Technical Assistance Closure Report Template

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 will capture outputs, outcomes and impacts of all activities conducted under the TA. Please copy and summarise relevant material from previous TA outputs/deliverables and the Response Plan, as relevant.
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	Developing Methodology and Capacity for Monitoring Climate Change and its Impacts on Agriculture in Sudan through Earth Observations
Technical assistance reference number	2019000057
Country / countries	Sudan
NDE organisation	National council for Environment
NDE focal point	Huyam Ahmed Abdalla Ahmed Position: Environmental Inspector
NDE contact information	Email: hoyamahmed66@gmail.com
Proponent focal point and organisation	Nora Abdelraheim Khojali Ministry of Agriculture and Forests Email: norakhan_2000@yahoo.com.
Designer of the response plan	Tor-Gunnar Vagen, World Agroforestry (International Centre for Research in Agroforestry-ICRAF), t.vagen@cgiar.org
Implementer(s) of technical assistance	World Agroforestry (International Centre for Research in Agroforestry-ICRAF)
Beneficiaries	Ministry of Agriculture and Forest Services, the Higher Council for Environment and Natural Resources, NDC partnership

Sector(s) addressed	Agriculture
Technologies supported	Geospatial and Earth observation for climate vulnerability assessment and agricultural monitoring
Implementation start date	29/01/2020
Implementation end date	31/08/2021
Total budget for implementation	USD 380,390
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	Activity 1: Development of implementation planning and communication documents CTCN Response Plan was developed, with detailed work plan. Monitoring and Evaluation plan developed and shared, along with impact description Activity 2: Identifying and mapping areas that are particularly vulnerable to changes in climate Climate (rainfall and land surface temperatures) data collated A geospatial database was developed to hold both satellite derived datasets and vector data Spatial datasets and associated analysis completed (number of rainy days, rainfall aggressiveness, mean annual precipitation and annual temperature variations) Spatial assessments of extreme rainfall events completed (hotspot and vulnerability assessment) completed Report produced and shared on the Identification and mapping of areas that are particularly vulnerable to changes in climate for White Nile and North Kordofan States Module to provide forecasting of extreme climate events (10-day forecasts) was developed and integrated into decision dashboard (part of deliverable 2.6). Hotspot and vulnerability assessments and maps were developed and integrated into interactive decision dashboard. *Activity 3:* Baseline assessment and mapping of land health Land health indicators to be assessed and mapped have been identified Report outlining protocols and indicators for assessment of land health was developed. Land health analysis at 30m spatial resolution was conducted. Given the expanded area now covered by the project (see above), the scope of these assessments and analyses were also expanded. Monthly and annual vegetation cover from MODIS at 250m resolution for the period 2000 – 2020 was processed and analysed Vegetation cover maps were developed and integrated into the decision dashboard

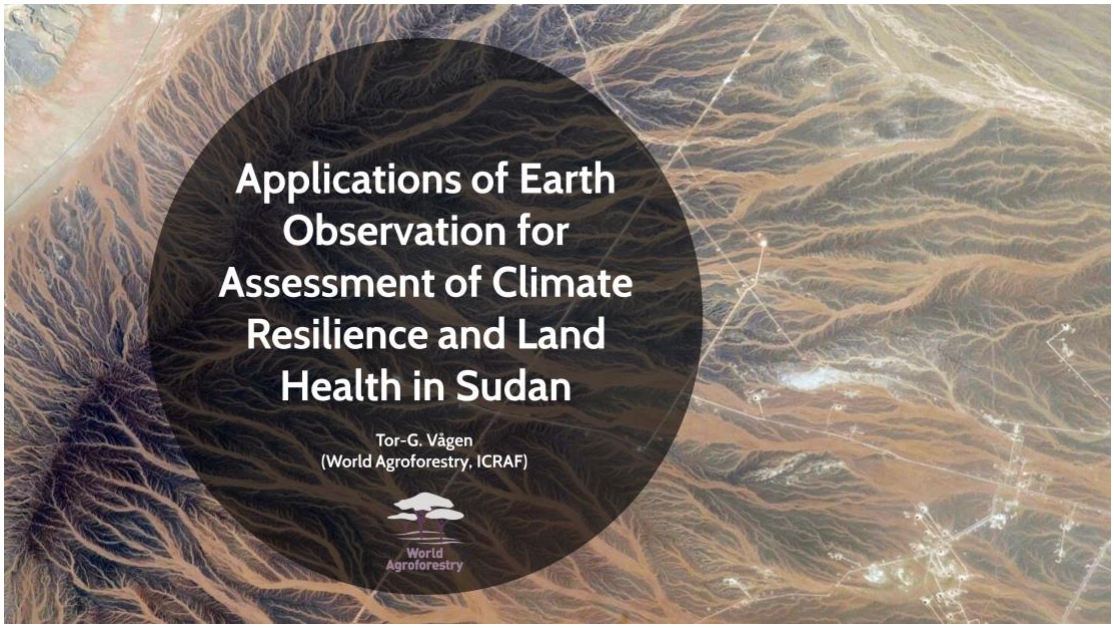
	<u>Activity 4: Interactive decision dashboard integrating climate variables with soil and land health</u> Online stakeholder (SHARED) workshop was conducted to introduce stakeholders to remote sensing data analysis and a workshop report developed Prototype dashboard was developed and shared with Sudan national partners for their review and feedback. A meeting report was developed Final dashboard was released to the Sudan national team during the training workshop on building the capacity of the Sudan national team to access and use the dashboard. A report documenting the workshop was developed
Methodologies applied to produce outputs and products	Baseline mapping at fine spatial resolution (30m) was conducted for: • Soil condition (soil carbon, pH and other soil functional properties) • Land degradation risk factors such as soil erosion and root-depth restrictions • Climate resilience (proxies), such as: – Number of days with precipitation – Rainfall aggressiveness – Mean annual precipitation – Annual temperature ranges and trends Data analytics using R statistics was conducted for spatial and temporal dynamics in rainfall and temperature across the six project states including assessments of extreme events, drought frequencies, seasonal dynamics, and floods The Land Degradation Surveillance Framework (LDSF) was used to identify a set of biophysical indicators or proxies for indicators for assessing and mapping land health and a range of statistical modeling and machine learning methods to assess land health at multiple spatial scales and across social and ecological systems The Stakeholder Approach to Risk-Informed Decision Making (SHARED) methodology was used to co-design the interactive dashboard.
Reference to knowledge resources	NA
Deviations	NA

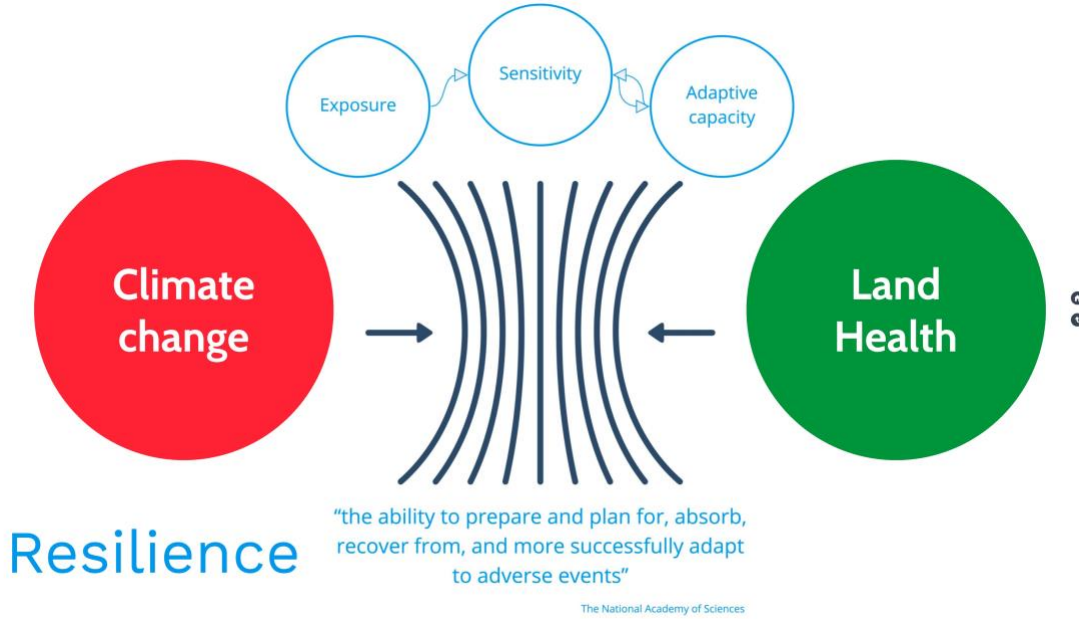
Anticipated follow-up activities and next steps	• A high-level meeting with decision makers from the Ministry of Agriculture, the Higher Council for Environment and Natural Resources, the Sudan Meteorological Authority to encourage political good-will on data sharing, and in the long run, embed a culture of data for decision making to secure climate resilience • Joint Development a uniform data sharing protocol to address barriers related to information sharing. • Use of new expertise acquired during training workshops to build national experts in earth observation and to build capacity on the whole knowledge management value chain for the Atlas

2. Lessons learned

	Lessons learned	**Recommendations**
Lessons learned from the CTCN TA process	*Interactions with the CTCN secretariat were generally good. Given that there is a CTCN liaison officer located at ICRAF, communication was excellent overall and CTCN was able to participate in a number of the stakeholder events.*	*Recommendations include* • *The timeline of these engagements is rather short, particularly in situations such as Sudan were there are significant capacity gaps (see below)*
Lessons learned related to climate technology transfer	There are significant capacity gaps in-country for the processing, analysis and use of data and evidence in decision making. Mechanisms for data sharing across departments are generally absent. This means that is remains challenging to access and synthesize data across departments and sectors, such as for example meteorological data and agricultural data.	*Recommendations include* • Additional technical support to the Sudan national partners to build the required capacity to further enhance the Interactive Sudan Climate Vulnerability Atlas and for high level buy-in and support • Establishing protocols and mechanisms that enable data sharing to effectively assess and generate management recommendations to enhance climate resilience in Sudan

3. Illustration of the TA and photos


Applications of Earth Observation for Assessment of Climate Resilience and Land Health in Sudan
Tor-G. Vågen
(World Agroforestry, ICRAF)
World Agroforestry


Exposure
Sensitivity
Adaptive capacity
Climate change
Land Health
Resilience
"the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events"
The National Academy of Sciences

CTCN
CLIMATE TECHNOLOGY CENTRE & NETWORK

Land and Ecosystem Health

- Healthy soil
- Biodiversity
- Regulation of water
- Productivity
- Ecological balance

adaptive capacity

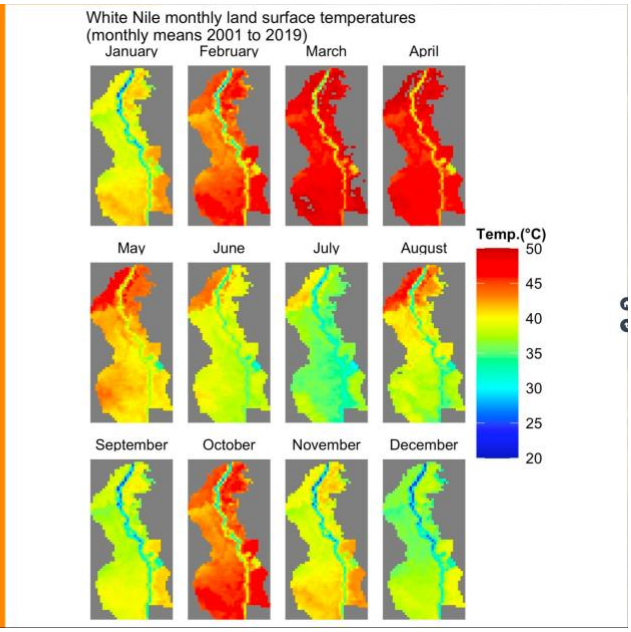
Measuring indicators of land health

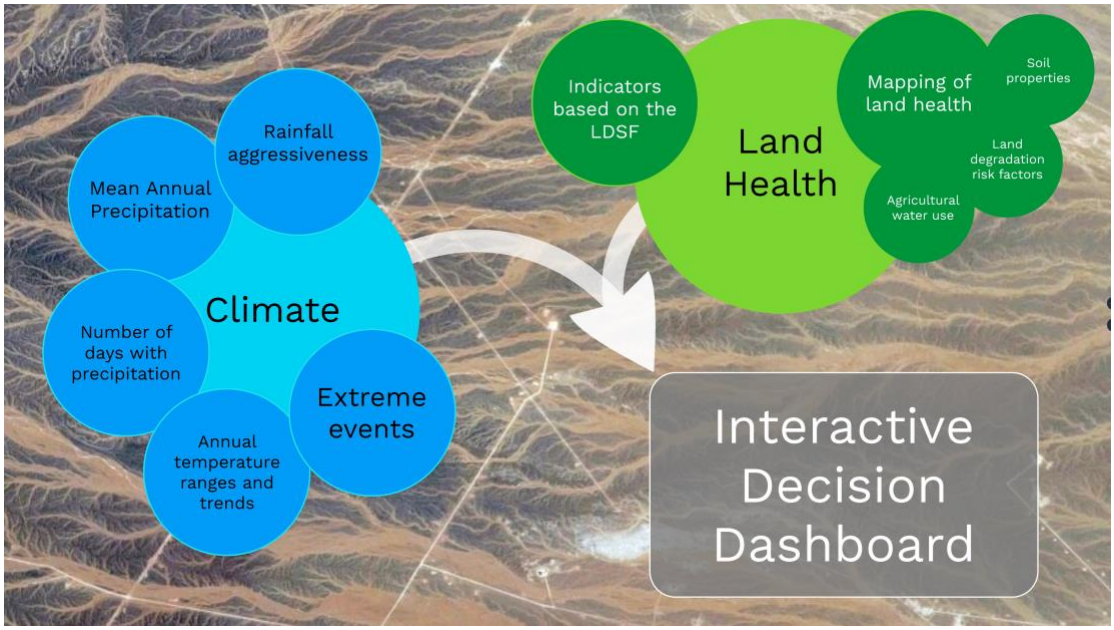
Soil health:

"the continued capacity of soil to function as a vital living system, within ecosystem and land-use boundaries, to sustain biological productivity, promote the quality of air and water environments, and maintain plant, animal, and human health"

Pankhurst et al., 1997

Land Surface Temperatures from MODIS satellite imagery





4. Impact Statement

The information in the table below will be used to communicate results and anticipated impacts of this technical assistance publicly. Please copy information from impact statement developed in the M&E Plan and update as relevant.

Challenge	Agriculture is the most important sector of Sudan's economy and it is crucial for meeting the country's food security. It is the main livelihood source for more than 70 per cent of the population and about 80 percent of the labour force is employed in agriculture and its related activities. In addition, agriculture contributes to about 30-35 per cent to the GDP and generates around 90 per cent of non-oil export earnings. According to Sudan's NAPA (2007), Sudan NDC and its First National Communication to the UNFCCC (2003), agriculture has been identified as one of the three highest priority sectors most vulnerable to climate change. For example, crop production is predicted to decline substantially with adverse impacts on both local incomes and food security. The economic performance of the Sudan, particularly agriculture; depends on weather conditions, especially rainfall the major climatic variable. However, climate change impacts are being experienced in the country, in the last forty years; summer rainfall pattern across the country has been decreasing by 15 to 20 percent, while temperatures have recorded an increasing trend. These climate changes are having a profound impact on the sector and

	thus necessary action needs to be put in place to build the sector resilience to climate change. The Republic of Sudan prioritized development goals, such as poverty alleviation, food security, services, GDP increase and natural resource management in its 25-year strategy. The country has also developed sectoral priorities for adaptation and mitigation in its NDC, TNA and NAP. Among the prioritized strategies is the used of earth observation systems for agricultural monitoring. That is the basis for this technical assistance request. In Sudan, the Barriers to the Transfer and Diffusion of Climate Technologies in Agriculture sector and the overall adaptation technologies is more obvious in Systematic observation and seasonal forecasting, early warning systems, crop insurance, drought-resistant crops, crop management, land management, improved water use and availability, including rainwater harvesting.
CTCN Assistance	This technical assistance targeted to enhance the resilience of the agriculture sector to climate change adverse impacts. It contributed to enhancing the Sudan national agricultural monitoring system through the integration of earth observation and geospatial technology and capacity development. The work included the following main activities. Activity 1. Development of implementation planning and communication documents Activity 2. Identifying and mapping areas that are particularly vulnerable to changes in climate Activity 3. Baseline assessment and mapping of land health Activity 4. Interactive decision dashboard integrating climate variables with soil and land health The activities aimed to identify areas that are particularly vulnerable to changes in climate and/or management is to develop a set of biophysical indicators or proxies for indicators that can be readily measured and monitored over time. The assistance included development of methodologies and user-friendly dashboards that will help in assessment of soil and land health, mapping of climate vulnerable hotspots, biomass predictive models that can be applied in yield prediction and agricultural water use.

Anticipated impact	Enhanced adaption capacity for Sudan particularly in the agriculture sector. Additional climate resilience benefits of improved soil quality, sustainable land management; improved water retention, reduced soil erosion, and inclusion of perennials that are better able to withstand climatic challenges.
Co-benefits: Achieved or anticipated co-benefits from the TA	This TA has contributed to building the country's' resilience to climate change. Enhancing the adaptation capacity of the agriculture sector, which is the largest source of livelihood for the country, helps advance several sustainable development goals. Thus, in the long run this TA is expected to advance the SDGs primarily 1,2, 13, 15 and 17 but also significantly in 3,6,7,8 and10.
Gender aspects of the TA	Women are more vulnerable to climate change than men, therefore any initiative designed to build resilience and mitigate climate change safeguards women. In Africa and Sudan in particular, women are more involved in agricultural activities and depend on the sector for their livelihood. This TA aimed at contributing towards improved productivity and more sustainable agricultural systems in general, thus ensuring advancement of gender equality and other co-benefits to include but not limited to, poverty alleviation, improved nutrition and food security, good health and wellbeing among others
Anticipated contribution to NDC	- GIS and Remote Sensing tools will help and contribute to the climate proofing process, through the availability of geographic and meteorological information and development of vulnerability hotspot maps - Use of Earth Observation and its applications and tools will support the quality of resource management and strengthen vertical and horizontal governmental hierarchical coordination (decision-making) within federal and state ministries - Use of Earth Observation in monitoring climate change variables and their contributions in the agricultural management that strengthen Food Security Monitoring and raise the resilience of the venerable communities especially in

	the traditional rainfed agriculture sector. It will contribute to the stability of crop production through monitoring the trend of agro-meteorological variables within the agricultural season. - Vulnerability assessment of areas vulnerable to climate change will support in identification of priority areas where adaptation contributions could be implemented during the ongoing NDC revision process.
The narrative story	Agriculture is a key sector in Sudan. The sector contributes up to a third of the country GDP which constitutes 80 percent of non-oil exports and is a source of livelihood for about 65 percent of the population. The sector is critical to ensure food security for the growing population which is expected to double by 2050. The economic performance of the Sudan, particularly agriculture; depends on weather conditions, especially rainfall the major climatic variable. However, climate change impacts are being experienced in the country, in the last forty years; summer rainfall pattern across the country has been decreasing by 15 to 20 percent, while temperatures have recorded an increasing trend. These climate changes are having a profound impact on the sector and thus necessary action needs to be put in place to build the sector resilience to climate change. EO-based monitoring systems could play a significant role in improving existing agricultural statistics and crop production assessments. However, Sudan, like other developing countries, is yet to fully take advantage of the EO-based monitoring systems. Referring to the Priorities in agriculture sector as outlined in Sudan NDC, the technical assistance will support technology transfer mechanism for using Earth Observation in monitoring the climate change variables and their contributions in the agricultural management that will led to strengthen the agricultural Monitoring systems and raise the resilience of the venerable communities especially in the traditional rain fed sector. In Sudan, the Barriers to the Transfer and Diffusion of Climate Technologies in Agriculture sector and the overall adaptation technologies is more obvious in Systematic observation and seasonal forecasting, early warning systems,

	crop insurance, drought-resistant crops, crop management, land management, improved water use and availability, including rainwater harvesting.
Contribution to SDGs A complete list of SDGs and their targets is available here: https://sustainabledevelopment.un.org/partnership/register/	SDG 1: End poverty in all its forms everywhere, Agriculture is a key source of livelihood for Sudan. The TA contributed towards ending poverty as most households especially the poor ones are highly depended on Agriculture. SDG 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture. SDG 13: Take urgent action to combat climate change and its impacts (Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries), Climate change is among key factors adversely impacting the agriculture sector in Sudan. This TA aimed to enhance the sectors resilience to climate change.

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 Please note indicators below highlighted as **anticipated**	**Quantitative value** *Numerals only; disaggregates must sum to the total*	**Qualitative description** *List the various elements corresponding to the quantitative value as well as timelines and responsible institutions*
Total number of events organized by proponents and implementing partners	*4*	- Stakeholder workshop to support the co-design of a Sudan decision dashboard, 3-4 November 2020 - Prototype review meeting to review and provide feedback on the prototype of the Sudan dashboard on 15th July 2021 - Training workshop on introducing stakeholders to

		remote sensing data analysis, including how to use GIS software to analyze spatial data and data sharing principles and process between various institutions in Sudan - A Training workshop on building the capacity to access and use the Interactive Sudan Climate Vulnerability Atlas, including an introduction to the R Statistics and RStudio software used analyze the data visualized on the Interactive Sudan Climate Vulnerability Atlas
Number of participants in events organized by proponents and implementing partners	*67*	- *All participants were from Sudan*
a) Number of men		
b) Number of women		
Number of climate technology RD&D related events		
Number of participants in climate technology RD&D events	*List total number here*	
a) Number of men		
b) Number of women		
Number of training organized by proponents and implementing partners	*2*	- Training workshop on introducing stakeholders to remote sensing data analysis, including how to use GIS software to analyze spatial data and data sharing principles and process between various institutions in Sudan - A Training workshop on building the capacity to access and use the Interactive Sudan Climate Vulnerability Atlas, including an introduction to the R Statistics and RStudio software used analyze the data visualized on the Interactive Sudan Climate Vulnerability Atlas
Number of participants in trainings organized by proponents and implementing partners	*33*	
a) Number of men	10	

b) Number of women	23	
Total number of institutions trained	*7*	
a) Governmental (national or subnational)		- Ministry of Agriculture and Forest Service - Higher Council for Environment and Natural Resources - Ministry of Animal Resources - National Centre for Information Services - Remote Sensing Authority - Sudan Meteorological Authority
b) Private sector (bank, corporation, etc.)		
c) Nongovernmental (NGO, University, etc.)	**1**	*University of Khartoum*
Percentage of participants reporting satisfaction with CTCN training (from CTCN training feedback form)		
Percentage of participants reporting increased knowledge, capacity and/or understanding as a result of CTCN training (from CTCN training feedback form)		
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.		
b) Number of tools and technical documents strengthened, revised or developed	**3**	- The Interactive Sudan Climate Vulnerability Atlas (interactive dashboard) - Guidelines for collecting data for the Sudan Decision dashboard (data collection protocol) - The Land Degradation and Surveillance Framework (Data collection and analysis protocol)
c) Number of other information materials strengthened, revised or created (For example training and workshop reports, Power Points, exercise docs etc.)	**5**	- Stakeholder workshop to support co-design of a Sudan decision dashboard (workshop report) - Sudan Decision dashboard (Miro Board) - Sudan Climate Vulnerability Atlas prototype review (meeting report)

		- Report for Training Course in Geoportal Database Building and Dashboard for Better Agricultural Data Management (training report) - Sudan Climate Resilience Training Workshop report
Total number of policies, strategies, plans, laws, agreements or regulations supported by the assistance	*NA*	
a) Adaptation related		
b) Mitigation related		
c) Both adaptation- and mitigation related		
Anticipated number of policies, strategies, plans, laws, agreements or regulations proposed, adopted or implemented as a result of the TA	*NA*	
a) Adaptation related		
b) Mitigation related		
c) Both adaptation- and mitigation related		
Anticipated number of technologies transferred or deployed as a result of CTCN support	*1*	- Geospatial and Earth observation for climate vulnerability assessment and agricultural monitoring
Anticipated number of collaborations facilitated or enabled as a result of technical assistance	*NA*	
a) Number of South-South collaborations		
b) Number of RD&D collaborations		
c) Number of private sector collaborations		
Number of countries with strengthened National System of Innovation as a result of CTCN support		
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 CO_2 equivalent (CO_2e) emissions reduced or avoided as a result of CTCN TA** *Please add your calculations in word or excel format as an Annex to this Closure Report, where applicable.*	
	Anticipated metric tons of CO_2e reduced or avoided as a result of the TA **on annual basis**	Anticipated metric tons of CO_2e reduced or avoided as a result of the TA **in total**
Quantitative value	*Total number (numerals only, no rounding or abbreviations)*	*Total number (numerals only, no rounding or abbreviations)*

(emissions reductions)		
Unit	tCO_2e	tCO_2e
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** *Please provide a **qualitative** description of the anticipated impacts on the categories below*
Infrastructure and built environment Anticipated increased infrastructure resilience (avoided/mitigated climate induced damages and strengthened physical assets)	Improved identification of areas including the surrounding infrastructure that are vulnerable to changes in climate and/or management including areas vulnerable to floods and extreme temperature thus allowing for mitigation measures to be employed.
Ecosystems and biodiversity Anticipated increased ecosystem resilience (areas with increased resistance to climate-induced disturbances and with improved recovery rates)	Increased climate resilience benefits of improved soil quality, sustainable land management; improved water retention, reduced soil erosion, and inclusion of perennials that are better able to withstand climatic challenges.

Economic Anticipated increased economic resilience (e.g. less reliance on vulnerable economic sectors or diversification of livelihood)	Enhanced adaptation capacity particularly in the agriculture sector ensuring that the production systems are resilient against the effects of climate change.
Health and wellbeing Anticipated increased health and wellbeing of target group (e.g. improved basic health, water and food security)	Improved productivity and more sustainable agricultural systems in general will ensure advancement of gender equality and other co-benefits including poverty alleviation, improved nutrition and food security, good health and wellbeing.

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