Using simple mobile technologies to scale up digital collection & processing of climate observation for adaptation actions in Malawi

UNEP CTCN Project: 2022000048

Reception & Equipment Installation

October 2024

Draft for review and not for disclosure

ADAPTATION FUND

UN environment programme

CTCN UN Climate Technology Centre & Network

Table of Content

A. Scope

In the project "Using simple mobile technologies to scale up digital collection & processing of climate observation for adaptation actions in Malawi", supported by UNEP CTCN, this document captures the hard and software installation of equipment and services for deployment of the project prototype in the southern region of Malawi.

The report is the outcome of Activity 4.6, encompassing the solicitation of physical assets needed to improve monitoring capacity at manual in-situ stations (for manual rainfall and river level monitoring) as well as the procurement of software, technology architecture and mobile communication services.

The associated deliverables in Output 4 are:

- Deliverable 4.1 Pilot sites: preliminary assessment
- Deliverable 4.2.a Minutes: 1-day workshop
- Deliverable 4.2.b Pilot sites: final selection
- Deliverable 4.3 Detailed pilot work plan/implementation plan
- Deliverable 4.4.a Minutes: meeting
- Deliverable 4.4.b Final Pilot Implementation Plan
- Deliverable 4.5.a Minutes: local workshop
- Deliverable 4.5.b Official community endorsement (written)
- Deliverable 4.6 Report: reception & equipment installation
- Deliverable 4.7 Report: demonstrating start of testing
- Deliverable 4.8 Digital system development & operationalisation
- Deliverable 4.9 Minutes: demonstration workshop (8 people)
- Deliverable 4.10 Report: updated equipment & digital system
- Deliverable 4.11 Minutes: technology validation workshop

B. Equipment installation

Equipment at manual monitoring stations

Informed by the initial phase of deployment where station equipment was assessed in detail during in-field visits, follow-up phone calls with manual Gauge Readers and Observers, and close collaboration with station managers at the Department of Climate Change and Meteorological Services (DCCMS) and the Department of Water Resources (DWR), the team has undertaken and enabled the purchasing, logistics and installation of monitoring equipment. In addition, key metadata was reconfirmed, such as geolocation and elevation. Water in Sight Ltd has also donated the equipment to the DWR and DCCMS as they fully integrate with their hydrometric monitoring network.

River gauge station for monitoring river levels

Of the 20 river and lake level monitoring stations identified for the pilot in southern Malawi, 9 stations (45%) were rehabilitated through installation of new river gauging plates, as well as restoration and realignment of existing gauging plates (table 1). In addition to the 20 stations identified for the southern region, DWR has agreed to include 4 stations in the central and northern regions where gauge readers have consistently submitted observations. These 4 stations did not need rehabilitation or new equipment. In addition, Gauge Readers have been equipped with slashers and spades to help clear vegetation and sedimentation from gauge plates, as well as rain coats and gum boots for personal comfort and protection during the forthcoming rainy season.

The piloting will include a total of 24 river and lake monitoring stations with functioning equipment.

Cross section measurements for river bathymetry

Cross sections were measured at all 9 river level stations for the purpose of developing rating curves that are key inputs in discharge estimation.

Table 1. Manual river level gauge stations with upgraded equipment

District	Station No	Station
Zomba	2C3	Domasi River @ Domasi TTC
Mulanje	14C8	Lichenya River @ Milonde
Zomba	2B21	Likangala River @ Mkokanguwo
Neno	1O1	Lisungwi @ Railway Bridge
Zomba	2C8	Naisi River @ Mwandama
Thyolo	14B8	Mkwakwasi @ Mangunda *(full rehabilitation)*
Phalombe	2B27	Phalombe @ Water Tank *(full rehabilitation)*
Mulanje	14C2	Ruo @ Old M1 Bridge *(full rehabilitation)*
Blantyre	1P2	Shire River @ Matope

Rainfall monitoring equipment

Of the 31 rainfall monitoring stations (at only rainfall monitoring stations as well as synoptic stations), 15 stations are receiving specific equipment to complete the rainfall monitoring, and 3 stations are having 3 full rainfall gauges installed. Hence, 18 rainfall monitoring stations are rehabilitated in the pilot (58%, table 2). The loose physical equipment procured include primarily measuring cylinders, collecting buckets and funnels. In addition stevensons screens are constructed and installed to house the loose physical items used in rainfall monitoring. Observers have also received gum boots and raincoats, as well as slashers and spades where requested for maintenance of the gauge area.

Table 2. Manual rainfall and synoptic weather stations with upgraded equipment

District	Station No	Station
Chikwawa	16344002	Billy Ngabu
Thyolo	15353056	Bvumbwe Research Center
Blantyre	15353036	Chichiri Met
Nsanje	16353002	Chididi Mission
Chikwawa	16342000	Chikwawa Boma Mitole EPA
Zomba	15351007	Chingale
Chiradzulu	15353013	Chiradzulu Boma Agriculture *(full rehabilitation)*
Dedza	14341008	Dedza MET
Blantyre	15353049	Lirangwe Agriculture
Neno	15342002	Lisungwi EPA
Chikwawa	16851082	Livunzu EPA
Dedza	14341011	Lobi Agriculture
Mangochi	14342008	Monkey Bay Met
Thyolo	16351036	Nchima *(full rehabilitation)*
Chikwawa	16353001	Nsanje Boma
Blantyre	15353077	Stella Maris *(full rehabilitation)*
Chikwawa	16342027	Thilasembe
Thyolo	16351010	Thyolo Agriculture

Computing and digital services

Mobile aggregator services

The shared short code SMS service has been procured (based on technology findings and testing from Water in Sight's preceding pilot in 2023). The local phone number to which Gauge Readers send their observations is "3064" and the two-way shortcode enables an automatic confirmation SMS response. The short code service is provided by the supplier Africa's Talking

(Kenya). The associated API has been built to ensure encrypted, secure and real time transmission of the data into the data management system. WhatsApp with API has been set up to receive observation data from users who prefer and can use WhatsApp. A dedicated WhatsApp link to a Malawian phone number has been established, but the supplier Meta has encountered a technical bug with servicing a Malawian phone number. Hence, the team has set up an international phone number through which data can be submitted as the bug is resolved. At the early stage of piloting, all Gauge Readers and Observers use the free SMS service.

Back end cloud computing services

The transition of the data management system to Microsoft Azure Data Factory involved the comprehensive migration of historical data and metadata from Google Big Query. This process required the setup of secure data pipelines and transformations to ensure data integrity and compatibility within the Azure environment. Figma wireframes have been completed for the final alpha version of the front end development.

API

Building the open APIs from the new database system in Microsoft Azure involved several key steps to ensure data accessibility, security, and performance. First, the data was structured and organized within the Azure SQL Database or other compatible Azure data storage services to ensure optimal retrieval and handling. Next, an API layer was developed, using Azure API Management, to create, secure, and manage the APIs. This layer defined endpoints, methods, and parameters, transforming internal data structures into consumable formats like JSON or XML. Authentication and authorisation measures were implemented to control access and protect data. Additionally, the API rate limiting, caching, and throttling configurations were applied to optimise performance and ensure scalability for different user demands. Finally, testing and monitoring are being conducted to validate functionality for the API linkages with HYDSTRA (DWR) and Climsoft (DCCMS), with ongoing management and logging set up to maintain performance and handle any troubleshooting needs.

B. Personnel involved in installation of equipment

Agency	DCCMS
DCCMS	Fatsanawo Dzigomvera *Sr Meteorologists, WG member*
DWR	Chilungambo Banda *Sr Hydrologist, WG member* Leman Ngwena *Sr Assistant Hydrologist* Japhet Khoza *Sr Assistant Hydrologist*
T-Notch	Thokozani Mtewa (NE2) *Project Officer, Water Expert*
Water in Sight	Chimwemwe Chiutula Love Eve Nsandu Mtike *Project AssistantsProject Assistants*

D. Photos

Example of river gauging plate restored at Lichenya River @ Milonde (left) and Mkwakwasi @ Mangunda (right)

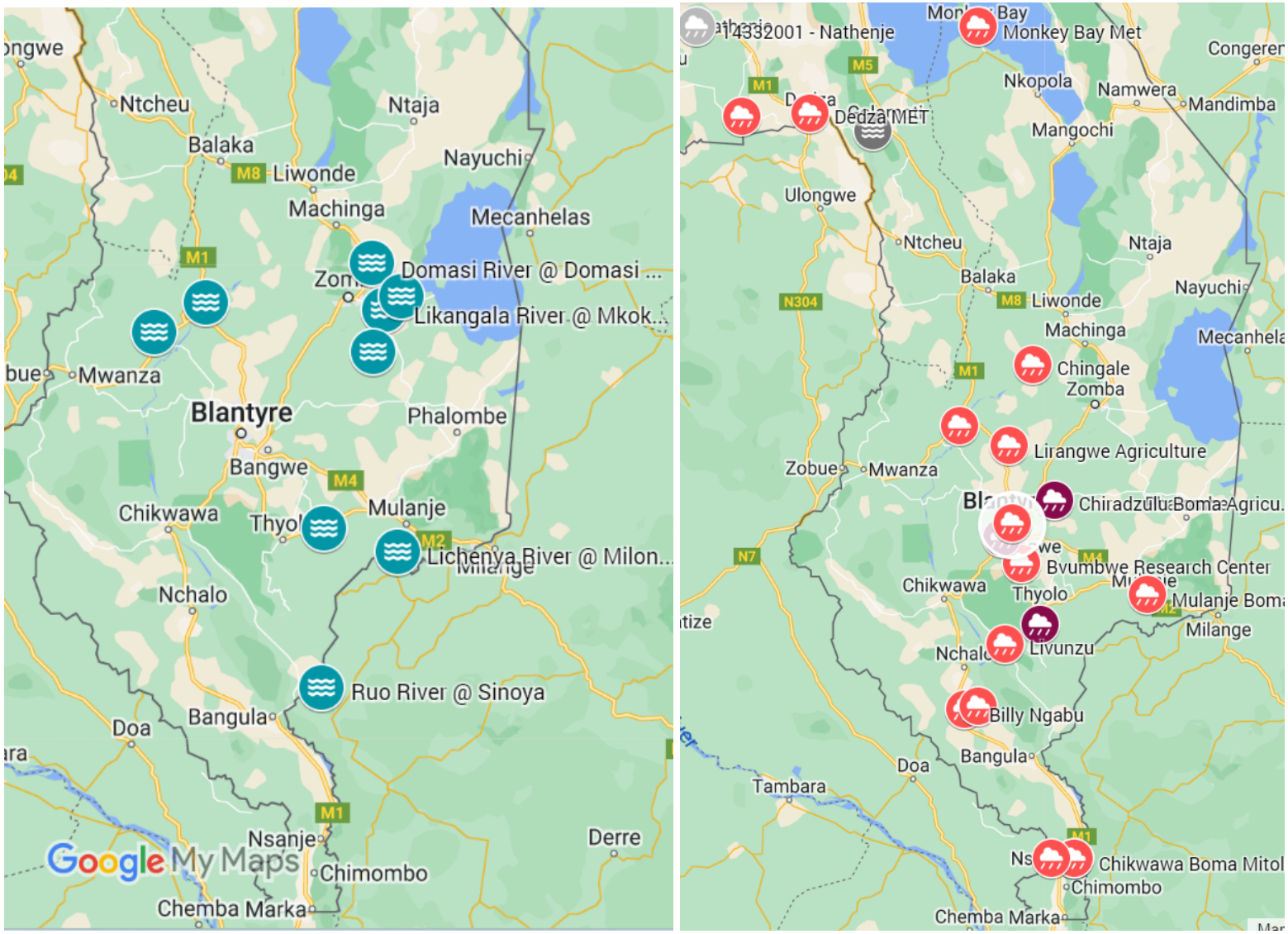
Rainfall measuring cylinder

Rainfall funnel

Rainfall bucket and gauge (photos pending DCCMS)

More photos being

Annex 1. Map of stations with rehabilitated equipment



Map of rehabilitated river level monitoring stations (left) and rainfall monitoring stations (right)

Annex 2. Detailed equipment rehabilitation at river level and rainfall station

DWR River level Station	Gauge Reader	No of gauge plates	Bags of cement	Angle irons	Working days	Paint	Cross section	Adjusting gauge	Painting posts
Mkwakwasi River @ Mangunda	Doreen Khumbanyiwa	2	2	2	1	1	1		1
Domasi River @ Domasi TTC	Rajab Mdala	4			1	1	1	1	1
Lichenya River @ Milonde	Shame Sakala	3	2	2	1	1	1	1	1
Likangala River @ Mkokanguwo	Everson Mustafa	3			1	1	1		1
Lisungwi River @ Railway Bridge	Davie Gongolo	5	1	1	1	1	1		1
Naisi River @ Mwandama	Hilda Mtemula	3	1		1	1	1	1	1
Phalombe River @ Water Tank	Stephen Allan Khwalala	`2	2	2	2	1	1		1
Ruo River @ Sinoya	Fole Pezo	4	4	4	2	1	1		1
Shire River @ Matope	Cosmas Lion	1			1				

DCCMS Rainfall Station	Observer	New rain gauge	Measuring cylinder	Collecting bucket	Funnel	Concrete stand	Stevensons screen	Lock
Chiradzulu Boma Agriculture	Innocent Asani	1	1				1	1
Nchima	Arthur Iphani	1	1				1	1
Stalla Maris	Marko Wilson Fole	1	1				1	1
Billy Ngabu	John Bizeck		1					
Bvumbwe Research Center	Ellita Kanjoka		1					
Chichiri Met	Kisa Nyasulu		1					
Chididi	Moses Shawa				1			
Chikwawa Boma Mitole EPA	Elsie Kamwendo				1			
Chingale	Andack Taibu		1	1				
Dedza MET	Harold Nkhoma		1					
Lirangwe Agriculture	Isaac Kambewa			1				
Lisungwi EPA	Vincent Amajih		1					1
Livunzu EPA	Henry Mthebuke					1		
Lobi Agriculture	Madalitso Machira		1					
Monkey Bay Met	Davie Kambalame		1	1				
Mulanje Boma	Violet Willard		1		1			
Nsanje Boma	Gerald Kadulira			1	1		1	
Thilasembe	Martha Chilokoteni				1			