

Technical Assistance Closure Report

Objective of the technical assistance (TA) Closure Report:

- To communicate publicly in one document a summary of progress made and lessons learned during the TA towards the anticipated impact (sections 1-4).
- To document qualitative and quantitative data collected during TA, for use in donor and UN reporting (Annex 1).

Steps for completing the TA closure report:

1. The lead TA implementer submits the closure report at the end of the technical assistance as a final deliverable. The TA closure report captures outputs, outcomes and impacts of all activities conducted under the TA. Relevant material from previous TA outputs/deliverables and the Response Plan Please are copied and summarized.
2. A CTCN Manager will review and revise the closure report before final approval by the CTCN Deputy Director.

Important note on public and internal use of the closure report:

Once approved by the CTCN Deputy Director, the TA closure report will be a public document available on the CTCN website www.ctc-n.org. Selected content will be used for targeted communication activities. Annex 2 is for internal use only and will not be publicly available.

Closure Report for CTCN Technical Assistance

1. Basic information

Title of response plan	Strengthening the community-based Flood and drought preparedness and early warning system in Sudan using operational and innovative models in addition to Satellite-based transmission technology for real-time automatic water level telemetry system
Technical assistance reference number	CTCN 23-001
Country / countries	Sudan
NDE organisation	Higher Council for Environment and Natural Resources Climate Change Directorate, Khartoum, Sudan
NDE focal point	Huyam Ahmed Abdalla Ahmed
NDE contact information	<i>hoyamahmed66@gmail.com</i>
Proponent focal point and organisation	<i>Abdelrahman Saghayroon Elzein, DG, Nile Water Affairs, MoIWR, a.saghayroon@gmail.com</i>
Designer of the response plan	<i>Abdelrahman Saghayroon Elzein, DG, Nile Water Affairs, MoIWR, a.saghayroon@gmail.com</i>
Implementer(s) of technical assistance	UNEP-DHI
Beneficiaries	<i>Nile Water Affairs Department, Ministry of Irrigation and Water Resources, Sudan</i>
Sector(s) addressed	Flood Forecasting and Early Warning
Technologies supported	<i>Forecasting systems and decision support systems</i>
Implementation start date	(16/03/2023)
Implementation end date	(31/10/2024)

<p>Total budget for implementation</p>	<p><i>Financial value of the technical assistance: \$249 951.</i></p>
<p>Description of delivered outputs and products as well as the activities undertaken to achieve them. In doing so, review the log frame of the original response plan and refer to it as appropriate</p>	<p><i>The delivered outputs are the following:</i></p> <ul style="list-style-type: none"> • <i><u>Inception Workshop: A multi-stakeholder inception workshop was held to understand the expectations, identify the needs, gaps, guidelines, and results and lessons learned from completed and ongoing projects to collect/generate and provide similar data/systems. The workshop was chaired and organized by the Nile Water Affairs Department with support by the TA implementer. It was a 1-day virtual with 16 participants (and 3 people from the TA Implementer). The inception workshop as an activity (Activity 1.3) was carried out after the Activity 1.1 – Kick-off meeting and stakeholder mapping and Activity 1.2 – Data collection and stakeholder consultation.</u></i> • <i><u>Inception Report: The inception report was delivered after the inception workshop and covered the earlier activities such as Activity 1.1 – Kick-off meeting and stakeholder mapping; Activity 1.2 – Data collection and stakeholder consultation.</u></i> • <i><u>Technical assistance management documentation: Documentation was prepared by the TA implementer which included an Implementation plan and Monitoring & Evaluation (M&E) Plan and Impact Statement as part of the project start deliverables.</u></i> • <i><u>Enhanced FEWS design report: The hydrologic and hydraulic components of the existing FEWS modelling framework were revised and the performance assessed. The forecasting and dissemination components were also reviewed, and the technical improvements captured in the enhanced FEWS design report. The output was achieved through Activity 1.4 – Review of the collected data and Activity 1.5 – Model and FEWS review</u></i> • <i><u>Model calibration and validation report: This output provides a report on the expansion and improvement of the FEWS components. This deliverable was achieved during Activity 2.1 – Expansion and improvement of the FEWS components</u></i> • <i><u>Enhanced FEWS operationalized: This output involved the review and improvement of the system’s overall performance and was carried out under Activity 2.2 – Review and improvement of the overall performance of the system</u></i> • <i><u>Updated technical manual: A technical manual that describes the system was produced under Activity 2.3 – Technical manual update</u></i> • <i><u>Training materials: The training materials for the capacity building activities were produced as well as presentations under Activity 3.1 – Production of training materials</u></i> • <i><u>Online and in person training sessions: The in-person training sessions were organized for the training of technical staff from the Nile Water Affairs Department, Ministry of Irrigation and Water Resources, Sudan</u></i>

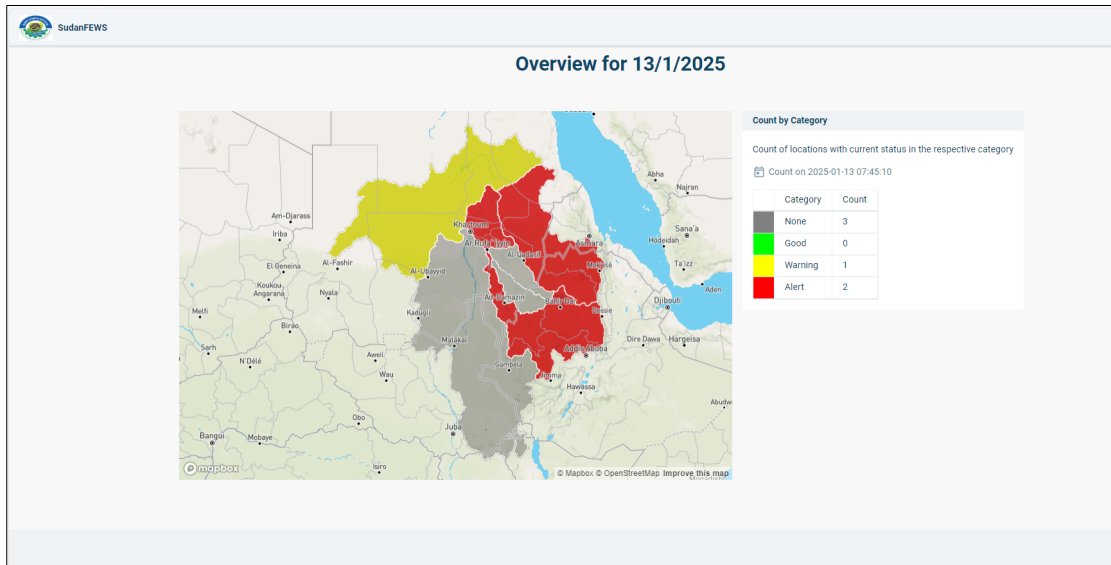
	<p><u>(proponent) and the Higher Council for Environment and Natural Resources Climate Change Directorate, Khartoum, Sudan (NDE organization) on the use of the system (a total of 8 participants). This output was delivered under Activity 3.2 – Training of government bodies and stakeholders for use of the system. This activity was held from 9 September to 12 September 2024. In addition, remote support was provided until the end of October 2024.</u></p> <ul style="list-style-type: none"> • <u>FEWS product end user workshops: This output involved the training of a broader range of selected relevant stakeholders, from those already identified during the activities of earlier outputs. This was achieved via a 1-day in-person workshop on 15 September 2024 for 12 participants.</u> • <u>Capacity enhancement report: At the end of Activity 3 (Capacity building for use of the enhanced FEWS) an encompassing Capacity enhancement report was produced, describing the outcomes of the technical training and the end user workshop as well as participants feedback and evaluation.</u> • <u>Technical assistance management documentation: This output is the Final Substantive Report (Annex 4) and the Final Expenditure report (Annex 5) as well as this closure report. This documentation is based on all the TA activities.</u>
Methodologies applied to produce outputs and products	<p><i>The methodologies applied to produce the outputs include stakeholder consultation, assessment of available data and existing FEWS; technical enhancement of the FEWS; capacity building of stakeholders for use of the enhanced FEWS</i></p>
Reference to knowledge resources	<p><u>Not applicable</u></p>
Deviations	<p><i>Activity 1.6 “Capacity needs assessment” could not be conducted in an in-person meeting as planned due to the situation in Sudan. Instead, several online meetings were carried out and a capacity needs assessment note was developed iteratively in collaboration with the proponent. The capacity needs assessment report was submitted to the proponent (31/01/2024). As a guidance for the assessment, it contains a checklist of required skills, competencies and pre-requisites. Then, the capacity needs assessment note informed the preparation of Activity 3.2 (selection of staff to be trained in the use of the system by the proponent).</i></p>
Anticipated follow-up activities and next steps	<ul style="list-style-type: none"> • <i>2-years of maintenance of the final system (by the TA implementer) using DHI’s infrastructure and transfer of the system</i> • <i>Use of new expertise acquired during training a part of the TA implementation.</i>

2. Lessons learned

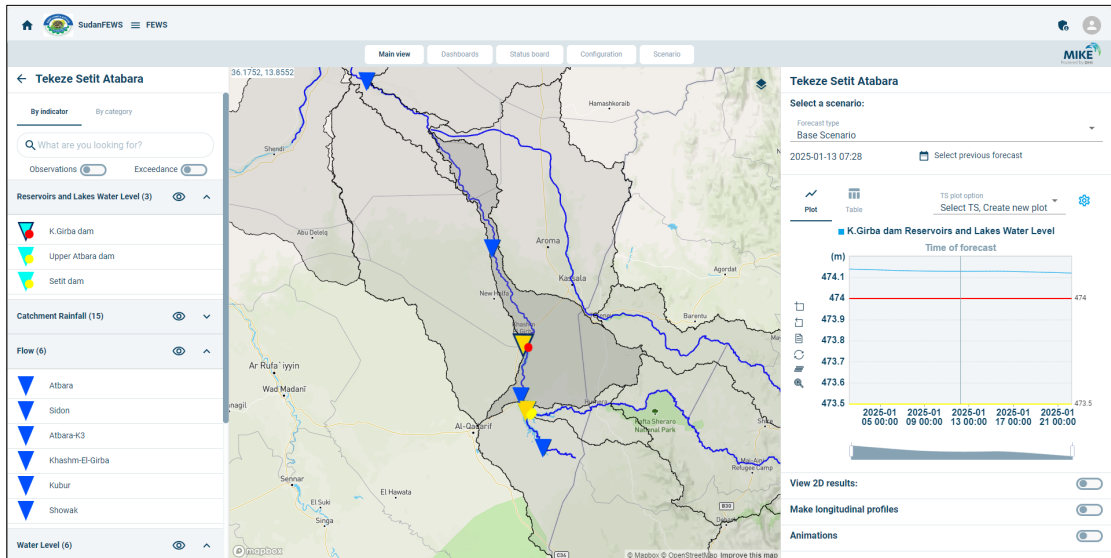
	Lessons learned	Recommendations
Lessons learned from the CTCN TA process	<p><i>The CTCN secretariat and personnel are quite responsive and worked with the TA implementer to find solutions to challenges as they came up. The implementation challenge was the current unstable situation in Sudan which resulted in people in the country not being able to carry out their work effectively. In addition, power interruptions made work in the country difficult and impeded effective communication. This situation led to the in-person capacity building activities being moved to another country (Kenya) after deliberation with the CTCN and the proponent. The responsiveness and flexibility of the CTCN secretariat contributed to a successful implementation.</i></p>	<p><i>Recommendations include</i></p> <ul style="list-style-type: none"> • <i>Establish communication channels early in the project</i> • <i>As far as possible, plan and arrange logistics for workshops months ahead of the workshop sessions</i>
Lessons learned related to climate technology transfer	<p><i>The technology can easily be used, deployed and transferred. The main barriers included the availability of input data on which to base the flood forecasting system, the stability of the country in which the technology is to be deployed (to ensure fluent interactions with beneficiary institutions, training etc.), long-term maintenance of the system (hosting and maintenance).</i></p>	<p><i>Recommendations include</i></p> <ul style="list-style-type: none"> • <i>Make provisions for technical, institutional and financial sustainability</i> • <i>Technical sustainability: IT systems should be hosted in the cloud.</i> • <i>Institutional sustainability: Applying the IT system should be part of the job description of designated users. The designated users should actively to system documentation during project implementation.</i> • <i>Financial sustainability: Financial resources for data acquisition, software maintenance, and cloud services should be mobilized as early as possible.</i>

3. Illustration of the TA and photos

A Power Point presentation file that illustrates and describes barriers, opportunities, methodology, activities, outputs and achieved results is submitted along with this report.



Screenshot of the web-based user interface: Entry Page and Dashboard of the FEWS



Screenshot of the web-based user interface: Exploring Flood Forecasts in the FEWS

Reservoirs and lakes

Water Level Forecasted Reservoirs and Lakes (maximum over 10 days, maximum today, maximum tomorrow and maximum the day after tomorrow); 2025-01-11 06:00 - 2025-01-21 06:00)

Status	Location	Alert	Maximum Water Level [m]	Day 1 Water Level Today [m]	Day 2 Water Level Tomorrow [m]	Day 3 Water Level After tomorrow [m]	Low Threshold [m]	Warning Threshold [m]	Danger Threshold [m]
	Jabel Aulia dam	Alarm	378.16 2025-01-12 13:00	378.16	378.16	378.16	372.5	377.4	378
	Sennar dam	Alarm	422.33 2025-01-17 05:00	421.42	422.1	422.31	415.0	421.7	422
	Roseires dam	Danger	492.13 2025-01-19 04:00	492.01	492.05	492.08	467.0	490.0	493

Alert "Undefined" - the threshold for alerts shall be established.

Dissemination of alerts: Flood alerts are automatically disseminated by e-mail



Workshop: Technical training session for developing hydrodynamic models



Workshop: Group discussions by stakeholders during the one-day workshop

4. Impact Statement

The information in the table below will be used to communicate results and anticipated impacts of this technical assistance publicly.

<p>Challenge</p>	<p><i>The challenge involves:</i></p> <ul style="list-style-type: none"> • <i>Reviewing and improving the existing FEWS model with regards to newly available data such as land use change and expand the model framework to cover the Dinder and Rahad basins, as well as the Main Nile Basin for the Nile river reach between Khartoum and Dongola.</i> • <i>Validating the Weather Research and Forecasting (WRF) model from ENTRO, reviewing and improving the overall performance of the FEWS.</i> • <i>Developing the dissemination component following the requirements of the Nile Water Department and the stakeholder consultation process.</i>
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<p>CTCN Assistance</p>	<ul style="list-style-type: none"> • <i>Enable Sudan to operate an innovative adaptation technology such as a FEWS to increase the resilience of communities, infrastructure, and economic sector investments in flood affected areas.</i> • <i>The enhancements to the existing technology include an early warning component that would allow better preparation and increased response capacity by authorities and communities for upcoming floods to minimize losses and damages.</i>
<p>Anticipated impact</p>	<ul style="list-style-type: none"> • <i>Increased number of direct and indirect beneficiaries in the flood prone areas as a result of the TA</i> • <i>increased economic, health, well-being, infrastructure and built environment, and ecosystems resilience to climate change impacts as a downstream result of the TA.</i>
<p>Co-benefits: Achieved or anticipated co-benefits from the TA</p>	<ul style="list-style-type: none"> • <i>The technology will improve the knowledge for future adaptation measures and climate resilient flood management solutions within Sudan.</i> • <i>The Flood Early Warning System (FEWS) is enhanced so that it is appropriate for Sudanese authorities to increase the resilience of communities in Sudanese national sub-basins.</i> • <i>The modelling framework is improved for forecasting purposes. This generates the opportunity for building on this output by carrying out very significant field data collection and repurposing the modelling framework for risk assessment purposes of the flood-prone areas.</i> • <i>The preparedness and response work of disaster management authorities in Sudan will directly benefit from the enhanced FEWS and the Nile Water Department's increased operational capacity. The</i>

	<p><i>data gathered on the flood affected areas will allow national/local authorities to better prepare for flood hazards and the enhancements to the early warning facility will allow increased lead time to the agents responsible for response in case of a flood disaster.</i></p>
<p>Gender aspects of the TA</p>	<p><i>Floods disasters can affect a large part of households living in major cities of Sudan along the mainstream or tributaries of the Nile. Many of these households will include women and the CTCN assistance will provide improved information on flood disaster management targeting these vulnerable communities through FEWS. The Nile Water Department under the Ministry of Irrigation and Water Resources will ensure that women and men participate equitably in decision-making related to climate technology implementation as well as benefit equitably from technical assistance and project-related training. More specific gender equality can be recognized as an integral part of the stakeholder engagement and capacity building process, which are part of Output 1 (Activity 1.3) and 3 (Activity 3.2 and 3.3 - Training).</i></p>
<p>Anticipated contribution to NDC</p>	<ul style="list-style-type: none"> • <i>Building resilience against floods by reducing risks, preventing loss of lives and assets, and reducing poverty in flood prone areas in vulnerable States in Sudan</i> • <i>Building resilience in the health sector by reducing public health risks due to flooding (contamination of water supplies and increased cases of diarrhea and cholera)</i>
<p>The narrative story</p>	<p><i>Climate change presents additional stress for Sudanese people. It has exacerbated Sudan's social and economic challenges with the increasing occurrence of floods and droughts due to the growing inter-annual variability of precipitation in the Nile basin. These effects can already be seen today and have a massive impact on the water-food-energy-nexus. Extreme events have led to widespread property loss, damage to irrigation facilities and water services, and the spread of waterborne diseases. The population along the river reaches in the Nile River system is estimated at 31 million.</i></p>

	<p><i>Although the population at risk of flood is unknown, many major cities of Sudan (e.g., Khartoum, Wad Madeni, Singa, Rabak, and Ad Damar) are located along the mainstream or tributaries of the Nile, and the combined population of these cities alone amounts to more than 10 million, many of whom have suffered severely from flood disasters in the last decades. During the recent flood in 2020 the Nile reached its highest water level in 100 years, by more than 60 centimetres, and inflicted devastating damage to Sudan. The flood began in mid-July and marked the country's worst event in 30 years. According to the National Council for Civil Defence in Sudan, at least 121 people died, 54 were wounded, more than 98,000 houses collapsed, and more than 97,000 agricultural acres and numerous livestock were lost. Moreover, many buildings and facilities were adversely affected.</i></p> <p><i>The main barrier for climate change adaptation is a weak capacity for flood and drought preparedness as well as the lack of an up-to-date Flood Early Warning System (FEWS) covering the key flood prone areas in Sudan. The requested technical assistance focused on strengthening the capacities for flood and drought preparedness and early warning system in Sudan using operational and innovative models.</i></p> <p><i>The technical assistance has enhanced and adapted the Eastern Nile Flood Forecasting and Early Warning System (EN-FFEWS) setup by the Nile River basin regional entity the Eastern Nile Technical Regional Office (ENTRO). The EN-FFEWS has been used as a point of departure to customize and tailor the FEWS for Sudan in accordance with the specific requirements of the Sudanese authorities: Critical flood prone areas have been added (e.g. Dinder, Rahad and Main Nile between Khartoum and Dongola), and the dissemination system has been tailored as such that it complies with the established operation procedures of the Sudanese authorities.</i></p>
<p>Contribution to SDGs</p> <p>A complete list of SDGs and their targets is available here: https://sustainabledevelopment.un.org/partnership/register/</p>	<p>SDG3: Ensure healthy lives and promote well-being for all at all ages</p> <ul style="list-style-type: none"> • The technology proposed in this TA will help reduce risks to public health by reducing those risks

	<p><i>caused by flooding (water supply contamination for example).</i></p> <p><i>SDG6: Ensure availability and sustainable management of water and sanitation for all</i></p> <ul style="list-style-type: none"><i>• This TA and the FEWS will provide valuable information for improving the management of water in Sudan.</i> <p><i>SDG13: Take urgent action to combat climate change and its impacts.</i></p> <ul style="list-style-type: none"><i>• This TA and the FEWS will help build the resilience and adaptive capacities of Sudan to flood impacts caused by climate change.</i>
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Annex 1 Technical assistance data collection

Please add quantitative and qualitative values for the indicators selected in the M&E plan and monitored throughout the technical assistance in the tables below. Indicators which have been monitored in addition to the proposed indicators below may be added at the end of table A. Non-relevant indicators should be left blank.

A. Output and outcome indicators

Indicator	Quantitative value	Qualitative description
Please note indicators below highlighted as anticipated	<i>Numerals only; disaggregates must sum to the total</i>	<i>List the various elements corresponding to the quantitative value as well as timelines and responsible institutions</i>
Total number of events organized by proponents and implementing partners	4	1 kick-off meeting (April 2023, with proponent, NDE, CTCN and implementing partner, 9 participants), 1 Inception workshop (August 2023, 19 participants), 1 four-day training event (12 participants plus trainers in September 2024), 1 one-day FEWS end users' workshop (8 participants plus facilitators in September 2024)
Number of participants in events organized by proponents and implementing partners	34	
a) Number of men	18	15 from Sudan, 1 from Germany, 1 from France, 1 (CTCN – not known)
b) Number of women	16	14 from Sudan, 1 from France
Number of climate technology RD&D related events		
Number of participants in climate technology RD&D events	<i>List total number here</i>	
a) Number of men		
b) Number of women		
Number of training organized by proponents and implementing partners	2	Activity 3.2 – Training of government bodies and stakeholders for use of the system Activity 3.3 – Stakeholder workshop for FEWS product end users
Number of participants in trainings organized by proponents and implementing partners	17	
a) Number of men	8	Without trainers or facilitators
b) Number of women	9	Without trainers or facilitators
Total number of institutions trained	7	

a) Governmental (national or subnational)	5	<i>Nile Water Affairs department (Ministry of Irrigation and Water Resources), National Council for Civil Defence, Sudan Met. Authority, Remote sensing Authority, Higher Council for Environment and Natural Resources,</i>
b) Private sector (bank, corporation, etc.)		
c) Nongovernmental (NGO, University, etc.)	2	<i>UNESCO Chair, ICPAC</i>
Percentage of participants reporting satisfaction with CTCN training (from CTCN training feedback form)	100%	<i>Satisfied= 4+ on 5-pt scale</i>
Percentage of participants reporting increased knowledge, capacity and/or understanding as a result of CTCN training (from CTCN training feedback form)		<i>Increased knowledge, capacity and/or understanding= 4+ on 5-pt scale</i>
a) Percentage of men		
b) Percentage of women		
Total number of deliverables produced during the assistance (excluding mission, progress and internal reports)	8	
a) Number of communication materials, including news releases, newsletters, articles, presentations, social media postings, etc.	1	<i>Linkedin post</i>
b) Number of tools and technical documents strengthened, revised or developed	1	<i>Flood forecasting and early warning system enhanced and expanded</i>
c) Number of other information materials strengthened, revised or created (For example training and workshop reports, Power Points, exercise docs etc.)	6	<ul style="list-style-type: none"> • <i>Technical assistance management documentation</i> • <i>Enhanced FEWS design report</i> • <i>Capacity needs assessment note</i> • <i>Model calibration and validation report</i> • <i>Updated technical manual</i> • <i>Training materials</i>
Total number of policies, strategies, plans, laws, agreements or regulations supported by the assistance	<i>List total number here</i>	
a) Adaptation related		<i>List the type and name of documents supported</i>
b) Mitigation related		<i>List the type and name of documents supported</i>
c) Both adaptation- and mitigation related		<i>List the type and name of documents supported</i>
Anticipated number of policies, strategies, plans, laws, agreements or regulations proposed, adopted or implemented as a result of the TA	<i>List total number here</i>	
a) Adaptation related		<i>List the type of documents anticipated to be proposed, adopted or implemented</i>
b) Mitigation related		<i>List the type of documents anticipated to be proposed, adopted or implemented</i>

c) Both adaptation- and mitigation related		List the type of documents anticipated to be proposed, adopted or implemented
Anticipated number of technologies transferred or deployed as a result of CTCN support	1	Flood forecasting and early warning system
Anticipated number of collaborations facilitated or enabled as a result of technical assistance	List total number here	
a) Number of South-South collaborations		List the names of the organisations (excluding the CTCN or TA implementers)
b) Number of RD&D collaborations		List the names of the organisations (excluding the CTCN or TA implementers)
c) Number of private sector collaborations		List the names of the organisations (excluding the CTCN or TA implementers)
Number of countries with strengthened National System of Innovation as a result of CTCN support	1	Sudan
Insert any additional indicators here		

B. Core impact indicators

Please fill in the tables for anticipated impacts of the CTCN assistance. Every technical assistance should contribute to at least one of the indicators below. For guidance on how to report on core indicators see the [‘M&E Guidance Document for TA Implementers’](#).

Core indicator 1	Anticipated metric tons of CO₂ equivalent (CO₂e) emissions reduced or avoided as a result of CTCN TA	
	<i>Please add your calculations in word or excel format as an Annex to this Closure Report, where applicable.</i>	
	Anticipated metric tons of CO ₂ e reduced or avoided as a result of the TA on annual basis	Anticipated metric tons of CO ₂ e reduced or avoided as a result of the TA in total
Quantitative value (emissions reductions)	<i>Total number (numerals only, no rounding or abbreviations)</i>	<i>Total number (numerals only, no rounding or abbreviations)</i>
Unit	tCO ₂ e	tCO ₂ e
GHG assessment boundary (project emissions)		
Identify expected post-TA activities, associated effects and assess boundary for quantification of GHG emission reductions		
Baseline emissions		

Describe baseline scenario, baseline candidates, emission factors and emissions calculated		
Methodology Explain the method or process of verifying the indicator and how data was gathered		
Assumptions Describe assumptions made during calculation and quantification of GHG reductions		

Core indicator 2	Anticipated increased economic, health, well-being, infrastructure and built environment, and ecosystems resilience to climate change impacts as a result of technical assistance <i>Please provide a qualitative description of the anticipated impacts on the categories below</i>
Infrastructure and built environment Anticipated increased infrastructure resilience (avoided/mitigated climate induced damages and strengthened physical assets)	<i>It is anticipated that the flood forecasting system developed as part of the technical assistance help improve the operations of dams and help reduce the damages caused to physical assets due to floods.</i>
Ecosystems and biodiversity Anticipated increased ecosystem resilience (areas with increased resistance to climate-induced disturbances and with improved recovery rates)	
Economic Anticipated increased economic resilience (e.g. less reliance on vulnerable economic sectors or diversification of livelihood)	
Health and wellbeing Anticipated increased health and wellbeing of target group (e.g. improved basic health, water and food security)	<i>It is anticipated that the health and wellbeing of the population in flood affected areas will be improved through effective flood early warnings.</i>

Core indicator 3	Anticipated number of direct and indirect beneficiaries as a result of the TA	
	Quantitative value	Means of verification

Total beneficiaries	23 million	GIS overlay of the potentially flooded areas that are covered by the Sudan-FFEWS – (1) White Nile, (2) Main Nile down to Dongola, (3) Atbara, (4) Blue Nile, (5) Dinder, (6) Rahad - with population density maps
Number of adaptation beneficiaries		Describe calculation methods and assumptions made
Number of mitigation beneficiaries		Describe calculation methods and assumptions made
Number of adaptation-and mitigation beneficiaries		Describe calculation methods and assumptions made

Core indicator 4	Anticipated amount of funding/investment leveraged (USD) as a result of TA (disaggregated by public, private, national, and international sources, as well as between anticipated/confirmed funding)			
	Quantitative value confirmed in USD	Quantitative value anticipated in USD	Qualitative description List the institutions, timelines, and description or title of the investment	Methods Describe methods used for quantification of funds leveraged
Total funding	Total number in USD (numerals only, no rounding or abbreviations)	Total number in USD (numerals only, no rounding or abbreviations)		
Anticipated amount of public funding mobilised from national/domestic sources				
Anticipated amount of public funding mobilised from international/ regional sources				
Anticipated amount of private funding mobilised from national/domestic sources				
Anticipated amount of private funds mobilised from international/regional sources				

Annex 2 (for internal use – to be filled in by the CTCN)

CTCN evaluation

This section will be completed by the relevant CTCN Technology Manager.

- Evaluation of the timeliness of the TA implementation as measured against the timeline included in the response plan;
- Evaluation of TA quality as defined in the response plan;
- Overall performance of the Implementers;
- Overall engagement of the NDE and Proponent;
- Lessons learned on the CTCN process and steps taken by the CTCN to improve.