TERMS OF REFERENCE FOR

THE SUPPLY, INSTALLATION AND FENCING OF STANDARD METEOROLOGICAL RAINFALL GAUGES FOR AGRICULTURE CAMPS

Activity 1.1.1. Strengthen climate information and data collection, including enhancing the observation networks.

Sub-Activity 1.1.1.1. Fabrication/Procurement/Installation of 220 Rainfall Stations (Rain Gauges) and Fencing in all the 16 Districts.

Sub-Activity 1.1.1.3. 220 Rainfall Station Fencing

Title**: Fabrication/Supply and Installation of Standard Meteorological Rainfall Gauges for Agriculture Camps.**

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 providing sector and location tailored weather and climate information and advisories.

Increasing the observation stations for rainfall will strengthen the understanding of climate risks and enhance the provision of localised climate services for smallholder farmers thereby improving productivity, reducing vulnerability, and strengthening food security.

In view of the foregoing, the SCRALA Project will contract a firm/organisation to fabricate 500 standard rain gauges for installation in 500-agriculture camps in 16 project districts.

B. PURPOSE OF THIS ACTIVITY

The purpose of this activity is to fabricate standard rain gauges for installation in 220 agriculture camps. This will involve engaging a company/Organisation through UNDP procurement processes and procedures, to design and fabricate standard rain gauges and accessories.

C. JUSTIFICATION

Rainfall in Zambia is an extremely variable parameter in both space and time. Therefore, more rainfall observing stations are required to characterize rainfall across the country's Agro-Ecological Regions I and II accurately. Rain gauge density is very crucial in order to quantify the rainfall amount over these regions. Additionally, the livelihood and the economy of the people in the country's Agro-Ecological Regions I and II is highly dependent on rain fed agriculture. Further, increased number of rainfall stations in Agro-Ecological Regions II and I will improve the accuracy of generated information such as forecasts, provide good input to crop forecasting models, and water resource management. In this activity, we propose to engage local institutions and organisations with capacity to design and fabricate rain gauges. The reasons for this are as follows:

1. Strengthen capacity of local manufacturing industry to develop and fabricate weather and climate observation instruments.
2. Ensure guaranteed support towards operation and maintenance of meteorological observation infrastructure through increased capacity of local industries to manufacture weather instruments according to WMO standards.
3. Support Zambia's economic recovery plan from reduced economic activity due to Covid, through restoring growth in the manufacturing sector and safeguarding livelihood to build resilience.

D. SCOPE OF WORK

The Works include:

1. Supply of 300 Rainfall Gauges
2. 600 Measuring Cylinders
3. Fencing of each installed Rain Gauge with Diamond Wire Mesh (4m x 4m x 1.8m height) with a gate of 1m on any side.

The area for installation are Mafinga, Chama, Mambwe, Nyimba, Luangwa, Rufunsa, Chongwe, Chirundu, Siavonga, Gwembe, Namwala, Kazungula, Sesheke, Mulobezi, Sioma and Senanga.

E. SPECIFICATIONS OF THE STANDARD RAIN GAUGE (WMO DIN 58666 C)

These specifications have been developed with reference to WMO CIMO Guide 2014 Chapter 6 on **non-recording precipitation gauges** (DIN 58666 C standard) Ordinary gauges.

The rain gauge consists of a **collector** placed above a **funnel** leading into a **container** where the accumulated water is stored between observation times. The stored water collected in a measure or poured from the container into a measuring cylinder. The most important general requirements of a rain gauge are as follows:

a) The **rim** of the **collector** should have a sharp edge and should fall away vertically on the inside, and be steeply bevelled (30° from vertical) on the outside; the design of gauges used for measuring rainfall should be such that any narrowing of the orifice caused by accumulated precipitation about the rim is small;

b) The area of the orifice should be known to the nearest 0.5%, and the construction should be such that this area remains constant while the gauge is in normal use.

c) The collector designed to prevent rain from splashing in and out. This is achieved if the vertical wall is sufficiently deep and the slope of the funnel is sufficiently steep (at least 45%). Suitable arrangements are shown in **Figure 1, Figure** 2**, and Figure 3**.

d) The construction should be such as to minimize wetting errors. This can be done by choosing the proper material and minimizing the total inner surface of the collector.

e) The **container** should have a narrow entrance and sufficiently protected from radiation to minimize the loss of water by evaporation.

1. Components of a Standard Manual Rain Gauge

The standard rain gauge will generally consist of an **upper part with receiving ring**, **lower part**, a **collecting Bottle/Can**, and a **Rain-Measuring Glass**/**Plastic**. Approximate Dimensions/Weight: H450 mm X Ø190, 2.3kg. This is depicted in the figures below.

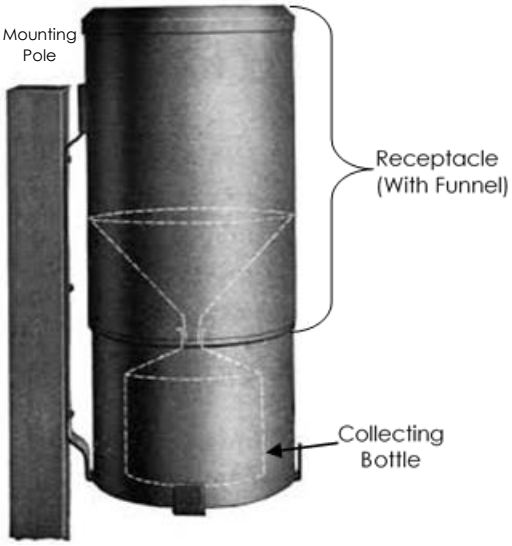

Figure 1: **cross section of the raingauge showing the funnels and the collecting bottle**

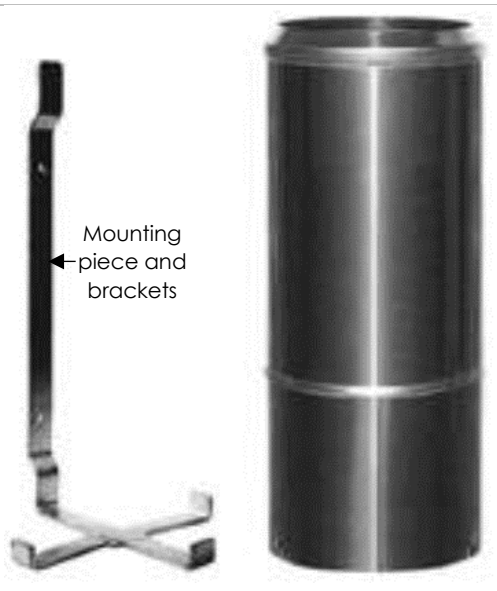

Figure 2: **assmbled rain gauge and the mounting pice**

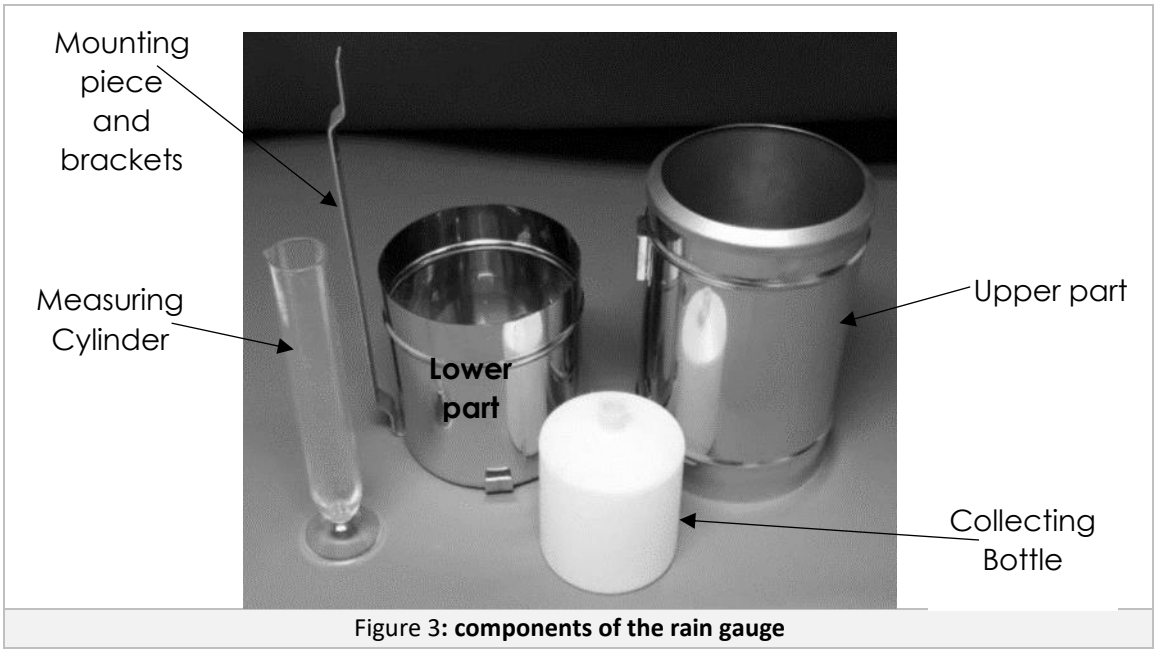

Figure 3**: components of the rain gauge**

a) Upper part

The collecting surface of the stainless-steel collector is 200 cm^2 and is limited by a sharp ring. The collected precipitation passes through a ***funnel*** into a plastic can whose ***narrow opening*** minimizes condensation/ evaporation. The volume measured using the ***corresponding graduated*** measurement vessel.

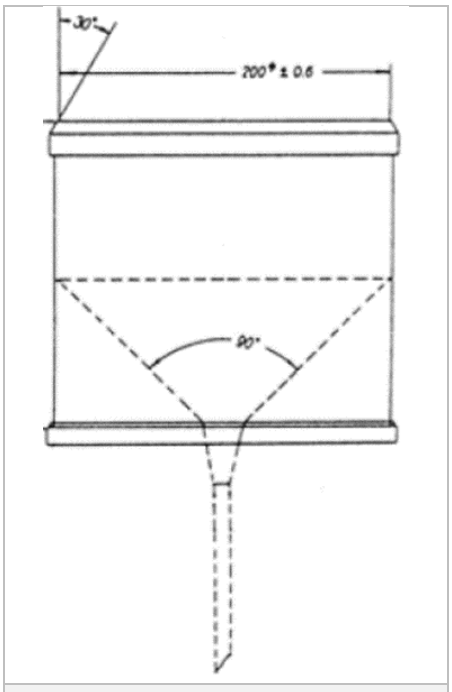

Figure 4: upper part

Technical Details

i. DIN 58666 C (WMO Standard)
ii. Collector Diameter – 200mm with knife- edge
iii. Collecting surface – 200 cm2/WMO
iv. Splash out protection – 50 mm (2")
v. Materials – stainless steel

b) Lower part

The lower part holds the collecting bottle/can in place as well as holding rainfall if the collecting bottle is full.

Technical Details

i. DIN 58666 C (WMO Standard)
ii. Collector Diameter should enable to fit and interface with the upper part to form one shell as in figure 1, figure 2 and figure 3.
iii. Materials – stainless steel

c) Collecting bottle

Technical Details

i. Collecting can capacity: >=60mm
ii. Material: Polystyrol/plastic DIN 58667 (WMO Standard)
iii. Inner bucket: 60mm capacity

d) Measuring Cylinder

Considerations when fabricating the Measuring cylinder:

1. The measuring cylinder should be made of clear glass or plastic which has a suitable coefficient of thermal expansion and should be clearly marked to show the size or type of gauge with which it is to be used.

2. Its diameter should be less than 33% of that of the rim of the gauge, the smaller the relative diameter, the greater the precision of measurement.

3. The graduations should be finely engraved; in general, there should be marks at 0.2 mm intervals and clearly figured lines at each whole millimetre. It is also desirable that the line corresponding to 0.1 mm be marked. The maximum error of the graduations should not exceed ±0.05 mm at or above the 2 mm graduation mark and ±0.02 mm below this mark.

4. To measure small precipitation amounts with adequate precision, the inside diameter of the measuring cylinder should taper off at its base.

5. In all measurements, the bottom of the water meniscus should define the water level, and the cylinder should be kept vertical when reading, to avoid parallax errors. Repetition of the main graduation lines on the back of the measure is also helpful for reducing such errors.

Technical Details

i. Measuring cylinder: 200 cm3 = 10 mm precipitation capacity.
ii. Graduation/Resolution: 0,1 mm/ 0…..10mm
iii. Maximum allowable error: 0.1mm
iv. Material: Polystyrol/plastic DIN 58667 (WMO Standard)

F. ESTIMATED LEVEL OF EFFORT

The level of effort required for these activities is estimated at 3months.

G. INSTITUTIONAL ARRANGEMENT

1. The firm/organisation will work under the supervision of the Director of the Meteorological Department (ZMD). The firm/organisation will be directly responsible for, reporting to, seeking approval and acceptance of output from the Director of the Meteorological Department. The firm/organisation will provide progress reports to ZMD and PMU. During the course of implementation, the firm/organisation will interact with technical staff at ZMD to understand the specifications and WMO requirements.

H. DURATION OF THE WORK

The expected duration of this assignment is three (3) months and shall commence at contract signing or no more than one week. The target date for the start of work is 5th July 2021 and expected completion date is 30th September 2021.

I. QUALIFICATIONS OF THE FIRM/ORGANIZATION

The ideal firm/organisation for this assignment should meet the following minimum requirements:

i. demonstrate capacity to design and fabricate using stainless steel.
ii. demonstrate at least 5 years' experience in metal fabrication.
iii. must be an established and registered company with PACRA.
iv. The **firm** should demonstrate capabilities and a thorough understanding of the work to be carried out as outlined in the Terms of Reference and present a clear methodology for implementing the project and.
v. The **firm/Organization** should provide a Technical proposal that best represents implementation of the activities listed in the TOR with best practice procedure.
vi. The firm/organization should have its engineers/technicians should have valid practicing license from the Engineering Institute of Zambia (EIZ).

J. CRITERIA FOR SELECTION OF THE BEST OFFER

This section indicates the criteria, which shall serve as the basis for evaluating offers.

PRELIMINARY EXAMINATION CRITERIA

Bidders	Description	Obtainable points
Section 1. Bidder's qualification, capacity and experience		**PASS/FAIL**
1.1	Reputation of Organization and Staff Credibility / Reliability / Industry Standing	
1.2	Litigation and Arbitration history	
1.3	General Organizational Capability which is likely to affect implementation - Financial stability -Project Financing Capacity - One firm - age/size of the firm	
1.4	Quality assurance procedures adopted by the firm	
1.5	**Relevance of**	
a	Specialised Knowledge in Meteorological, manufacturing and hydrological related works	
B	Experience in manufacturing	
C	Membership with an appropriate Engineering body	
2.6	**Overall, Mark; PASS/FAIL**	

TECHNICAL EVALUATION CRITERIA (REQUIREMENTS MANDORY, REJECT QUOTATION IF MINIMUM TECHNICAL REQUIREMENTS ARE NOT MET.

Item No	Technical Specifications	Compliance with Technical Specifications YES/NO	Delivery Date (confirm that you comply or indicate your delivery date YES/NO	Quality Certificate YES/NO	Comments
1.	Workmanship				
2.	Easy Operational of Parts				
3.	**Upper Part:**				
	The collecting surface of the Stainless-Steel Collector is 200 square cms (cm2) and is limited by a sharp ring. The collected precipitation passes through a ***funnel*** *into a plastic can whose* ***narrow opening*** *minimizes condensation/evaporation.*				
	DIN 58666 C (WMO Standard)				
	Collector Diameter 200mm with knife-edge				
	Collecting surface-200 square cms (cm2/WMO				
	Splash out protection – 50mm (2")				
	Materials – metallic material that does not rust or corrode with water				
4.	**Lower Part**				
	The lower part holds the collecting bottle/can in place.				
	DIN 58666 C (WMO standard)				
	Collector Diameter should enable to fit and interface with the upper part to form one shell as in figure 1, figure 2 and figure 3.				
	Materials – metallic material that does not rust or corrode with water				
5	**Collecting Bottle**				
	Collecting can capacity :>=60mm				
	Material: Polystyrol/borosilicate/plastic DIN 58667 (WMO Standard)				

	Inner bucket: 60mm capacity				
6.	**Measuring Cylinder**				
	The Measuring Cylinder should be made of clear borosilicate/plastic which has a suitable coefficient of thermal expansion and should be clearly marked to show the size or type of gauge with which it is to be used.				
	Its diameter should be less than 33% of that of the Rim of the gauge; the smaller the relative diameter, the greater the precision of measurement.				
	The graduations should be finely engraved; in general there should be marks at 0.2mm intervals and clearly figured lines at each whole millimetre. It is also desirable that the line corresponding to 0.1mm be marked. The maximum error of the graduations should not exceed $\pm$ 0.05mm at or above the 2mm graduation mark and $\pm$0.02mm below this mark.				
	To measure small precipitation amounts with adequate precision, the inside diameter of the measuring cylinder should taper off at its base.				
	In all measurements, the bottom of the water meniscus should define the water level, and the cylinder should be kept vertical when reading, to avoid parallax errors. Repetition of the main graduation lines on the back of the measure is also helpful for reducing such errors.				
	Measuring Cylinder; 200 cm3 = 10mm precipitation capacity.				
	Graduation/Resolution: 0.1 mm/0…10mm				
	Maximum allowable error: 0.1mm				
	Materials: Polystylrol/borosilicate/plastic DIN 58667 (WMO Standard)				