



Government of The People's Republic of Bangladesh
Agro-Meteorological Information Systems Development Project
(Component-C of BWCSR)
Department Agricultural Extension
Khamarbari, Farmgate, Dhaka-1215

কৃষি সমৃদ্ধি

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
কৃষি আবহাওয়া তথ্য পদ্ধতি উন্নতকরণ প্রকল্প
কম্পোনেন্ট-সি, বিডারিউসিএসআরপি
কৃষি সম্প্রসারণ অধিদপ্তর
খামারবাড়ি, ফার্মগেট, ঢাকা-১২১৫



Memo No: 12.01.0000.018.01.001.21.6373

Date: 19 December 2021

To
Kumar Margasahayam
Director Asia
Earth Networks Inc.,
12410 Milestone Center Drive
Suite 300, Germantown, Maryland, USA.
Email: KMargasahayam@earthnetworks.com

**Sub: Request to provide Technical and Financial proposal separately on Early Warning System (EWS)
Based on Total Lightning Detection in Bangladesh under package No: AMISDP-SD-011.**

Dear Sir,

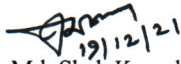
You are aware that lightning in Bangladesh is one of the reckonable disasters having very high kill ratio. As per the lightning climatology, over the past decade, lightning strikes have accounted for more than 100 deaths every year throughout Bangladesh. It is pertinent to mention that the frequency of lightning is expected to on the higher side in this country due changing climate and rising global temperatures and also rise in climatic extremities deforestation, environmental degradation, sudden change in weather conditions leading to cloud burst, thunderstorms, frequent cyclonic storms pollution etc. Thus, at this point of time it is necessary to mitigate lightning hazards in Bangladesh especially in the agricultural sectors.

During the last 3-4 years, Agro-Meteorological Information Systems Development Project (AMISDP), Department of Agricultural Extension, Ministry of Agriculture is rendering creditable services to the farmers in the country by issuing crop and location specific agromet advisories on irrigation, fertiliser and pesticides applications etc along with alert system to the farmers for the extreme events for saving the standing crops through different multi-channel dissemination system including SMS & BAMIS (<http://bamis.gov.bd/>) portal.

AMISDP is now venturing to issue appropriate agromet advisories to the farmers due to lightning in terms of Dos and Don'ts(attached). As Earth Network has enough experience and doing similar services in number of countries and as discussed with you, we would request you to send proposals entitled "Early Warning System based on Total Lightning Detection in Bangladesh" both financial and technical separately to our Project Director (kamlamo@gmail.com) and CC to kazi_obaidullah@yahoo.com and hasan.imam0@gmail.com for favour of kind consideration.

Thanking you in anticipation of your kind cooperation.

With warm regards,



Dr. Md. Shah Kamal Khan
Project Director
Cell no. +8801712184274
Telephone: +88-02-55028422
Email: kamlamo@gmail.com

Attachment:

1. Terms of Reference (ToR)
2. Dos & Don'ts for Thunderstorm and Lightning in Agriculture



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Agro-Meteorological Information Systems Development Project
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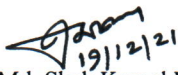
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Terms of Reference (ToR)
For Hiring a Consulting Firm
for

**Early Warning System Based on Total Lightning Detection in Bangladesh,
Package No: AMISDP-SD-011**

Assignment Duration	: 12 Months
Assignment location	: Country-wide
Funding source (s)	: IDA, World Bank
Contracting entity	: Project Director, Agro-Meteorological Information Systems Development Project' (Component-C of "Bangladesh Weather and Climate Services Regional Project"), Department of Agricultural Extension, Khamarbari, Dhaka.
Method	: Direct Selection

GENERAL COMMENTS.

- It is always good to have a multi-parametric measurement which include LDS, satellite and radar observations and information is composited and processed to generate the final information. Hence, such requirement may also be included in the tender.
- Out of total lightning only a small percentage is cloud to ground. It is equally important to capture intra cloud and cloud to cloud lightning with higher efficiency as this information is very critical to enhance the lead time of prediction. As most of it cannot be captured in the frequency range of detection in the range of 1 to 10 MHz. Hence, the same should be 1 to 30 MHz to capture intra-cloud, cloud to cloud discharges.
- As better signal-to-noise ratio requirement calls for improved sensitivity of the sensor to low amplitude lightning-generated signals, the ability to enhance the detection efficiency for cloud to cloud and cloud-to-ground lightning is essential.
- As lightning detection efficiency is very important parameter and there are specific requirements of efficiencies/skill, the validation method for the same must be clearly defined to avoid ambiguity.
- Data base is very critical component. Hence, the aspects related to data management should be strengthened in the tender.

1. Background

It is pertinent to mention that the frequency of lightning is on rise due to rise in climate extremities like global warming, deforestation, environmental degradation, sudden change in weather leading to cloudburst, thunderstorms frequent cyclonic storms, pollution etc. It is estimated that there are more than 2,000 thunderstorms taking place around the world at any given instant. Each year, lightning flashes about 1.4 billion times over Earth. Research based on satellite observations indicate that the highest lightning flashes in the world occur over South Asia (Bangladesh) during the pre-monsoon season (March-May). Hence, concerted efforts are needed in Bangladesh to mitigate lightning hazard.

Lightning and severe weather phenomena which includes heavy rain, hailstorms, gusty winds are on the rise in Bangladesh. This has resulted in increased deaths of humans and livestock. At the same time, its impact on farmers and agriculture has been the most as most deaths to either humans or livestock happens when they are out in the open fields. It has recorded rapid rise in both frequency intensity and so the fatalities to life, livestock and livelihood. Lightning became the biggest killer as compared to other natural disasters. This being a Thermohydro-electrical phenomenon needed scientific approach, focused toward the ultimate safety of community.

Lightning is an extremely common weather phenomenon, with over 100 cloud-to-ground strikes occurring every second around the globe. However, the statistics are even greater when examining total lightning, which is both cloud-to-ground (CG) and in-cloud (IC) strikes. While a common occurrence, lightning poses a deadly threat. Over the past decade, lightning strikes have accounted for more than 100 deaths every year

throughout Bangladesh. Each years' numbers are alarmingly disproportionate to the rest of the world's lightning fatalities.

S.No	Year	No. of Deaths due to Lightning
1.	2011	179
2.	2012	301
3.	2013	285
4.	2014	210
5.	2015	186
6.	2016	245
7.	2017	205
8.	2018	148 Deaths during March, April and May 2018
It is important to mention that a large number of cases go unreported.		

Many deaths are attributed to taking shelter during storms especially by farmers under a tree. Often, victims are caught by surprise with little warning, and no time to seek safety. Due to the changing climate and increase in global temperatures, incidences of severe thunderstorms and lightning activity is forecasted to increase in the future. However, the risks associated with lightning and dangerous thunderstorms can be reduced with the use of lightning detection technology.

Lightning detection technology has been successfully used in various countries including neighboring India successfully to reduce deaths by providing early warnings. The derivative products of lightning are also being used to predict heavy levels of precipitation during convective storm events to warn people of potential flash floods, flooding caused due to heavy rainfall. Additionally, the acquisition of pertinent lightning data with real time processing in a cloud-based system, easily made available through visualization tools results in accurate dissemination of alerts. Further, the historical data that is made available is helpful for agricultural research and operational programs to study trends and recommend governmental policies for mitigation of risks.

An attempt has been undertaken by Agro-Meteorological Information Systems Development Project (AMISDP) under Component C: Bangladesh Weather Climate and Services Regional Project, funded by the World Bank) implemented by DAE. This component of the project will provide improved Agro-Meteorological services to farmers of Bangladesh to sustain and increase agricultural productivity and assist them in coping with weather and climate extremes. The goal is to ensure a science-based severe weather alerting platform based on total lightning detection that will provide the agricultural sector with a decision support information system to mitigate climate-related agricultural production risks.

2. Objectives

- To make Bangladesh a lightning Resilient Country, save lives of farmers and livestock by providing timely early warnings of lightning and dangerous storms to farmers through SMS messages and mobile apps
- Collect Observations of Lightning
- Forecasting and Warning of Lightning
- Propagate Lightning Safety Measures
- Create Community Awareness
- Carry our Research related to Lightning.
- Prepare Lightning Climatology
- Lightning Mapping and Risk atlas, highlights lightning vulnerable zones
- Lightning education, awareness and capacity building of Government officials, community and disaster management professionals
- Provide an easy to use interface at the headquarters to visualize storms as they occur

- Set up Lightning Safe Zones that is install Lightning Early Warning system for public notification system and Lightning safe shelter in highly sensitive zone on priority.
 - Develop low-cost Lightning Protection solutions for farmers, villages and others
 - Policy Advocacy
 - Knowledge sharing
3. **Scope of Service** Combating lightning calls for multipronged action includes carriage of Early Warning (EW) to community in an impact-based forecast on time, create awareness towards EW, lightning safety and protection along with research, simultaneous advocacy for policy and technology intervention through meaningful academia and partnership with others. Hence, the scope is wide and has following aspects.
- Supply, delivery, and installation of lightning detection sensors to meet with performance criteria as established in technical specifications
 - Supply visualization module
 - The supplier will provide the ongoing services required to ensure that reliable and accurate data continues to be generated throughout the contract period, to include regular software updates and refresher training
 - The supplier shall provide 5 days of onsite, formal training sessions to on the technology, systems, services, installation, maintenance, and standard operating procedures of Severe Weather Early Warning System Based on Total Lightning Detection
 - The supplier will sign an SLA and shall ensure the delivery of data and services with 85% or higher availability every month
 - The supplier should provide 24/7 automated technical monitoring and help desk support during business hours over the full contract term
 - Supplier to provide API's and training on API's as well as facilitate the storing of historical data

4. Technical Specifications:

- A. Supplier should as part of this project install additional Lightning Detection Sensors that meet the following Hardware Specifications (Supplier is responsible for installing and maintenance of these sensors at their cost for the duration of the contract)
- a) Lightning Detection Sensor (LDS) Performance Specifications.
- The LDN shall use the Time-Of-Arrival methodology to integrate multiple Lightning Detection Sensors into a single network from the same manufacturer due to compatibility to precisely locate and classify lightning stroke data across the country and subregion.
 - The LDN shall enable the location of lightning strokes, and their classification as either Cloud to Ground (CG), cloud to cloud (CC) or In-Cloud (IC) flashes
 - The LDN shall operate according to the following performance criteria:
 - Ninety percent (95%) Detection Efficiency (DE) rate for Cloud to Ground (CG) lightning over the specified coverage area. Methodologies used to arrive at the DE rate must be described and verified through ground truth case studies supplied in the bidder's response.
 - Seventy percent (80%) Detection Efficiency rate for In-Cloud (IC) lightning over the specified coverage area. Methodologies used to arrive at the DE rate must be described and verified through comparative case studies supplied by the supplier/bidder.
 - ? percent (?%) Detection Efficiency rate for Cloud-Cloud (CC) lightning over the specified coverage area. Methodologies used to arrive at the DE rate must be described and verified through comparative case studies supplied by the supplier/bidder.
 -
 - Location Accuracy of CG, CC and IC Flashes shall be an average of 400 meters or better. Methodologies used to arrive at the Location must be described and verified through ground truth case studies supplied by the supplier/bidder.

- Apart from the network performance criteria (above) there shall be no fewer than 4 Lightning Detection Sensors (LDS) included in network configuration.
 - The supplier must have sensors operating in the surrounding countries to extend the effective range of the LDN for inbound storm tracking purposes.
 - The bidder shall provide maps demonstrating the expected CG, CC and IC Detection Efficiency and Location Accuracy performance.
- b) Lightning Detection Sensor (LDS)
- The frequency range of detection should be 1 to 30 MHz to capture intra-cloud, cloud to cloud and cloud to ground discharges.
 - The LDS method of lightning detection must be described in detail in the supplier's response document.
 - LDS electronics shall be housed in environmentally sealed enclosures.
 - LDS shall operate using standard internet (IP) communications and electric power.
 - LDS shall require no regularly scheduled maintenance.
 - LDS shall enable remote functions like calibration, software updates and/or testing without mandatory site visits.
 - LDS shall have digital and/or analog noise filtering at sensor site.
 - LDS shall have detection range 700km or greater.
 - Sensors shall enable total lightning detection by broad frequency range of detection so that IC lightning can be captured from far away.
 - Timing accuracy shall be +/- 40nsec to GPS/UTC.
 - There should be no sensor-dead/re-arm time so as to avoid lost data
 - LDS shall be capable of recording and sending the full waveform of the electrical or magnetic field pulse so that mobile telecom towers can be used effectively.

B. Lightning Detection Network Data Management System (LDN DMS)

a. Functional Characteristics

- i. The LDN DMS shall collect, validate, locate, classify, process, store and redistribute all lightning data received from the LDN.
- ii. Performance shall be continuously monitored and/or controlled by the LDS DMS and accessible via its internet-based software interfaces.
- iii. The LDN DMS shall have a defined and documented API that makes data available in real-time for ingest into Real-time Weather Data Display or other GIS display systems, databases or applications including SMS, IVR, and Smartphone Apps.

b. Basic Lightning Data

- i. The LDN DMS shall record the following data characterizing the observed lightning activity:
 - Pulse or Flash time in Coordinated Universal Time (UTC)
 - Location
 - Latitude in decimal degrees
 - Longitude in decimal degrees
 - Polarity
 - Signal strength
 - Type: Cloud to Ground (CG), cloud to cloud or In-Cloud (IC)
 - Height of IC in km

- ii. Total time from when lightning occurs to when that flash is reported must be 1 minute or less for 99% of all flashes.
 - iii. Accuracy of the reported time of lightning strikes shall be one (1) second or better.
 - iv. No more than 1% of reported lightning flashes can be considered false alarms.
- c. Severe Weather Warnings Based on Total Lightning
- i. The LDN DMS shall use the collected lightning data to identify and track the initiation and development of convective storm cells and to automatically generate real-time severe weather warnings.
 - ii. The LDN DMS shall automatically cluster lightning data into storm cells with defined boundaries at no longer than 1-minute intervals and no less than 1-minute latency.
 - iii. The storm cells shall record perimeter boundaries, center, size, speed and direction of travel, as well as IC and CG flash and stroke rates every minute.
 - iv. The LDN DMS shall have the capacity to issue no less than three different levels (colors) of weather warnings: mild, moderate and severe.
 - v. A Severe Weather Warning shall be issued by the LDN DMS once a storm cell's flash rate characteristics have exceeded thresholds indicating an imminent severe weather threat.
 - vi. The Severe Weather Warning shall be in two forms: a polygon indicating the speed and direction of the threat and its probable location and duration and a corresponding text alert bulletin in CAP (Common Alert Protocol) format.
 - vii. The Severe Weather Warnings shall be automated and provide advanced warning on the potential for severe weather such as frequent lightning, hail, heavy rainfall, wind gusts and other types of severe weather.
 - viii. The Severe Weather Warnings shall be updated at regular intervals until the dangerous weather activity is no longer a threat and the warning expires.
 - ix. The Severe Weather Warnings shall be made available via a documented API and be fully accessible to Real-time Weather Data Display or other GIS display systems, databases or applications including SMS, IVR, and Smartphone Apps.
- b. Convective Rainfall Intensity Estimates
- i. The LDN DMS shall use CG, CC and IC lightning data to create thunderstorm rainfall estimate imagery simulating composite radar reflectivity in standard dbZ units.
 - ii. This simulated radar product shall be based on correlating the supplier's LDN data with actual weather radar reflectivity data in other geographic areas.
 - iii. The data shall provide the basis for real-time thunderstorm rainfall intensity estimates.
 - iv. The simulated radar product shall be made available via a documented API and be fully accessible to the Real-time Weather Data Display or other GIS display systems, databases or applications including SMS, IVR, and Smartphone Apps
- C. Real-Time Weather Data Display System (RWDDS)
- a. Functional Characteristics
- i. RWDDS shall be an internet browser-based visualization tool that enables the display of information generated by the LDN.
 - ii. RWDDS shall visualize convective storm activity and severe weather warnings
 - iii. RWDDS shall enable individual user profiles to create custom views and alerts for specific geographic areas and/or data types that are displayed and delivered for their personalized log in.
 - iv. RWDDS content shall be accessible from PC's, laptops or smartphones using standard web browser technology and the internet.
 - v. RWDDS shall incorporate Geographic Information System (GIS) principles that aid visualization of weather data layers with facility to add custom layers.

- vi. RWDDS shall enable remote collaboration through real-time sharing of on-screen user activity between parties at different locations.
- vii. Automated notification functionality
 - The RWDDS shall provide a tool that enables each individual user to define specific weather alerts based on the presence of severe weather in a specific area.
 - The Weather Alerts shall provide instant notifications to the user
 - Notification channels shall include visual, audible and email
- b. The RWDDS shall provide users with ability to visualize data in appropriate formats:
 - i. Real-time Mesoscale Weather Conditions
 - All CG and IC lightning data parameters from LN DMS shall be displayed for every lightning stroke or flash identified by the LDN with latency no greater than 1 minute.
 - Storm Cells shall be displayed for every storm identified by the LDN DMS with latency no greater than 1 minute.
 - Storm Tracks shall be displayed for every storm identified by the LDN DMS until that storm has diminished.
 - Severe Weather Warnings shall be displayed for every Storm Cell determined by the LDN DMS to require an alert.
 - Convective Rainfall Estimates shall be displayed in visual form for all convective rainfall activity as determined by the LDN DMS.
- D. Data Services Configuration and Architecture
 - a. Primary data management, processing and storage functions of the LDN DMS shall be performed by supplier's cloud computing infrastructure.
 - b. Specialized data management and display portals and API services shall transfer data from cloud computing to the database server and applications including SMS, IVR, and Smartphone Apps, such as
 - c. Lightning observations and derivative content from LDN DMS
 - d. Access to user portals must be provided through standard web browser-based software to Operations and Research personnel, field stations and other users and/or network management teams via authenticated username/password controls.

5. Data Formats/System Overview

The Severe Weather Early Warning System (SWEWS) shall observe high impact phenomena, such as, convective storm development, intensification and movement and provide storm warnings and rainfall/precipitation intensity estimates. These observations should be based on data from lightning sensors installed in country and also in neighboring regions/counties. A total of 8 or 10 sensors should contribute to this data. The SWEWS will enable early warnings of severe weather to be issued by DAE to farmers and other clients. The SWEWS shall be based on data that is obtained from ground-based Lightning Detection Sensor (LDS) of the supplier. The SWEWS will locate both cloud-to-ground and in-cloud lightning flashes with high efficiency. The SWEWS will transmit data in real-time to Lightning Detection Network Data Management.

- 1. National Severe Weather Early Warning System (SWEWS) – Data from the combined network of minimum of 8 *lightning detection sensors* (LDS) installed in the country and also neighboring countries/region will be collected and integrated at the onsite data logger to locate cloud-to-ground and in-cloud lightning flashes so that DAE could better observe, predict and provide early

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warnings about high impact short term weather, especially convective storm development and movement, heavy rainfall and other dangerous conditions.

2. Data Management delivered by supplier's cloud computing through a perpetual license for the lifecycle of the project defined as a minimum 2-year period:
3. Real-time Weather Data Display System (RWDDS). An internet browser-based weather data and forecast visualization tool that will display information from the above and other sources and will be equipped with automated notifications for customization and real-time usage by DAE.

A number of established formats and protocols will be available for the exchange of data to end users. Large amounts of data are typically required for processing, analysis and dissemination etc. It is extremely important that data will be in a format that is both easily accessible and user-friendly. This is particularly pertinent as more and more data will become available in electronic format.

6. Technical Approach and Methodology

The firm should explain/describe its understanding of the objectives of the assignment, approach to the services, methodology for carrying out the activities and obtaining the expected output, outcomes and the degree of detail of such outcome. The firm should highlight the problems being addressed and its importance and explain the technical approach that would adopt to tackle them. The firm should also explain the methodologies that it proposes or adopts and highlight the compatibility of those methodologies with the proposed approach.

7. Deliverable

- a. Lightning Detection Sensors in country
- b. Installation, maintenance and support of LDS
- c. Visualization Platform
- d. API data feeds
- e. FTP Data Feed
- f. Data base management
- g. Training
- h. User Manuals
- i.

8. Duration of Services and Reporting

Total project duration will be 12 months Study period will be considered 24 months. The tentative reporting schedule for the consultant's assignment is given below:

Milestone	Planned Time
Provide forecast of lightning	Within 1 months of contract signing
Training and User manuals	Within 3 Months of contract signing
Maintenance and support	Ongoing over 12 months
Provisioning of Visualization platform, API feeds, FTP data feed	Within one week of signing of contract

9. Selection Method:

The consultant shall be selected following Direct Selection based selection method set forth in Guidelines: Selection and Employment of Consultants under IBRD Loans and IDA Credits & Grants by World Bank Borrowers, January 2011 (Revised July 2014) on the basis of consultant's qualification, experiences and capability to carry out the assignment.



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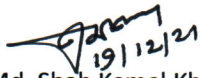
Dos & Don'ts for Thunderstorm and Lightning in Agriculture

Dos

- If farmers are in the field and can't find any shelter, avoid the tallest object in the area. If only isolated trees are nearby, best protection is to crouch in the open.
- Immediately get out of and away from ponds, lakes, and other bodies of water. If working in an outdoor watery area (e.g. paddy transplantation), immediately move out of the field to a dry area (at least to the field border).
- Keep animals away from open water, pond or river.
- Keep animals away from tractors and other metal farm equipment.
- Ideally, find a shelter in a low-lying area and make sure that the spot chosen is not likely to flood
- Move out of forested area (especially Pine forests) towards clear ground. There is possibility of start of forest fires due to lightning strike

Don'ts

- Avoid contact with electrical equipment or cords.
- Keep away contact with anything metal - tractors, farm equipment and bicycles. As metal or other surfaces that conduct electricity.
- Don't allow your animals to congregate under trees. Watch your animals closely and try to keep them under your direct control.
- Don't take shelter under trees and particularly under isolated tree, as these conduct electricity.


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