorized in 5 technology principles (Figure 2).

1. Spreading methods
2. Induced bank infiltration
3. Well/borehole recharge
4. In-channel modifications
5. Runoff harvesting

	Technology	Sub type	
Techniques referring primarily to getting water infiltrated	Spreading methods	infiltration ponds & basins	
		flooding	
		ditch, furrow, drains	
		irrigation	
	Induced bank infiltration		
	Well, shaft and borehole recharge	deep well injection	AS(TR)
			ASR
		shallow well/ shaft/ pit infiltration	
Techniques referring primarily to intercepting the water	In-channel modifications	recharge dams	
		sub surface dams	
		sand dams	
		channel spreading	
	Runoff harvesting	barriers and bunds	
		trenches	

Figure 2. MAR technology principles (IGRAC & Acacia Institute, 2007)

The question is which MAR technique fits where in the landscape (Figure 3) and where do we need a MAR system given the drought risks and water demands? This will be investigated in phase 2 of the project. Five hotspot areas will be designated and the SWG will finally select a site and appropriate

MAR technique for phase 3. During this phase the project will focus on the savannah belt and the coastal plain in the North of Suriname. This 20 to 100 km wide coastal zone bordering the Atlantic Ocean in the North harbours the majority of the population (about 565.000) is living (See Figure 1 with six northern districts of Suriname). The flat coastal zone is underlain by productive sand aquifers. Domestic water supply already depends largely on groundwater. Given these hydrogeological conditions and water demand MAR interventions are deemed feasible in this area. This contrasts with the interior part of the country south of the coastal zone. The hilly and sparsely populated interior is covered by tropical rainforests and underlain by crystalline rocks. Productive aquifers do not exist, and people (about 53,000) rely mostly on abundant surface water for domestic use. Water supply shortages and water quality problems certainly exist in this part of the country. Groundwater recovery may be an option in some specific places, but there is no scope for MAR development for high demand areas in the interior.

A MAR system comprises various elements (Figure 6). First there is the source water for the enhanced recharge, generally surface water, which in some systems requires pre-treatment before the water is stored underground. Other MAR elements are the infiltration facilities like ponds or wells from where water is led into the subsurface and subsequently the recovery facilities like drains and wells. Even though the water quality generally has improved during the underground passage post-treatment may be needed. Finally there are the usual water supply elements of storage and transport to the demand area. The design of the MAR system, which will be reviewed by the SWG, will be in a conceptual form. Costs estimates will have an accuracy of approximately 30%.

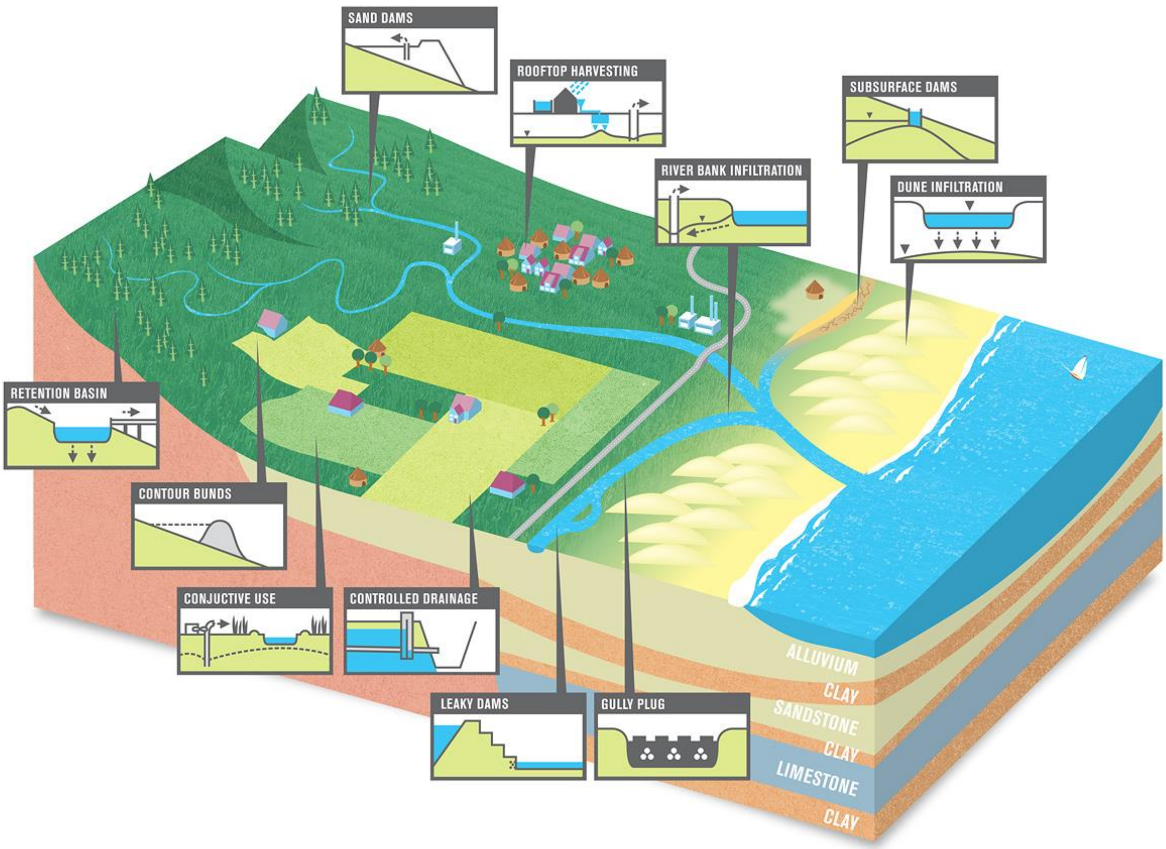


Figure 3. What fits where in the landscape? (from Steenbergen en Tuinhof, 2010)

3 Activities and deliverables

Tables 1, 2, 3 and 4 contain the foreseen activities and deliverables. Activities and deliverables closely follow the TOR, though some of the original TOR activities have been rearranged to fit the logical framework described above. (See codes referring to the original TOR activities).
For instance, the 3D aquifer mapping with geophysics, a part of the TOR activity 2.2 in phase 2, is moved to phase 3. According to the TOR this mapping is to be carried out on one particular site. However, the site for the detailed design is not yet known at the start of phase 2. It seems more logical to carry out this task after the site has been selected at the end of phase 2. Another aspect is the review of the appropriate MAR technique. This TOR activity 3.1 was part of the phase 3, but now moved to phase 2. Insight in the general aspects of MAR techniques is needed in phase 2 to select the appropriate site and MAR technique for phase 3, because physical terrain conditions and MAR options are strongly related.

Phase 1. Inception

Main activities and related deliverables during the inception phase are the preparation of the present implementation plan; the mapping of stakeholders; the formation of the SWG; the acquisition of data and the gender disparities analysis. The deliverables will be presented to the SWG at the end of the inception phase. MROM plays a crucial role in this phase with respect to the data acquisition, the stakeholder mapping and the formation of the SWG.

The kick-off meeting took place on September 20, 2024. Present were:

- Ritesh Sardjoe, client MROM), ritesh.sardjoe@rom.gov.sr,
- Ramiro Salinas (donor UNEP CTCN), ramiro.salinas@un.org,
- Roberto Wong Loi Sing, ILACO dep. team leader, r.wongloising@ilaconv.com,
- Ravindra Patandin, ILACO director, r.patandin@ilaconv.com
- Jacobus (Koos) Groen, ILACO team leader, groen.watersolutions@gmail.com

During the kick-off meeting the team and the proposed activities were presented. The project coordinator of MROM, Mrs Samantha Kromoredjo was not present. First meeting with her was on October 9, 2024. Present were:

- Roberto Wong Loi Sing, ILACO dep. team leader, r.wongloising@ilaconv.com,
- Jacobus (Koos) Groen, ILACO team leader, groen.watersolutions@gmail.com
- Radjen Ramkisoen, ILACO consultant, r.ramkisoen@ilaconv.com
- Samantha Kromoredjo, policy officer MROM, samantha.kromoredjo@gov.sr
- Radjindredath Narain, Policy Advisor MROM, r.narain27@hotmail.com

The draft implementation report (this report) has been issued (November, 2024.with an update in January 2025). As it takes some time to form the SWG and to acquire all necessary data, the consultant team proposed to organize the SWG at the end of November 2024. The preliminary date has been set at November 27, 2024. See Table 1 for a more detailed overview of activities, deliverables, dates and periods.

Note that also administrative reports will be produced during the inception phase. These are Monitoring and Evaluation plan, the Initial Impact statemen and the 1st Adaptation Fund Result Tracker. CTCN has provided formats for these reports.

Table 1. Activities and deliverables of Phase 1. Inception

Phase 1. Inception	
Activities	**Date/Period**
Kick off meeting	20-09-2024
Mapping of stakeholders (see gender analysis report for the mapping of the stakeholders)	20-09-2024 to 10-11-2024
Establishing Stakeholder Working Group (SWG)	20-09-2024 to 10-11-2024
Acquisition of data and information	20-09-2024 to 10-11-2024
Gender analysis	20-09-2024 to 10-11-2024
1st SWG meeting	27-11-2024
Deliverables	
Draft implementation plan	26-10-2024
Stakeholder mapping report	10-11-2024
Gender report	10-11-2024
Presentation for 1st SWG meeting	25-11-2024
Minutes of SWG meeting	03-12-2024
Final implementation plan after SWG meeting	10-12-2024
Monitoring and evaluation plan (administrative)	10-12-2024
Initial Impact statement (administrative)	10-12-2024
1st Adaptation fund result tracker (administrative)	10-12-2024

Data Collection

Project Overview: The technical assistance project, “Enhance the resilience of Suriname’s water supply system by modelling drought risks and developing a roadmap of prioritized alternatives for aquifer recharge,” aims to safeguard Suriname’s water resources against the growing threat of droughts and climate change. By focusing on the coastal aquifers, particularly those near Paramaribo and Nieuw Nickerie, the project will assess drought risks, identify areas most vulnerable to water shortages, and propose sustainable solutions for Managed Aquifer Recharge (MAR). This initiative will directly support Suriname’s long-term water security, benefiting not only the drinking water supply but also key sectors like agriculture.

Objectives: The primary goal is to enhance Suriname's resilience to droughts by providing decision-makers with the necessary tools and data to recharge aquifers during dry periods. The project will achieve this by:

- Assessing drought risks and mapping areas with high vulnerability to water shortages.
- Identifying and evaluating the potential of coastal aquifers for Managed Aquifer Recharge (MAR) solutions.
- Designing an integrated system to facilitate safe, sustainable aquifer recharge in times of drought.
- Providing training to national officers in the use of drought risk models and aquifer recharge systems.

Data Collection Types: To achieve these objectives, the following data types will be collected and analyzed:

1. **Precipitation and Climate Data:** To assess meteorological droughts and trends in rainfall patterns across different regions of Suriname.
2. **Hydrological Data:** Surface and subsurface water availability, streamflow records, groundwater levels, and water extraction rates, necessary for assessing hydrological drought risks.
3. **Soil Moisture Data:** To determine agricultural drought risks, focusing on how declining soil moisture impacts crop yields and water availability for irrigation.
4. **Groundwater Quality and Quantity Data:** Collected through monitoring wells to map aquifer potential and water quality, essential for designing MAR solutions.
5. **Geological and Hydrogeological Data:** Subsurface formations and aquifer characteristics (permeability, storage capacity) to evaluate MAR suitability.
6. **Socio-economic Water Demand Data:** Current and projected water usage patterns for domestic, agricultural, and industrial purposes, crucial for understanding socio-economic drought risks.
7. **Ecological Data:** Assessing environmental drought impacts, focusing on ecosystems sensitive to water shortages.
8. **GIS-based Risk Mapping Data:** Geospatial data to create risk maps of the regions most vulnerable to drought, helping guide aquifer recharge interventions.

Data Collection Methods: For this project, data collection will be a collaborative effort between the client and the consultant. While the client will facilitate access to relevant data sources, the consultant will also actively engage in the collection process to ensure comprehensive coverage. The data collection strategy will prioritize the use of publicly available and free-of-cost data, while also leveraging the consultant's network and stakeholder relationships to obtain specialized datasets. Fieldwork will be conducted where necessary to gather primary data that cannot be sourced through secondary means.

Publicly available meteorological datasets including historical rainfall patterns, drought indices, and temperature trends will be sourced from government agencies, international organizations (e.g., FAO, IDB, and WMO), and climate research institutes. The consultant will utilize datasets from climate monitoring stations, online repositories, and research papers.

Publicly available (geo) hydrological databases including surface water flows, groundwater levels, and water extraction rates, and other geo-hydrological information will be obtained from the government agencies and the national water company. In addition, relevant environmental reports published by other institutions (IDB, UNEP) will also be considered. Soil moisture data relevant to agricultural drought will be sourced from international bodies such as the FAO or from local agricultural institutions. Remote sensing data from satellites (e.g., NASA's Soil Moisture Active Passive – SMAP mission) will be explored for more recent information.

Existing groundwater quality and quantity data will be collected from water management institutions, universities, and previous environmental assessments conducted by organizations such as IDB, FAO, or other international organizations. This will include reports on salinity, pollutant levels, and recharge rates.

Demographic and population data, as well as reports on water usage patterns, will be gathered from government censuses (ABS, CBB), economic reports, and international studies (e.g., UN, FAO or World Bank reports). This will provide insights into water demand for domestic, agricultural, and industrial use.
Ecological data on drought-sensitive ecosystems will be collected from publicly available environmental assessments, biodiversity studies, and conservation reports, particularly those produced by international bodies like UNEP or local environmental NGOs.

Geospatial data for creating drought risk maps will be obtained from national land agencies (SBB), international organizations (e.g., the United Nations or IDB), and remote sensing sources such as satellite imagery. Publicly available topographical maps, land use data, and hydrological models will be utilized to generate GIS layers**.**
Where gaps in the data exist, the consultant will collaborate with local agencies and institutions such as the meteorological services of Suriname, agricultural cooperatives, private sector companies and environmental agencies for specialized datasets. The client will support the request by reaching out to the relevant stakeholders via formal requests or introductory letters. The inception workshop will also be used to establish contacts with stakeholders who can provide additional data.
In areas lacking sufficient information, the consultant will conduct site visits and, where feasible, arrange fieldworks such as drone technology and remote sensing, to fill data gaps.
Where more detailed or recent water usage data is needed, the consultant will reach out to water utilities, agricultural organizations, and industrial bodies to collect information through surveys or interviews.
The consultant will employ GIS tools to process the data and create comprehensive GIS-based maps.
The collection of existing data is prioritized to avoid redundant efforts and to create a robust understanding of the current situation. However, when existing data is insufficient, fieldwork will be conducted by the consultant, always within the project's scope.

Existing reports (already collected):
State of the Environment Report
NC3
HACAS

Suriname Water Supply Master Plan
ABS data
CBB data
Environmental Statistics
State of the Climate Report
To be collected:
Disaster Plans for Suriname

On Oct 11th an email was sent to the project leader of ROM as a reminder of the required data necessary to proceed with the project with the most priority topics. See table below

Table 2 (Tentative) priorities list of required data.

#	List of required data	Priorities	Partner
1	Latest census data		Consortium lead ILACO
2	Latest data of drinking water production of all SWM and DWV pumping stations (except Sipaliwini)	• Data from SWM pumping stations (SWM), particularly from the period 2016-2024, including overviews of extraction flows, logbooks of measured groundwater levels, and also salinity measurements (regarding salinization);	RHDHV
3	Data of water supply/abstractions for industries and agriculture (irrigation)		ACACIA WATER
4	Reports on climate change and sea level rise (climate models)	• Relevant study(ies) and report by Professor Naipal (Adek FTW)	ACACIA WATER
5	**Policy papers on:** a. mitigation and adaptation to climate change b. land use and housing projects c. future water supply to households, industry and agriculture d. Economical development in general		
6	Hydrographic data a) Discharge of rivers and creeks b) Water levels in rivers, creeks and canals	• Water quality of surface water and pollution sources: 1. Locations of gold mines (legal and illegal extractions, which river basins this	RHDHV

	c) Water quality of surface water d) Hydrological and hydrographical studies	occurs in, even if there are likely no official data on this, please try to represent as accurately as possible on maps, showing locations / along which rivers this occurs); 2. Measurements of surface water quality / contamination; 3. Locations of other (potential) sources of contamination (if no X-Y coordinates are available, a map with indicative locations will also be very useful).	
7	Hydrogeolocal data a) Well construction and capacity data b) Groundwater levels c) Groundwater quality d) Hydrogeological and water supply studies		
8	Maps (in digtal format) a) Topography (digital elevation models) b) Stream network c) Landuse and landcover (vegetaTion) d) Soils e) (Hydro)geology f) Climate g) Drinking water pumping stations and water delivery areas h) Industries and agricultural areas (with water demand) i) Population density j) Settlements k) Roads	• MAR specific: 1. Location of fresh water lenses (stripes) in the coastal area (map); 2. Locations of salinizing rivers (map); 3. Most recent aquifer map, including where aquifers outcrop; 4. Reports and (most recent) data on the riverbank infiltration extraction in the Republic;	ACACIA WATER
		• All data, studies, reports, and maps regarding the location and properties of aquifers collected after the 2016 HACAS study (> 2016 post-HACAS);	ACACIA WATER

Phase 2. Analysis

In Phase 2 seasonal and interannual droughts will be investigated under current and future climate. This will be based on historical records in Suriname and results from existing climate modelling studies. An assessment will be made regarding the climate effects on the occurrence and intensity of droughts. The amount of precipitation will be taken as a proxy to identify the risk of future drought events. The coastal plain is large, and the data density is too small to model these hydrological effects in detail. Therefore, simple, empirical models will be used. Also, analogous situations elsewhere in the world and droughts that have occurred in the past in Suriname will be studied. The hydrological effects will be translated into impacts on various sectors, where water shortages already exist or emerge in future. The emphasis of this study will be on drinking water and industrial sector. These are the most important users of groundwater in Suriname. The present and future water demands of various areas and sectors will be mapped quantitatively as much as possible. In this respect the study will provide an update of the Water Masterplan of Suriname from 2011 (Genivar & ILACO, 2011). In particular Drougth risks lead to water shortages. Quantification may be difficult, but indicative order of magnitude numbers (estimated percentage increase) are desirable.

As the project focuses on managed aquifer recharge, the aquifers in the coastal plain need to be assessed in more detail. This concerns the extent of the aquifers, the depths and the water quality, of which salinity is the most important parameter. There are already a number of groundwater pumping stations showing signs of salinization. The study will also entail an assessment of the recharge of the aquifers and the present abstractions (water balances). Finally, an overview will be given of various MAR methods and the conditions under which they can be applied in Suriname (MAR fact sheets).

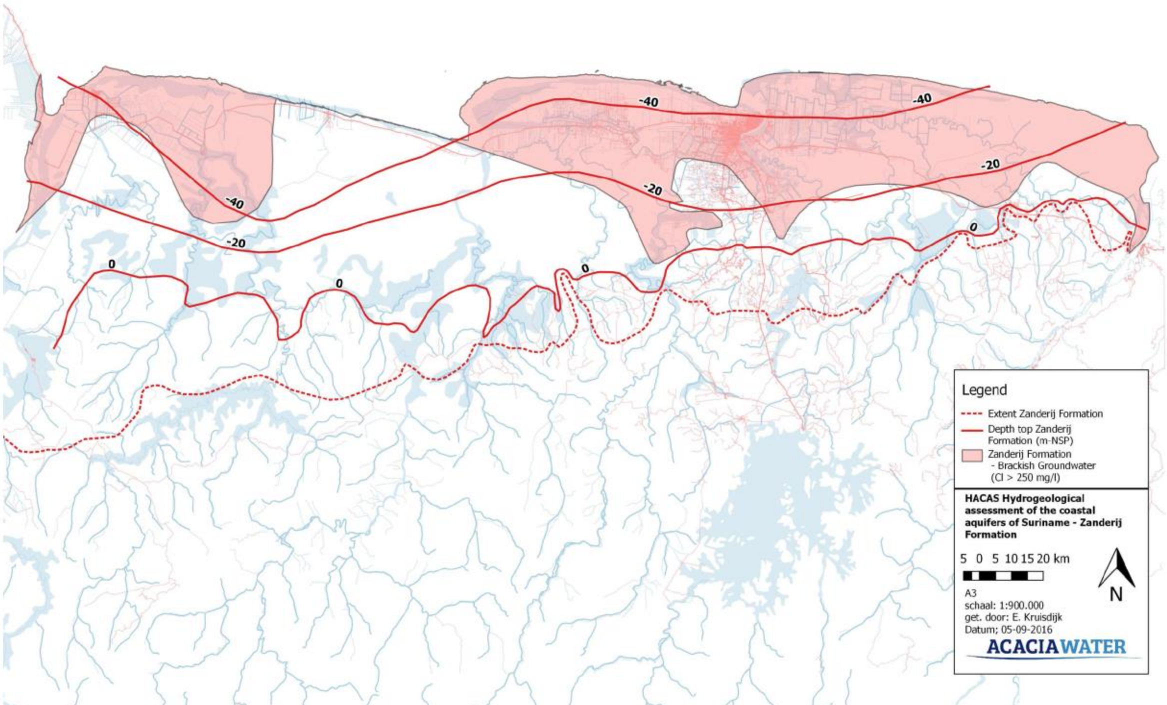


Figure 4. Extent, depth and salinity of the Zanderij aquifer (from RTI, 2016)

Based on the information on droughts, water demand, aquifers and MAR fact sheets, the consultant team will select 5 locations in the coastal area, which have a potential for a pilot MAR. All results of

Phase 2 will be submitted to 2nd SWG meeting. During that meeting the location and MAR types (Figure 5) will be defined for phase 3, the design of the pilot MAR.

The 2nd Adaptation fund result tracker was scheduled in month 8 of the project according to the TOR. We have proposed to deliver this result tracker at the end of Phase 2. This seems to be a logical moment and will take place in month 7.

Table 3 Activities and deliverables of Phase 2. Analysis

Phase 2. Analysis	
Activities	**Date/Period**
Assessment of drought risks and water demand in Suriname (2.1)	01-12-2024 to 15-02-2025
Assessment of water balances and aquifers in Suriname (part of 2.2, 2.3)	01-12-2024 to 15-01-2025
Assessment of MAR techniques and feasibility in Suriname (2.4, part of 3.1)	15-01-2025 to 15-03-2025
2nd SWG meeting and selection of site and MAR (2.5)	15-04-2025
Deliverables	
Report on drought risks and water demand in Suriname	15-02-2025
Report of water balances and aquifers in Suriname	15-01-2025
Report on MAR techniques and feasibility in Suriname	15-03-2025
Summary all results with 5 hotspot areas	01-04-2025
Presentation of all results for 2nd SWG meeting	12-04-2025
Minutes of 2nd SWG meeting	22-04-2025
2nd Adaptation fund result tracker (administrative)	22-04-2025

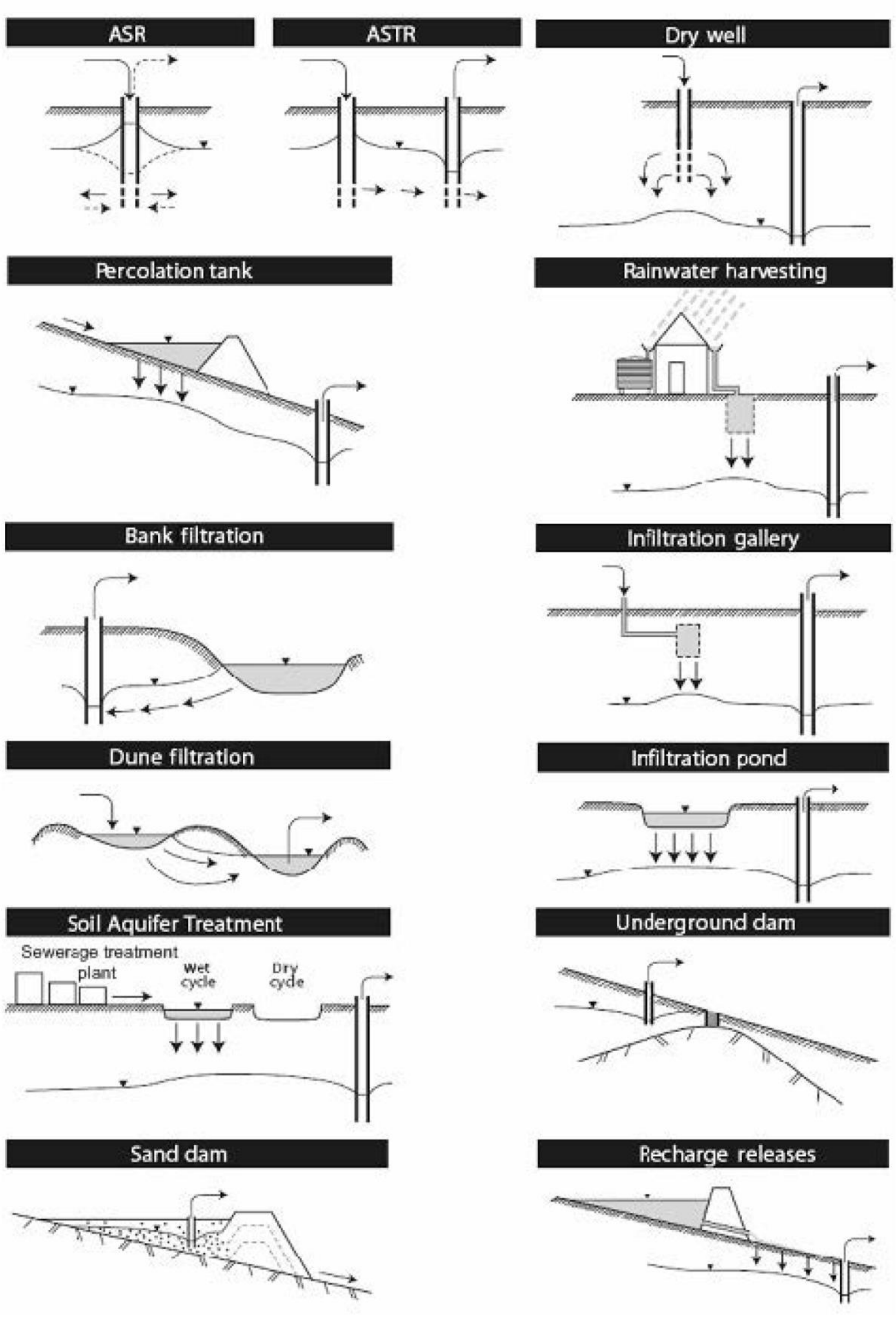


Figure 5. Schematic types of managed aquifer recharge (from NRMMC-EPHC-AHMC, N., 2006).

Phase 3. Design

In Phase 3 the selected site for the pilot MAR will be visited. Local stakeholders will be consulted with regard to land use and ownership and the state of water supply in that area. Also, physical site conditions will be surveyed in preparation for the aquifer mapping, Existing wells and surface water will be sampled and analysed. If possible, wells tests will be carried out.

For the aquifer mapping geophysical surveys will be executed. The envisaged techniques are VES soundings and ERT 2-D profiling. These measurements will provide insight in the extent and thickness of the aquifers and the groundwater salinity. This information is crucial for the siting of infiltration wells or ponds and the abstraction wells of a MAR system.

Based on all information draft conceptual designs will be made of the components of the pilot MAR system. Where relevant, alternative designs will be made. The MAR design encompasses 1) recovery, pre-treatment or protection measures of surface water, which is to be used for infiltration, 2) infiltration wells, ponds or other infiltration means, 3) abstraction wells or drains, 4) post-treatment of recovered groundwater and finally the traditional elements of 5) storage constructions and 6) transport pipes to the water demand areas. Note that for assessment of the pre- and post-treatment of the water we will need ready to use data from sample analyses. Both from the residing groundwater as well as the source of water which is infiltrated into the aquifer.
This will be based as much as possible on existing representative analyses.
During the subsequent 3rd SWG meeting, the design of the pilot MAR and its components will be presented and discussed. The meeting, which has the character of a workshop, will lead to the final outline of the pilot MAR.

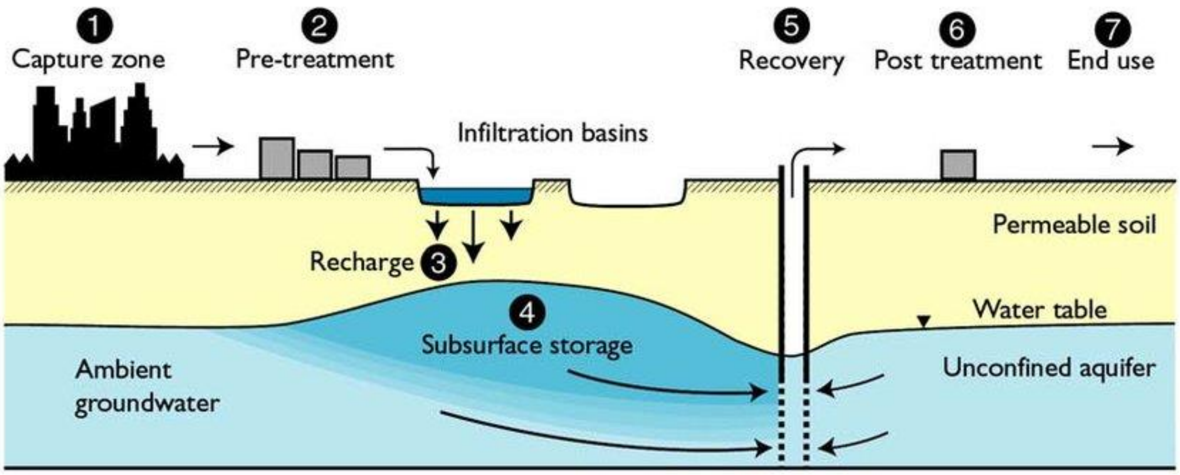


Figure 6. Components of a MAR system (from Ward & Dillon, 2009)

With feedback from the SWG the final design and cost analysis of the pilot MAR will be carried out. The design is conceptual: it will demonstrate the feasibility of the MAR pilot and all its processes; the design will also contain dimensional indications, but construction details will not be provided. Cost estimates will have an accuracy of 30 %.
The consultant team will also carry out a benchmarking study into potential financial sources and donors for realization of the pilot MAR.

All results from the three phases will be compiled into the draft closure report and will be reviewed by the SWG during the 4th SWG meeting or workshop.
The results of this study will also be presented and discussed with a larger audience of stakeholders and interested parties during a national workshop, which could have a public character.

The feedback from the 4th SWG meeting and national workshop will be incorporated into the final technical assistance closure report. Presenting the closure report to the client with the 3rd Adaptation fund result tracker and Impact statement marks the end of the project.

Table 4 Activities and deliverables of Phase 1. Design

Phase 3. Design	
Activities	**Date/Period**
Consultation of local stakeholders at the selected site and physical site survey (2.1)	16-04-‘25 to 01-05-2025
3D mapping of aquifer (part of 2.2)	01-05-‘24 to 15-06-2025
Draft design of pilot MAR with various technology components of pre-treatment, infiltration, recovery, post-treatment, storage, transport) (part of 3.1 and 3.2)	15-06-‘25 to 15-08-2025
3rd SWG meeting and decision of technology components of pilot MAR (3.3)	01-09-2025
Final conceptual design of MAR system and cost analysis (3.4 en 3.5)	01-09-‘25 to 01-10-2025
Benchmarking financing sources for MAR pilot project (3.6)	01-10-‘25 to 15-10-2025
4th SWG meeting or workshop (3.7) with review draft closure report (all results)	01-12-2025
One day workshop with other stakeholders and interested parties (3.7)	10-12-2025
Deliverables	
Report 3D aquifer mapping (geophysical survey)	01-07-2025
Report of draft design MAR technologies	15-08-2025
Presentation of all technologies for 3rd SWG meeting	27-08-2025
Minutes of 3rd SWG meeting	08-09-2025
Report of final conceptual design and cost analysis of MAR system	15-10-2025
Report on benchmarks financing sources	01-11-2025
Draft technical assistance closure report (all results)	15-11-2025
Presentation for SWG meeting and national workshop	28-11-2025
Minutes of 4th SWG meeting or workshop	09-12-2025
Report of national workshop	19-12-2025
3rd Adaptation fund result tracker (administrative)	19-12-2025
Impact statement (administrative)	19-12-2025
Final technical assistance closure report (all results)	19-12-2025

4 Planning

In the following Tables 4 and 5 all activities and deliverables are shown in a timetable with envisaged execution periods and delivery dates. The objective is to finalize the study before the end of 2025. The project comprises a period of 15 months, as foreseen in the TOR.

Table 5 Overview of activities and deliverables

Phase 1. Inception	Date/Period	sep	oct	nov	dec	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec
Activities																	
Kick off meeting	18-9-2024	*															
Mapping of stakeholders	18-09-2024 to 10-11-2024																
Establishing Stakeholder Working Group (SWG)	18-09-2024 to 10-11-2024																
Acquisition of data and information	18-09-2024 to 10-11-2024																
Gender study	18-09-2024 to 10-11-2024																
1st SWG meeting	27-11-2024			*													
Deliverables																	
Draft implementation plan	26-10-2024		*														
Stakeholder mapping report	10-11-2024			*													
Gender report	10-11-2024			*													
Presentation for 1st SWG meeting	25-11-2024			*													
Minutes of SWG meeting	3-12-2024				*												
Final implementation plan	10-12-2024				*												
Monitoring and evaluation plan	10-12-2024				*												
Initial Impact statement	10-12-2024				*												
1st Adaptation fund result tracker	10-12-2024				*												
Phase 2. Analysis	Date/Period	sep	oct	nov	dec	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec
Activities																	
Assessment of drought risks and water demands (2.1)	01-12-2024 to 15-02-2025																
Assessment of water balances and aquifers (part of 2.2, 2.3)	01-12-2024 to 15-01-2025																
Assessment of MAR techniques/feasibility (2.4, part of 3.1)	15-01-2025 to 15-03-2025																
2nd SWG meeting, selection of site and MAR type (2.5)	15-4-2025								*								
Deliverables																	
Report on drought risks and water demand in Suriname	15-2-2025						*										
Report of water balances and aquifers in Suriname	15-1-2025					*											
Report on MAR techniques and feasibility in Suriname	15-3-2025							*									
Summary all results with 5 hotspot areas	1-4-2025								*								
Presentation of all results for 2nd SWG meeting	12-4-2025								*								
Minutes of 2nd SWG meeting	22-4-2025								*								
2nd Adaptation fund result tracker	22-4-2025																

Table 6 Overview of activities and deliverables follow up

Phase 3. Design	Date/Period	sep	oct	nov	dec	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec
Activities																	
Consultation of local stakeholders and site survey (2.1)	16-04-2025 to 01-05-2024																
3D mapping of aquifer (part of 2.2)	01-05-2024 to 15-06-2024																
Draft design of MAR technologies (part of 3.1 and 3.2)	15-06-2025 to 15-08-2025																
3rd SWG meeting and selection of MAR technologies (3.3)	1-9-2025													*			
Final conceptual design and cost analysis (3.4 en 3.5)	01-09-2025 to 01-10-2025																
Benchmarking financing sources for MAR pilot (3.6)	01-10-2025 to 15-10-2025																
4th SWG meeting or workshop (3.7)	1-12-2025																*
One day workshop with all other stakeholders (3.7)	10-12-2025																
Deliverables																	
Report 3D aquifer mapping (geophysical survey)	1-7-2025											*					
Report of draft design MAR technologies	15-8-2025												*				
Presentation of all technologies for 3rd SWG meeting	27-8-2025												*				
Minutes of 3rd SWG meeting	8-9-2025													*			
Report of final conceptual design and cost analysis	15-10-2025														*		
Report on benchmarks financing sources	1-11-2025															*	
Draft technical assistance closure report (all results)	15-11-2025															*	
Presentation for SWG meeting and national workshop	28-11-2025															*	
Minutes of 4th SWG meeting or workshop	9-12-2025																*
Report of national workshop	19-12-2025																*
3rd Adaptation fund result tracker	19-12-2025																*
Impact statement	19-12-2025																*
Final technical assistance closure report (all results)	19-12-2025																*

5 Organization

The project's organization under the consultants' team is made visual with the Organogram and accompanying table hereunder. It shows how the consultants' team of key and non-key experts is organized and will function in a clear and useful manner to guarantee the best quality outcome of the project:

See Figure 7 below.

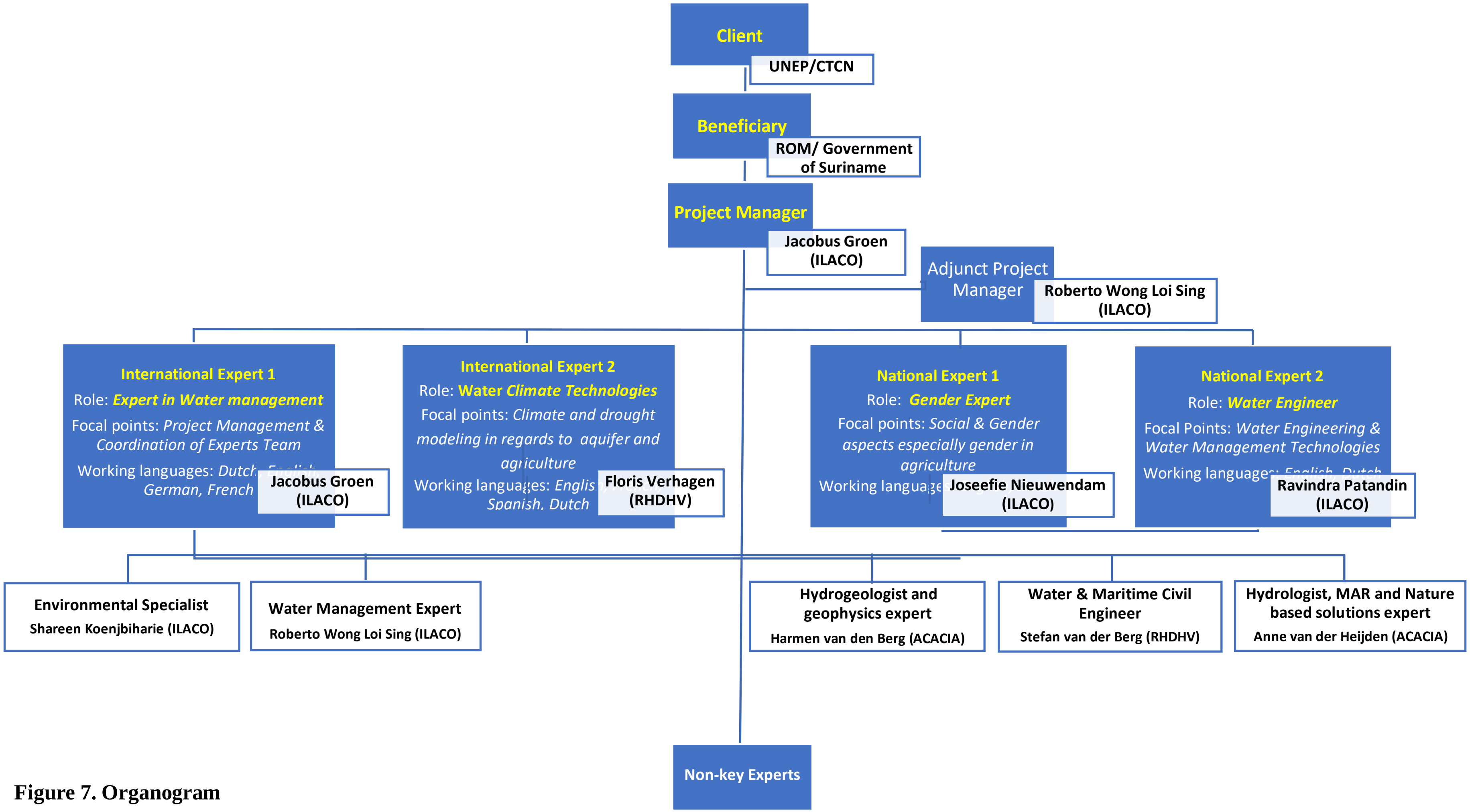
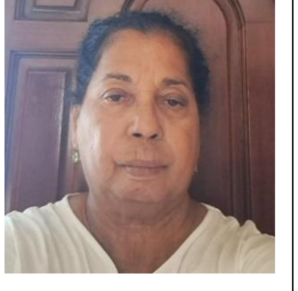


Figure 7. Organogram

Table 7 Overview information Key & Non key experts

#	Experts name	Proposed position	Working languages	Areas of expertise	No. of years of experience	Country of experiences	Profile photo
1	Jacobus (Koos) Groen (ILACO)	International Expert 1: Expert in Water management	Dutch, English, German, French	Hydrogeology, groundwater assessment and water resource management	>40 (43)	Netherlands Resident consultant in Mozambique, Burkina Faso, Pakistan, Suriname, Ethiopia. Short time consultant in 23 countries	
2	Floris Verhagen (RHDHV)	International expert 2: Water Climate Technologies	Dutch, English, Spanish German, French	(Geo)hydrology, flood and water management, climate adaptation, water quality, European Water Framework Directive, monitoring, subsidence, project management	20	The Netherlands, Mozambique, Ethiopia, New Zeland, Tunisia, Oman, Singapore	
3	Joseefie Nieuwendam (ILACO)	National expert 1: Gender expert	Dutch, English	Consultant and research studies, Stakeholders’ assessments and engagement, hinterland social project management, Gender specialist	45	Suriname, French Guyana	

#	Experts name	Proposed position	Working languages	Areas of expertise	No. of years of experience	Country of experiences	Profile photo
4	Ravindra Patandin (ILACO)	National expert 2: Water engineer	Dutch, English	Contract management, project management in water, hydraulics, river embankment and river shore protection, geotechnical engineering, water management, infrastructure (roads) and sanitation projects. Planning, designs, engineering, environmental assessment, tendering, supervision and contract management (works and D&B).	Ca. 30 (29)	Suriname, Ghana, India, Eritrea, Vietnam, Sri Lanka, Egypt, Bangladesh, China, The Netherlands, Netherlands Antilles, Indonesia	
Supporting Non key experts							
5	Roberto Wong Loi Sing (ILACO)	Water Management Expert	Dutch, English, Sranan tongo	Design, engineering, supervision, contract management, water supply, drainage, sewerage, project management, NRW, water audit.	>25	Suriname, Trinidad & Tobago	
6	Shareen Koenjbiharie (ILACO)	Environmental Specialist	English, Spanish, Sranan Tongo, Dutch	Project and quality management, environmental baselines, impact assessment and monitoring frameworks. Environmental contamination assessments. Institutional and legal frameworks, international best practices, alternative technologies related to climate change and adaption and resilience, waste management, extensive experience in stakeholder engagement, assessments and training	15	Suriname, St. Maarten	

#	Experts name	Proposed position	Working languages	Areas of expertise	No. of years of experience	Country of experiences	Profile photo
7	Stefan van der Berg (RHDHV)	Water & Maritime Civil Engineer	English, Afrikaans	(Waste) water treatment process selection, sizing and design, slow sand filters, rapid sand filters, high rate slow sand filters, membrane filtration, hydraulic design, water treatment chemistry, WWTW Inlet design, de-gritting, PST's, SST's, pump station design, pressure pipeline design, gravity pipeline design, water abstraction (river intake and boreholes), clariflocculator design, generating quantity schedules, specifications (both Civil & mechanical), compiling contract documents, design team management, client liaison, tender evaluations, construction supervision, commissioning, business development.	16	United Kingdom, Africa	
8	Harmen van den Berg (ACACIA)	Hydrogeologist and geophisics expert	Dutch, English, Portugese	Senior Hydrogeologist, project management, (ground)water resources assessment and management, execution and interpretation of geophysical surveys, water quality assessments, hydrogeological mapping, MAR / AS(T)R design and implementation, geophysical surveys, SWC through 3R measures and NBS, groundwater monitoring, GIS, borehole siting and well field design, IWRM, and other hydrogeological assessments	14	Netherlands, Mozambique (resident: 2014-2017), Uganda, Ethiopia, Kenya, Tanzania, Rwanda, Bangladesh, Angola, Oman, Suriname	

#	Experts name	Proposed position	Working languages	Areas of expertise	No. of years of experience	Country of experiences	Profile photo
9	Anne van der Heijden (ACACIA)	Hydrologist, MAR and Nature based solutions expert	Dutch, English	Senior Hydrologist, project management, specialized in water resources assessments, IWRM, catchment hydrology, MAR systems and Nature Based Solutions, field surveys, GIS and remote sensing, smart technologies and water saving techniques, salinization, water scarcity and capacity building	8	Burkina Faso, Colombia, Ethiopia, Gambia, Kenya, Morocco, Algeria, Tunisia, Niger, Nigeria, Rwanda, Sudan, South Sudan, Uganda, and The Netherlands	

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7 Colophon

Client	:	The United Nations Environment Programme (UNEP) on behalf of the Climate Technology Centre and Network (CTCN)
Beneficiary	:	Government of the Republic of Suriname; Ministry of Spatial Planning and Environment
Project	:	Enhance the resilience of Suriname´s water supply system by modelling drought risks and developing a roadmap of prioritized alternatives for aquifer recharge.
Subject	:	Inception Report and Implementation Plan
File/ Code	:	IS-471
Acronym	:	ARADIS project
Author	:	J. Groen
Contributions	:	R. Wong Loi Sing, S. Koenjbiharie, S. Lachman, RHDHV, ACACIA
Authorisation	:	R. Patandin
Date	:	26 November 2024; Updated 08 January 2025