# Monitoring & Evaluation (M&E) Plan and Impact Statement

# Template

**Objective of the M&E Plan and Impact Statement:**

- The M&E Plan and Impact Statement must be designed based on the Technical Assistance Response Plan and must enable the Implementer to complete the Closure Report at the end of the assistance.

**Process for filling in the template:**

- The Implementer must identify relevant quantitative and qualitative indicators as specified in the Closure Report. A sub-set of indicators to monitor and assess must be chosen among these.
- The Implementer may also identify other specific, measurable, achievable, relevant, and time-bound indicators suitable to monitor Activities, Outputs and anticipated Outcomes from the technical assistance and add to the M&E Plan and Impact Statement.
- During implementation of the TA or FTA, the Implementer must collect all relevant data as described in the Monitoring & Evaluation Plan. Aggregated data on selected indicators as well as an updated version of the Impact Statement will be presented in the Closure Report at the end of the assistance.

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| **Basic Information** | |
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| 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 focal point and organisation | National council for Environment<br>Huyam Ahmed Abdalla Ahmed |

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| | Position: Environmental Inspector |
| Sector(s) addressed | Agriculture, |
| Technologies supported | Geospatial and Earth observation for climate vulnerability assessment and agricultural monitoring |
| Implementation period and total duration | Jan 2020 - August 2021 |
| Total budget for implementation | USD 380,390 |
| Designer of the response plan | World Agroforestry (International Centre for Research in Agroforestry-ICRAF) |
| Implementer of response plan | World Agroforestry (International Centre for Research in Agroforestry-ICRAF) |

| **(A) Outputs and Activities as described in the Response Plan** | **(B) Indicator** | **(C) Expected results** | **(D) Method and frequency for data collection** | **(F) Comments** |
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| Output 1: Add title from the Response Plan | *Select relevant indicators from the Closure Report. You may also define additional relevant indicators to be added.* | *Add the expected quantitative or qualitative target/value of the indicator (e.g. number of studies, policy recommendations, etc.).* | *Describe the expected method and frequency for data collection (e.g. survey, head count at a training workshop, application of a standard methodology etc.)* | *Describe any assumptions made or anticipated challenges for collecting quantitative and qualitative data* |
| **Output 1: Development of implementation planning and communication documents** | Project implementation reporting tools | Response plan (1)<br><br>Detailed work | At the start of project implementation<br><br>Project inception | - |

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| | | plan (1)<br><br>Monitoring and evaluation plan (1)<br><br>CTCN Impact Description. (1)<br><br>CTCN Impact Description Updated post assistance. (1)<br><br>Closure and Data Collection report. (1) | <br><br>Project inception<br><br>Project inception<br><br>Project closure stage<br><br>Project completion | |
| **Output 2: Identifying and mapping areas that are particularly vulnerable to changes in climate.** | | | | |
| **Activity 2.1: Climate data collection**<br>**Activity 2.2: Database design**<br>**Activity 2.3: Spatial datasets and associated analysis** for rainfall/ precipitation and temperature trends, including:<br>a. Number of days with precipitation<br>b. Rainfall aggressiveness<br>c. Mean annual precipitation<br>d. Annual temperature ranges | Total number of tools, technical documents and information material supported by the assistance (excluding mission, progress, and internal reports):<br>a) Number of tools and technical documents strengthened, revised, or developed | Deliverable; One (1) report on climate hotspot mapping and vulnerability assessment. Detailing rainfall timeseries indicating rain days/month; annual rainfall distribution and | Data source; Rainfall dataset obtained from; a) Global Precipitation Mission (GPM) for rainfall data from year 2015 onward with a resolution of 10Km sq. b) TRMM - NASA for rainfall data before 2015 with a resolution of 25km sq. Temperature dataset obtained for MODIS from | Availability of the satellite rainfall and temperature dataset for the 2 selected sites in Sudan (White Nile and North Kordofan regions) |

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| and trends | | intensity as well as temperature timeseries | year 2000 to date. Analysis methodology to include timeseries computation for the above data | |
| | Number of organizations engaged through this CTCN support during the conception and execution of the activity (site selection consultation) | One (1) List of organizational participants engaged. | A documented list of organizational participants engaged | - |
| **Output 3: Baseline assessment and mapping of land health;** | | | | |
| **Activity 3.1:** identification of Set of biophysical indicators or proxies for indicators that can be readily measured and monitored over time based on the Land Degradation Surveillance Framework (LDSF). | Total number of tools, technical documents and information material supported by the assistance (excluding mission, progress and internal reports):<br>a) Number of tools and technical documents strengthened, revised or developed | One (1) report mapping the set of indicators or proxies for indicators that can be readily measured and monitored over time based on the Land Degradation Surveillance Framework (LDSF). | The dataset for this activity was obtained from vast libraries of soil, vegetation and remote sensing data collected by and hosted at World Agroforestry (ICRAF) for assessments and mapping of soil, vegetation, land use and various ecosystem metrics at landscape scale.<br><br>Stakeholder consultation was conducted to identify six states where the activity focused on. These were: North Kordofan, South Kordofan, White Nile, Sennar, Gezira and Blue Nile.<br><br>Rainfall and temperature dataset and analysis was used in execution of | *Data availability and successful stakeholder consultation and consensus on geographical region of focus.* |
| | Number of organizations engaged through this CTCN support during the execution of activity 3.1 to among others build consensus on the scope of this activity including but not limited to site selection. | One (1) List of organizational participants engaged. | | |
| **Activity 3.2:** Development of consistent protocols and analytical | Total number of tools, technical documents and information | One (1) report /guideline document on | | |

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| procedures for assessment of land degradation status and trends | material supported by the assistance (excluding mission, progress and internal reports):<br>a) Number of tools and technical documents strengthened, revised or developed | development of Consistent protocols and analytical procedures for assessment of land degradation status and trends | activity 3.3. to correlate the irregularities/ seasonality trend observed with soil and land health conditions | |
| **Activity 3.3**: Development of Maps for the baseline mapping at fine spatial resolution (30m) conducted for.<br>a. Soil condition (soil carbon, pH and other soil functional properties)<br>b. Land degradation risk factors such as soil erosion and root-depth restrictions<br>c. Cropland phenology and biomass/yields (where data is available to train predictive models)<br>d. Spatial assessment of agricultural water use, particularly in irrigated areas. | Total number of tools, technical documents and information material supported by the assistance (excluding mission, progress and internal reports):<br>a) Number of tools and technical documents strengthened, revised or developed | Maps for the baseline mapping at fine spatial resolution (30m) conducted for the biophysical indicators indicated in activity 3.3 | | |
| **Activity 3.4:** Analysis and maps of vegetation cover dynamics and trends at moderate spatial resolution for 2001 to 2020 | Total number of tools, technical documents and information material supported by the assistance (excluding mission, progress and internal reports):<br>a) Number of tools and technical documents strengthened, revised or developed | Maps of vegetation cover dynamics and trends | Annual vegetation cover data for the period from 2000-2020 was obtained from MODIS at 250m resolution | |
| **Activity 3.5:** Analysis and maps of vegetation cover dynamics and trends at moderate spatial resolution for 2001 to 2020 | | | | |
| **Output 4: Interactive decision dashboard integrating climate variables with soil and land health** | | | | |

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| **Activity 4.1:** Development of a user-friendly decision dashboard where stakeholders can interact with both climate and soil/land health maps and analysis results. | Total number of deliverables produced during the assistance (excluding mission, progress and internal reports)<br>a) Number of other information materials strengthened, revised or created (For example training and workshop reports, Power Points, exercise docs etc.) | A user-friendly decision dashboard for North Kordofan, South Kordofan, White Nile, Sennar, Gezira and Blue Nile states | | |
| | Number of organizations engaged through this CTCN support during the development of dashboards | (1) List of organizational participants engaged. | A documented list of organizational participants engaged | |

*Note: The information in the table below will be used by the CTCN for public communication of the achieved and expected results of the Technical Assistance through the CTCN website www.ctc-n.org and other communication channels. See for example:* https://www.ctc-n.org/sites/www.ctc-n.org/files/benin_a_ag_forestry.final_.pdf

| **Impact Statement** | |
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| 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.<br>The economic performance of the Sudan, particularly agriculture; depends on weather conditions, especially |

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| | 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.<br><br>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.<br><br>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 these 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 TA included the following main activities.<br><br>Activity 1. Development of implementation planning and communication documents<br>Activity 2. Identifying and mapping areas that are particularly vulnerable to changes in climate<br>Activity 3. Baseline assessment and mapping of land health<br>Activity 4. Interactive decision dashboard integrating climate variables with soil and land health<br><br>These activities aimed tot of biophysical indicators or proxies for indicators that can be readily measured and monitored over time. This included development of methodologies and a user-friendly dashboard 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 |

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| | • 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. |
| Achieved or anticipated co-benefits from the TA | Having timely and spatially explicit information on rainfall events is critical for reducing the vulnerability of agricultural systems in the face of climate change, particularly in marginal agricultural areas. Also, being able to predict extreme events is important for mitigation efforts and for disaster risk management. The TA contributed to building the country's resilience to climate change by identifying areas that are particularly vulnerable to changes in climate and/or management using a set of biophysical indicators or proxies for indicators that can be readily measured and monitored over time. Spatial assessments of key indicators, including vegetation cover dynamics, soil organic carbon (SOC) and land degradation processes such as soil erosion were conducted, in addition to precipitation and temperatures. Assessments of soil and land health were built on data and predictive models from the Land Degradation Surveillance Framework (LDSF) and the indicators mapped at high spatial resolution for the six states included in the project (North Kordofan, South Kordofan, White Nile, Sennar, Gezira and Blue Nile). These indicators can be readily combined with climate data and indicators related to socioeconomic aspects of climate change vulnerability. This is a key step in overcoming one of the main limitations of most current assessments of climate change vulnerability, which are often conducted at relatively high levels of aggregation, such as a state or country level. The developed Sudan Climate Vulnerability Atlas also now provides stakeholders in Sudan with a user-friendly way of interacting with the various spatial assessments and maps providing up-to-date evidence that can be applied at various levels of decision making. |
| Achieved or anticipated gender benefits from the TA | Women are more vulnerable to climate change than men, therefore any initiative designed to build resilience and mitigate climate change safeguards women. Agriculture represents the most important sector of Sudan's economy, contributing to about 35% of the country's GDP or nearly 99% of the country's export earnings if we exclude the oil sector. Approximately 80% of the population is employed in agriculture and related activities. However, most of the agriculture is rainfed and is very vulnerable to climate change. 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 by enhancing the capacity of the agriculture sector in Sudan to adapt to Climate change. This in turn ensured advancement of gender equality and other co-benefits including, poverty alleviation, |

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| | improved nutrition and food security, good health, and wellbeing among others. |
| Linkages and contribution to NDC | **Sudan's NDCs** is based on Sudan's strategy to integrate climate mitigation and adaptation into its national sustainable development process to achieve low-carbon and resilience development objectives. NDC pg. 13; mentions Climate-proofing of some of existing developmental project to increase their resilience for current and future climatic changes as one of its intended contributions. GIS and RS are tools that help and contribute to the climate –proofing process, through the availability of geographic and meteorological information.<br><br>**Sudan's NAP** endorsed by Ministerial council aims to integrate climate risks into all national development planning processes and reduce vulnerability to the impacts of climate change, by building adaptive capacity and resilience. Chapter 5 page 47, outlines need for enabling Environments, Technical capacity with new technology such as Earth Observation and its applications and tools will support the quality of resources management and strengthening the vertical and horizontal governmental hierarchies coordination (decision-making) within federal and states ministries, also helps in creating vulnerability hotspot mapping, climate proofing: especial focus needed on development of the national climate scenarios, enhancement of systems observation networks, training in methods and tools for vulnerability hotspot mapping and climate proofing. This can be useful tool for policymakers to prioritize areas in which to invest in adaptation, conduct further research, and/or carry out other efforts to reduce exposure and sensitivity to climate variability and change<br><br>**Technology Needs Assessment (TNA);** mitigation strategies focus on Agricultural and Forestry and Other Land Use (AFOLU) Sector. The strategies aim to address the degradation in soil and declining in agricultural productivity in most of the cultivable lands, Soil erosion, loss of soil fertility, flooding and loss of biodiversity are increasing in both irrigated and rain fed areas. strategies include using of the remote sensing for monitoring land degradation and collecting data by GIS to create geo data base which supports precision farming technique and provide appropriate intervention in specific time with specific appropriate measures to increase agriculture productivity in cultivated land in economic and environmental means. Additionally, space technology and GIS& RS can help in estimating GHGs emissions associated with this sector.<br><br>- For adaptation strategies in the agriculture sector, the TNA, refers to priorities that will support technology transfer mechanism. This includes new technology of using Earth Observation in |

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| | monitoring the climate change variables and their contributions in the agricultural management that will led to strength the Food Security Monitoring and raise the resilience of the venerable communities especially in the traditional rain fed sector. Also, it will contribute in stability of crop production (food) through monitoring the trend of the agro-meteorological variables within the agricultural season. |
| 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.<br><br>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.<br>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. ***This technical assistance will thus aim to contribute to enhancing the technological capacity in adoption of earth observation systems by building the capacity of the local expertise and demonstration of this technology application in the Agriculture sector***. |
| Contribution to SDGs | 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. |

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| | SDG 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.<br>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. |