Republic of Zambia

MINISTRY OF TRANSPORT AND COMMUNICATIONS

ZAMBIA METEOROLOGICAL DEPARTMENT

TERMS OF REFERENCE FOR STRENGTHENING THE CAPACITY OF ZAMBIA METEOROLOGICAL DEPARTMENT (ZMD) IN GENERATION, ANALYSIS AND MODELLING OF CLIMATE INFORMATION, PARTICULARLY ON THE USE OF MODELLING SYSTEM FOR AGRICULTURAL IMPACTS OF CLIMATE CHANGE (MOSAICC)

Activity 1.1 Strengthen generation and interpretation of climate information and data collection to ensure timely and detailed weather, climate, crop and hydrological forecasts are available to support smallholder farmers in planning and management of water resources use in resilient agricultural practices

Sub Activity 1.1.3. Strengthen capacity of ZMD on generation, analysis and modelling of climate information, particularly on the use of Modelling System for Agricultural Impacts of Climate Change for shorter-term planning

A. PROJECT DESCRIPTION

The Strengthening Climate Resilience of Agricultural Livelihoods in Agro-Ecological Regions I and II in Zambia (SCRALA) project, funded by the Green Climate Fund (GCF) through the United Nations Development Programme (UNDP), intends to strengthen the resilience to climate change risks of vulnerable smallholder farmers in the country's Agro-Ecological Regions I and II.

The project will achieve this by taking a value chain approach, addressing risks posed across key stages of the value chain – planning, inputs, production and post-production. The major risk across all stages of the value chain is climate-induced shocks. Therefore, the project will focus on enhancing the understanding of climate risks in these regions and support the generation and provision of quality and consistent weather and climate services, agriculture and water advisories as well as early warning information and will involve strengthening stakeholder collaboration.

Recent developments have seen an increase in the number and availability of free satellite and reanalysis data platforms providing weather and climate datasets which can easily be downloaded. However, the datasets acquired at a

global scale have coarse spatial resolution and are associated with different types of errors and biases. There is need for evaluation, verification and validation by comparing with the long-term station data and apply different statistical approaches in correcting the errors before they are adopted and used at a local scale. Weather and climate global gridded datasets are widely used to compliment the observations from agrometeorological stations.

In this regard, the Zambia Meteorological Department (ZMD) would like to engage a consultant to strengthen the capacity of ZMD, WARMA and MoA Staff on the use of the MOSAICC platform and develop command line based statistical computing handling of very big datasets and aid in generating and dissemination of location specific weather and climate information.

The activity will also aid in improving accuracy and usability of seasonal weather and climate information from Global Climate Models (GCMs). Corrected and verified weather and climate datasets will be used as input in the MOSAICC. This is aimed at improving the quality and accuracy of tailored agricultural advisories and compliment products and services ZMD has been producing for the smallholder farmers.

B. PURPOSE OF THIS CONSULTANCY

The main purpose of this activity is to strengthen the capacity of ZMD, WARMA and MoA staff in generation, analysis and modelling of climate information for Agriculture applications using tools under the MOSAICC platform.

C. SCOPE OF WORK

The Consultant will work under the supervision of the Zambia Meteorological Department (ZMD) in coordination with Ministry of Agriculture (MoA) and the Project Management Unit (PMU), in the production of agro climatic information for smallholder farmers. This will be achieved by undertaking three (3) broad activities with tasks as follow:

1. **DATA PREPARATION**

   Task 1: undertake evaluation of North America Multi Model Ensemble (NMME) Seasonal Forecasting Models and determine their usefulness and performance over Zambia. This will involve testing the statistical performance of the NMME Models against the ground station rainfall and temperature observations. The resulting statistical metrics will be used to improve the forecast and to statistically downscale the NMME forecast to increase the resolution and accuracy. The corrected forecast will form part of the input data in the MOSAICC Platform for further application.

   Task 2: Perform verification of forecast models from ECMWF, UK Met, GFS and WRF. This task will involve verifying international models which are used to generate the daily weather forecast and select those that can be

adopted to be used in forecast generation. The verified forecasts will be part of the input data for analysis in the MOSAICC.

Task 3: Perform verification and validation of Satellite Rainfall Estimates (TAMSAT, RFE, ARC2, CMORPH and CHIRPS) and Climate Reanalysis data from the ECMWF and NOAA/DoE. This will aid in identifying the best Satellite Rainfall Estimate products and climate reanalysis datasets to be used as input in the MOSAICC platform. The corrected and verified satellite rainfall estimates and climate reanalysis datasets will be used as an input in the MOSAICC platform.

Task4: update the crop and soil parameters and coefficients in the MOSAICC platform.

2. **MOSAICC PLATFORM TRAINING**

Task 1: in this task, ZMD, WARMA and MoA staffs will be trained to prepare and upload agriculture, water and meteorological data into the MOSAICC platform. The task will also involve the creation of user accounts for users of the platform.

Task 2: train ZMD, WARMA and MoA staff on the use of the five components of MOSAICC platform which will include Climate, Agriculture, Hydrology, Economic and Forestry. This will include training staff on climate data processing; Crop simulation; Hydrological and Economic modelling.

Task 3: undertake training of ZMD, WARMA and MoA staff to use the modelling tools under the MOSAICC platform including Water Balance (WABAL), AQUACROP, River Basins, Environment and Analysis of Management options (STREAM). Undertake simulations of the impact of climate on Maize and soya bean yield as part of the training. The two crop models are WABAL a crop specific water balance model that simulates soil water balance and AQUACROP, which simulates the crop water response. The training will also include training on hydrological model called STREAM, which aims to stimulate flow accumulation and discharge rate in large catchment areas. The consultant will prepare manuals for undertaking the tasks outlined.

3. **INFORMATION GENERATION**

Task1: develop procedures for estimating crop yield based on the inputs from the NMME seasonal forecast and GCMs. Weather and climate information generated will address climate change adaption concerns

related to the agriculture and water sectors. This will consists of estimating the yields of Maize, Sorghum, Beans, Cotton and Soya beans among others.

Task2: develop yield functions to project future crop yield per province.

Task3: develop procedures for generating information of start of season, length and end, as well as dry spells based on climate conditions and soil parameters.

D. EXPECTED OUTPUT AND DELIVERABLES

The consultant will give reports for each task upon completion of the task at prescribed times. The consultant will submit reports in electronic format for review and comments. The consultant will submit the final reports in electronic and printed versions, which will account for correction, omissions and other issues raised during the review. The expected deliverables will include among others the following:

Deliverable 1: Inception report

This report will outline plans and timelines with milestones. The report will provide a comprehensive roadmap, for this undertaking agreed upon by ZMD. The submission of the report is **1 week** after signing the contract.

Deliverable 2: Report on Data preparation for the MOSAICC Platform

This report will outline the data preparation. It will include all tasks under Data Preparation giving details of how Forecasts, Rainfall estimates and reanalysis datasets were analyzed. The report will include statistical metrics to indicate the performance of each evaluated dataset. This report is expected to be submitted 4 weeks after **Deliverable 1**.

Deliverable 3: Report on training of Staff on generation of Information

This report will have all the training undertaken to build capacity and skills in the ZMD, WARMA and MoA staff to conduct data analysis using the WABAL, AQUACROP and STREAM models under the MOSAICC Platform. The report will also have manuals outlining and guiding how to perform tasks in the MOSAICC and how to generate agro-meteorological information. The report will also include how tasks under generation of information section were conducted. This report is expected to be submitted 4 weeks after **Deliverable 2**.

Deliverable 4: Completion Report

The completion report will combine all the reports submitted taking into accounts corrections, concerns raised, omissions and any other deficiencies brought up by

staff and management of ZMD, WARMA and MoA. This report is expected to be submitted 6 weeks after **Deliverable 3**.

E. INSTITUTIONAL ARRANGEMENT

The Consultant will work under the supervision of the Director of Zambia Meteorological Department (ZMD). They will be directly responsible for, reporting and seeking approval/acceptance of output from the Director of Zambia Meteorological Department. The consultants will provide progress reports as outlined in section **D** above. During the course of implementing the assignment, the Consultants will interact with all stakeholders to understand their expectations.

F. DURATION OF THE WORK

The expected duration of this assignment is four (4) months and shall commence at contract signing or no more than one week. The target date for the start of work is 1 June 2021 and expected completion date is 30 September 2021. The execution of this assignment should take into account the COVID-19 prevention guidelines provided by the Ministry of Health.

G. DUTY STATION

During the contract duration, office space for the consultants will be provided at the Zambia Meteorological Department.

H. QUALIFICATIONS OF THE SUCCESSFUL CONSULTANT

The ideal firm/consultant should have proven experience working with the models /components under the MOSAICC platform. The lead consultant should have excellent technical writing skills and in-depth knowledge and experience in agrometeorological services.

The firm/consultant for this assignment should provide a team of experts with the following minimum qualifications:

Key Experts

1. **Team Leader**

   a) Master's Degree in Agriculture Sciences/ Meteorology/ Hydrology/ Water Resources Management;
   b) A PhD preferred in Agriculture Sciences/ Agro-meteorology will be added advantage;
   c) Demonstrated (at least 7 years') experience in mapping out climate relevant data sources and means of accessing data from various sources.
   d) Strong knowledge of satellite rainfall estimate data, climate reanalysis data.
   e) Experience in working with WABAL, AQUACROP, STREAM and the MOSAICC Platform, technology and innovations.

Additional Competencies Required

a) Proven experience with satellite data, agro-weather datasets, and big data will be an added advantage
b) Experience with Geographical Information Systems (QGIS, ESRI ArcGIS), Climate Data Operators (CDOs), Statistical, and Dynamical Downscaling, Linux, Crop modeling and processing of satellite data will be an added advantage
c) High-level written and oral communications skills in English.
d) Ability to organize and facilitate meetings, calls and documents that may require the input of multiple sources.
e) Proven ability to work both independently and as part of a team.
f) Concise and analytical skills.
g) Proficiency in the use of Microsoft office packages.

2. Agriculture expert (Crops specialist)

a) Bachelor Degree in Agriculture Sciences;
b) Master Degree in Agriculture will be added advantage;
c) Demonstrated (at least 5 years') experience in crop;
d) Knowledge of modelling climate and crop data.
e) Experience in working with WABAL, AQUACROP.

3. Meteorologist expert

a) Bachelor Degree in Meteorology/ Mathematics/ Physics/ Hydrology;
b) A Master Degree in Meteorology will be added advantage;
c) Demonstrated (at least 5 years') experience in weather forecasting, meteorological data analysis;
d) Knowledge of satellite rainfall estimate data, climate reanalysis data.

I. PROPOSAL SUBMISSION

The proposal for this consultancy should comprise of the following:

a) An understanding of the consultancy requirements.
b) Methodology and work-plan for performing the assignment.
c) Project delivery plan.
d) Team composition and tasks assignment.

J. SCOPE OF PRICE PROPOSAL AND SCHEDULE OF PAYMENTS

In this contract, the Lump Sum Amount will be the preferred approach of payment to the successful local consultant. This is because it is representative of IC payments closely linked to deliverables. The contract price will remain fixed

regardless of changes in the cost components. The Client shall base all payments on acceptance of the Deliverables.

The Payment Schedule

Deliverable	Payment (% of Lump Sum Contract Amount)	Timing
Deliverable-1: Inception Report	20%	1 week after contract signing
Deliverable-2: Report on Data preparation for the MOSAICC Platform	20%	4 weeks after Deliverable-1 report
Deliverable-3: Report on training of Staff on generation of Information	20%	4 weeks after Deliverable-2 report
Deliverable-4: Completion Report	40%	6 weeks after Deliverable-3 report

K. CRITERIA FOR SELECTION OF THE BEST OFFER

This section indicates the criteria, which shall serve as the basis for evaluating offers. In this activity, Combined Scoring method will be applied where the qualifications will be weighted a maximum of 70%, and combined with the price offer which will be weighted a max of 30%.

The Proposal for this contract will be evaluated according to the following criteria:

a) Consultant's experience and capacity.
b) Strong familiarity with scope of work.
c) Quality of technical proposal.
d) Methodological approach.
e) Clarity of the proposed Work plan.
f) Realistic financial proposal (implementation budget)

L. APPROVAL

This TOR is approved by: [Edson Nkonde].

Signature
Name and Designation DIRECTOR OF METEOROLOGY
Date of Signing 20/04/2021

REPUBLIC OF ZAMBIA
MINISTRY OF TRANSPORT WORKS
SUPPLY AND COMMUNICATION
28 APR 2021
DIRECTOR
ZAMBIA METEOROLOGICAL DEPARTMENT
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