Across Sub-Sahelian Africa, daily atmospheric activity provides sustenance for the success of agriculture and daily life, but also poses serious risks to farm productivity, citizen health, and economic stability. Unexpected rain and temperature changes can result in spoiled food drying, fertilizer run-off, disrupted travel, and malarial shock. Consequently, daily planning is heavily dependent on access to accurate weather forecasts. With the goal of supporting underserved farmers, FarmersFirst: Africa (FFA) will provide timely, relevant, and actionable meteorological data to improve their livelihood.

While the academic canon of African hydrometeorology runs deep, applications addressing real-time needs are lacking. Few countries in Central Africa have access to weather bulletins. Forecasts that are available are riddled with inaccuracies (previous tests have yielded accuracy rates as low as 35%). The nature of convective systems across Central Africa is such that numerous forecast models lack the geospatial resolution to capture storm activity – and therefore accurately predict rainfall. **FFA aims to produce an *actionable* next-day rain forecast to help smallholder farmers effectively plan and prepare their agricultural and economic activities to build a sustainable future.**

The advent of big data technologies enables an entirely automated, algorithmic method for producing weather forecasts. In partnership with Weather Analytics, FFA will develop essential weather forecasts in our pilot country, Central African Republic (CAR). More specifically, we are **building an artificial intelligence next-day rain forecast to drive better decision-making and results on and off the farm.**

Working with local partners, we will deploy a network of sixty rain-gauges operated by farmers that will provide ground truth data in order to train an artificial neural network (ANN) to blend the output of the different forecast models to improve accuracy. Sixty rain-gauges will be deployed in 20 villages across CAR, increasing the number of daily rainfall measuring sites in the country from 3 to 63. Additionally, we will use the rain-gauge network to calibrate satellite observed data across the region, which will allow us to train the network even in areas where the rain-gauges are not deployed. The goal of this work will be to **produce a next day rain forecast with a >75% accuracy to be distributed via shortwave radio that can reach farmers in their native language, Sango, as well as French.**

PILOT

Our pilot has four stages as part of an improving feedback loop:
1) Establish the rain-gauge network program with agricultural partners, 2) build the multi-model machine-learning ensemble forecast, 3) broadcast forecasts out to constituents, and finally 4) test its impact. Forecasts will be measured against the rain-gauge data, which in turn will help improve the accuracy of the model, leading to an update in the broadcasts.

OPPORTUNITY TO SUCCEED

Our success is tied equally to utilizing our partnerships to establish and manage a reliable rain-gauge network and the effectiveness of our science team's ability to continually refine, quality control, and test the outputs of the forecast model.
On the former, we are currently working with a shortwave radio station in Boali, CAR, to broadcast geographically limited weather forecasts. At the same time, we are allied with several farmer co-ops

and ag-focused NGOs as well as the Ministry of Agriculture; all of whom are committed to support distributed Internet and Communication Technology (ICT) applications.

The novelty and success of our program is achieved by bringing the '*three legs of the stool*' together - **ground truth data** that increases accuracy and involves our constituents on a daily basis, **state-of-the-industry data science** that uses the highest resolution satellite data possible for previously unattainable output, and a **medium to broadcast** and distribute this information to ensure its usefulness, intelligibility, and ultimately, long-term adoption.

Weather Analytics has unique expertise in applying machine-learning techniques to meteorological data to produce more accurate results than traditional weather forecasting methods can achieve. For this pilot, we will leverage state-of-the-science global forecast models from the European Centre for Medium Range Weather Forecasts (ECMWF) and the U.S.'s National Oceanic and Atmospheric Administration (NOAA), which will yield a high spatial resolution in our forecasts (up to 9km). We expect the ECMWF and NOAA weather models to have particular skill in certain regions, at certain times of year, and for certain atmospheric conditions. However, due to the paucity of ground station data in Central Africa, the relative strengths and weaknesses of these models have never been fully characterized in the sub-Sahelian region of Africa. This pilot will be the first of its kind here.

COSTS

Much of the data and technology has already been developed in the private sector and is hosted by Weather Analytics on Amazon Web Services; as a result, the primary cost to operate this program involves set-up, in-country operations, hardware procurement, and incentive programs for farmers.

• 3 Trips to CAR (cost based on previous travels)	$36,000
• 60 Rain-Gauges at $50 each (shipment included)	$3,000
• Training Seminars / In-Country Operations	$40,000
• Data collection incentives program (max $1USD/gauge/day)	$21,900
Total:	$100,900

TIMELINE

Q4: 2017: Finalize collaboration with partners, procure rain-gauges.
Q1: 2018: Deliver gauges. Begin installation and training. Begin testing and prepare broadcasts.
Q2: Forecasts built and delivered, broadcasts run daily.
Q3: Site visits/review, field surveys, data review/validation.

NOVEL DATA, MODEL OUTPUTS, and NEXT STEPS

Three main outputs from our pilot include: Daily rainfall data for 20 communities for 6 months, bias-corrected next-day rain forecasts, and forecast accuracy metrics. Learn, adjust, expand, and repeat.

Following a successful trial, we intend to Install additional rain gauges, target more demographics with rainfall forecasts, utilize government agencies and University of Bangui to promote meteorological literacy/educated (e.g. ways to incorporate weather into daily planning, agronomy).