

# **TERM OF REFERENCES AND TECHNICAL SPECIFICATIONS FOR AWS**

**Procurement under WASCAL Transboundary Observation  
Network expansion**

**Procurement for Supply, Training and After Sales Services  
of Automatic Weather Station (AWS) for West African  
Countries**

**Ouagadougou, Burkina Faso**

**October 2024**

## 1. Introduction

- a. **Background:** WASCAL (West African Science Service Centre on Climate Change and Adapted Land Use) is a research and capacity building institution operating across 12 member countries (Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, The Gambia, Ghana, Guinea, Mali, Niger, Nigeria, Senegal, and Togo), with a mission to combating climate change and improving livelihood in West Africa. It specializes on the provision of climate & environmental services and capacity building needed to address the challenges of climate change for improving the resilience of human and environmental systems in West Africa.

WASCAL has a large Hydro-Meteorological Observation Network across its member countries including 53 Automatic Weather Stations (AWS). These AWS have played a crucial role in supporting climate research, environmental monitoring, and the development of climate adaptation strategies in West Africa. To extend the reach of its climate observation network and ensure better coverage, WASCAL is planning to purchase and install 15 additional AWS across some West African Countries.

- b. **Scope:** This Terms of Reference (ToR) outlines the technical specifications and requirements for the procurement of 15 new Automatic Weather Stations (AWS) for some West African countries. The proposed Automatic Weather Stations (AWS) must meet WMO standards, providing accurate and continuous data on key weather parameters, including Air Temperature, Relative Humidity, Rainfall, Wind Speed, Wind Direction, Solar Radiation, Atmospheric Pressure, Soil Moisture and Soil Temperature as well. The AWS should be designed to function in diverse and challenging environments, particularly in the Sub-Saharan zone, with the ability to store data locally and transmit it in real-time to a central database.
- c. **Objectives:** The goal of this international bid is to select a qualified supplier capable of delivering high-quality, durable, and reliable AWS. This ToR will serve as the guiding document for potential suppliers to submit their proposals, ensuring that all technical and functional requirements are met in alignment with WASCAL's strategic goals and meet with WMO standard for climate data.

## 2. General Characteristics of the equipment

The following requirements shall be considered:

- The individual sensors should be WMO-No. 8 (2008 edition, Updated in 2017) compatible and traceable.
- Wind Speed/Direction sensor to be installed at 10 m height: all other sensors at 2 m above ground.
- Soil moisture and soil temperature sensors at 4 different levels underground (e.g., 5cm, 20cm, 50cm, and 1m).
- Integration of all sensors with the data logger to be ensured by the supplier.
- All sensors will be supplied with complete accessories, i.e., connectors, adequate length cables and mounting fixtures.

- All sensors will be supplied with complete tools and fixtures required for the installation and dismantling.
- All sensors will be guaranteed to perform consistently without need of recalibration or replacement within five years from the date of installation.
- Details of all the mounting arrangements including drawings and design calculations of each item shall be provided, including the safety and security arrangement for the sensors.
- **Durability:** All equipment must be rugged, reliable, and suitable for harsh environmental conditions, with a lifespan of **at least 5 years** without recalibration.

### 3. Details Specifications of equipment and Quantity

#### a. Data Logger

Table 1 shows the technical specifications of Data Logger

**Table 1: Technical specifications of Data Logger**

	<b>Technical Specifications</b>	<b>Quantity</b>
<b>Data Logger</b>	<p>The data logger must:</p> <ul style="list-style-type: none"> <li>- Support 15 meteorological sensors.</li> <li>- Ensure real-time transmission via LoRaWAN and backup via 3G/4G as an option.</li> <li>- Store data locally when offline and transmit it when the network is reestablished.</li> <li>- Be rugged, waterproof, and capable of withstanding harsh outdoor conditions.</li> <li>- Record data every 10 minutes and transmit via LoRaWAN every 60 minutes.</li> <li>- Include a USB interface for direct data access and configuration updates</li> <li>- Ensure that all external connectors are waterproof.</li> </ul>	<b>15</b>
Data Transmission: LoRaWAN and 3G/4G as option	<ul style="list-style-type: none"> <li>- Protocol: LoRaWAN for low-power, long-range communication.</li> <li>- Gateway Setup: Deploy LoRaWAN gateways in strategic locations within West African countries to ensure seamless data transmission, even in remote villages without internet coverage.</li> <li>- Data Frequency: Real-time transmission of data every 1 hour, with the capability for local storage if the gateway is temporarily unavailable.</li> <li>- Network Coverage: LoRaWAN gateways will be positioned to ensure full coverage, with redundancy where possible to avoid data loss.</li> <li>- <b>Backup systems</b> via 3G/4G should be available for redundancy.</li> </ul>	15

	<ul style="list-style-type: none"> <li>- Data Backup: In case of transmission failure, data must be stored locally in the data logger and transmitted once connection to a gateway is restored.</li> <li>- Compatibility: The AWS system and sensors must be fully compatible with LoRaWAN for wireless data transmission to the central server.</li> <li>- Power Efficiency: The transmission system must be optimized for low power consumption to extend the lifespan of solar-powered batteries in remote locations.</li> </ul>	
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**b. Redundant Power supply system**

The power supply should be redundant with 2 batteries including one backup battery, charging regulator and solar panel. Stations must use a battery with a regular charge from the solar panel when the sun shines. The system should be smart enough to provide power shift using the backup battery when the operating one is discharged. Table 2 shows the technical specification of the power system component. Provision of a **smart battery management system** for optimal power distribution is welcome.

**Table 2: Power supply technical specifications**

Component	Technical specifications	Quantity
<b>Solar Panel</b>	<ul style="list-style-type: none"> <li>- Power Output: 50-150 Watts (depending on power consumption of AWS).</li> <li>- Voltage: 12V.</li> <li>- Type: Monocrystalline or Polycrystalline.</li> <li>- Modular design: Replacement of the module should be easy.</li> </ul>	<b>15</b>
<b>2 Batteries (Operating + Backup)</b>	<p>Two batteries (operating and backup) to ensure continuous operation, with smart shifting between batteries:</p> <ul style="list-style-type: none"> <li>- Capacity: Battery should not be discharged more than 80% during cloudy periods or nighttime.</li> <li>- Backup Autonomy: 5-7 days (to ensure operation during cloudy days, poor solar conditions or others).</li> <li>- Type: Deep cycle, Lithium-Ion Battery.</li> </ul>	<b>15</b>

**c. Sensors**

Sensor type	Technical specifications	Quantity
<b>Mast</b>	10 m mast (due to the height of wind sensors installation)	<b>15</b>
<b>Rainfall</b>	<ul style="list-style-type: none"> <li>- Sensor type: tipping bucket rain gauge or any other suitable sensor.</li> <li>- Range: 0 to 300 mm/hr.</li> <li>- Accuracy: 1%</li> <li>- Resolution/sensitivity: 0.1 mm or 0.2 mm.</li> </ul>	<b>15</b>

<b>Air temperature</b>	<ul style="list-style-type: none"> <li>- Sensor Type: resistance type.</li> <li>- Range: -40°C to 60°C.</li> <li>- Accuracy: 0.1 °C or better (with ventilation &amp; radiation shield).</li> <li>- Resolution/sensitivity: 0.01°C.</li> <li>- Response Time: 5 sec or better.</li> <li>- Must be protected by a built-in ventilated radiation shield.</li> </ul>	<b>15</b>
<b>Relative humidity</b>	<ul style="list-style-type: none"> <li>- Sensor type: capacitive/solid-state.</li> <li>- Range: 0 to 100%, non-condensing.</li> <li>- Accuracy: 3% or better.</li> <li>- Resolution/sensitivity: 1%.</li> <li>- Response time: 5 sec. or better.</li> <li>- Must be protected by a built-in ventilated radiation shield.</li> </ul>	<b>15</b>
<b>Atmospheric Pressure</b>	<ul style="list-style-type: none"> <li>- Sensor type: capacitive/solid-state.</li> <li>- Range: 500 to 1100 hPa.</li> <li>- Resolution: 0.05 hPa</li> <li>- Precision: 0.4 hPa 20C.</li> <li>- Working conditions: -40°C to 60°C.</li> <li>- Response time: &lt; 2s</li> </ul>	
<b>Wind speed (at 10m)</b>	<ul style="list-style-type: none"> <li>- Sensor Type: ultrasonic cells/Anemometer.</li> <li>- Range: 0 to 60m/s minimum.</li> <li>- Sustainability: up to 170 m/sec.</li> <li>- Accuracy: 0.5 m/s or better.</li> <li>- Resolution: &lt; 0.01 m/s.</li> <li>- Threshold: 0.5 m/s or less.</li> <li>- Response time: 5 sec. or better.</li> </ul>	<b>13</b>
<b>Wind direction (at 10m)</b>	<ul style="list-style-type: none"> <li>- Sensor Type: ultrasonic/Wind Vane.</li> <li>- Range: 0 to 359 degrees.</li> <li>- Accuracy: 5 degrees or better.</li> <li>- Resolution: 1 deg.</li> <li>- Threshold: 0.5 m/s or better.</li> <li>- Response time: 5 sec. or better.</li> </ul>	<b>13</b>
<b>Global Solar radiation</b>	<ul style="list-style-type: none"> <li>- Range: 0 to 1500 W/m2.</li> <li>- Accuracy: 5% or better.</li> <li>- Resolution: 5 W/m2.</li> <li>- Working conditions: -40°C to 60°C.</li> </ul>	<b>15</b>
<b>Soil moisture (5cm, 20cm, 50cm, 1m)</b>	<ul style="list-style-type: none"> <li>- Sensor type: resistance type or equivalent.</li> <li>- Range: 0 to 100%.</li> <li>- Water Content Accuracy: ±1.5% typical with most soils.</li> <li>- Response time: 5 seconds or better.</li> <li>- Depths: Four (5 cm, 20 cm, 50 cm, 1m).</li> <li>- Working conditions: -40°C to 60°C.</li> </ul>	<b>15 packages (4 sensors per package)</b>

<b>Soil temperature (5cm, 20cm, 50cm, 1m)</b>	<ul style="list-style-type: none"> <li>- Sensor type: resistance type or equivalent.</li> <li>- Range: -40°C to 60°C.</li> <li>- Accuracy: 0.1°C or better.</li> <li>- Resolution: 0.01°C.</li> <li>- Response time: 5 seconds or better.</li> <li>- Depths: Four (5 cm, 20 cm, 50 cm, 1m).</li> </ul>	<b>15 packages (4 sensors per package)</b>
<b>Methane (CH<sub>4</sub>)</b>	<ul style="list-style-type: none"> <li>- Sensor type: Non-Dispersive Infrared (NDIR) CH<sub>4</sub> Sensor</li> <li>- Range: 0 to 10,000 ppm (parts per million)</li> <li>- Accuracy: ±2% of Reading or ±50 ppm</li> <li>- Resolution: 1 ppm</li> <li>- Response time: &lt; 60 seconds</li> <li>- Working conditions: -40°C to 60°C</li> </ul>	<b>2</b>
<b>CO/CO<sub>2</sub></b>	<ul style="list-style-type: none"> <li>- Sensor type: Non-Dispersive Infrared (NDIR) CO<sub>2</sub> Sensor</li> <li>- Range: 0 to 5,000 ppm (parts per million)</li> <li>- Accuracy: ±50 ppm or 3% of reading</li> <li>- Resolution: 1 ppm</li> <li>- Response time: &lt; 60 seconds</li> <li>- Working conditions: -40°C to 60°C</li> </ul>	<b>2</b>
<b>Nitrogen Dioxide (NO/NO<sub>2</sub>)</b>	<ul style="list-style-type: none"> <li>- Sensor type: Electrochemical NO<sub>2</sub> Sensor</li> <li>- Range: 0 to 20 ppm (parts per million)</li> <li>- Accuracy: ±1% to ±5% of reading or ±20 ppb</li> <li>- Resolution: 1 ppb to 10 ppb</li> <li>- Response time: 30 to 60 seconds</li> <li>- Working conditions: -40°C to 60°C</li> </ul>	<b>2</b>
<b>Sulfur Dioxide (SO/SO<sub>2</sub>)</b>	<ul style="list-style-type: none"> <li>- Sensor type: Electrochemical SO<sub>2</sub> Sensor</li> <li>- Range: 0 to 20 ppm (parts per million)</li> <li>- Accuracy: ±2% to ±5% of reading</li> <li>- Resolution: 0.1 ppm</li> <li>- Response time: &lt; 30 seconds</li> <li>- Working conditions: -40°C to 60°C</li> </ul>	<b>2</b>
<b>Lightning conductor system</b>	<ul style="list-style-type: none"> <li>- protection of the AWS from lightning strikes</li> <li>- Direct Lightning Energy to the ground</li> </ul>	<b>15</b>

#### 4. Delivery

The AWS equipment must be delivered to Conakry, Guinea by 15 December 2024, the latest.

#### 5. Capacity building and training

The manufacturer/supplier will host 05 technicians (03 from WASCAL, 02 from national institutions) on its premises for in-depth training over 5 working days. The training must include:

- Installation and setup of AWS and LoRaWAN gateways.
- Operation, maintenance, and data monitoring.
- Remote diagnostics and field calibration of sensors.

Upon successful completion of the training, participants will receive a **Certificate of Completion**, formally recognizing their qualifications in AWS operation, maintenance, and data management. This certification should be issued by the supplier and serve as proof of competence in managing the AWS systems.

## 6. Warranty

A minimum warranty of **2 years** must be provided after the commissioning of the AWS, covering all system components, including the sensors, data logger, and power supply.

**Attention: Please provide your Warranty system in your offer.**

## 7. Contacts at WASCAL

For more information, please contact:

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