Microsoft

AI for Earth Grantee Profile

SunCulture

Bringing precision agriculture to Africa with AI

Summary

Africa offers the best potential to meet the increasing needs of food production for the world's growing population, but the great majority of its farmers are smallholders lacking the resources to meet that demand. SunCulture was founded to help those farmers, initially by improving their productivity through solar-powered irrigation. But the company realized the farmers needed better guidance to use more efficient precision agriculture methods, and that required gathering more information on the needs of their specific farm. By working with Microsoft, first with its Airband Initiative and now with AI for Earth, SunCulture has been building an Internet of Things solution using local sensors and cloud-based machine learning models to produce detailed recommendations for farm management based on weather predictions, soil conditions, and pest levels. With access to irrigation, financing, and reliable, real-time recommendations on how best to manage their farms, the farmers can improve their lives and be better positioned to help feed the world.

Improving the livelihood of African farmers with AI

In 2009, the Food and Agriculture Organization (FAO) of the United Nations hosted a "High-Level Expert Forum on How to Feed the World in 2050", examining the issues as the world's population was projected (at that time) to grow to 9.1 billion by 2050. Meeting that growth will require an increase in food production (not including crops for biofuels) by 70 percent. Africa has great potential to help fulfill that need, as it has 60 percent of the world's uncultivated arable land, according to a 2010 McKinsey Global Institute report, and although its population is rapidly urbanizing, over 60 percent of its labor force is involved in agriculture. However, one of the challenges Africa would need to overcome is the plight of its smallholder farmers.

As much as 80 percent of the farming in Africa is done by smallholders with less than two hectares of land—an estimated 33 million such farms. And almost all these farms rely on a combination of direct rainfall and gathering water from nearby shallow wells (which may still be as deep as 200 feet), a process requiring up to a few hours a day manually filling and moving large heavy buckets of water. These water sources are subject not only to the normal vagaries of weather but also to the increasing effects of climate change upon weather patterns. The uncertainty and increasing unreliability of rainfall makes farming a risky business in terms of actual production, which translates into unpredictable income. As a result, banks and insurance companies are reluctant to extend credit to smallholder farmers, leaving US $450 billion every year in demand for agricultural

finance. The inability of financial institutions to meet this demand means that farmers are unable to invest in infrastructure such as irrigation systems that could improve their productivity, reduce uncertainty and risk, and help them rise out of poverty.

Helping smallholder farmers improve their lives

"What we said is if we can figure out how to improve and protect the productivity of smallholder farmers, we can lift an entire group of people out of poverty, while creating a really meaningful business," says Samir Ibrahim, explaining the origins of SunCulture, where he is co-founder and CEO. Started as part of a business plan competition, SunCulture develops and commercializes life-changing irrigation and farming technology aimed at the world's millions of smallholder farmers. The company looked first at the economic water scarcity in sub-Saharan Africa—the continent has good groundwater supplies, but most farmers lack the irrigation infrastructure to access it and the financial resources to acquire that infrastructure. In other words, water is physically available, it's just not affordable.

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To meet that need, SunCulture began by developing solar-powered pump and irrigation systems that would enable more efficient watering of crops with the flip of a switch. Beyond freeing the farmers from hours of hauling water, irrigation enables them to increase yields, grow higher-value cash crops, grow during dry seasons, and raise more livestock. Merely building devices wouldn't be sufficient, though; SunCulture also offers installation, training, and support services, as well as long-term financing that allows the farmers to pay for the products and services while still increasing their income from the improved productivity. But the company saw that something more was needed, a vital yet intangible resource: information.

Enabling precision agriculture with sensors and AI

"We realized that technology wasn't enough, either," explains Ibrahim. "They're missing out on what could be a better harvest, because there's a lack of information. And if we had that information, we could provide real-time recommendations." As a company with expertise in hardware, SunCulture could develop sensors to collect local data on soil composition, moisture, pest levels, and other factors that could help guide farmers toward more responsive farming practices. Such sensors would need to be paired with a machine learning solution as

part of a cloud-based platform that could deliver the recommendations to the farmers, so SunCulture needed a partner with expertise in software. They turned to Microsoft.

At that time, in 2015, Microsoft had started its FarmBeats project to investigate ways to bring technology and data together to help farmers meet the challenge of increasing the world's food supply by 2050, and its Airband Initiative, which works to make affordable broadband access a reality for unserved communities around the world. Airband partners with equipment makers, internet and energy access providers, and local entrepreneurs to connect the unconnected and extend broadband internet access globally. SunCulture's proposed project fit right into these programs. With funding and collaboration from the Airband team, SunCulture developed the data analysis and recommendation platform using Microsoft Azure cloud computing services. Rolling out a pilot project in Kenya, SunCulture worked with internet provider Mawingu Networks, another Microsoft Airband partner, to connect its sensors to the cloud. This system enabled the farmers to use precision agriculture tools and practices, for example watering the crops just the right amount for the current moisture conditions, rather than indiscriminately and either not using enough or letting some water go to waste. The improved efficiency would lead to higher yields and better-quality crops.

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Although the pilot project in Kenya had immediate benefits for the participating farmers, it also revealed perhaps the most crucial missing piece for reducing the risks of farming: accurate, local weather forecasting. "Weather is the single most contributing factor to all agricultural risk," says Ibrahim. "If you know the weather, you can start predicting pests, you know when to irrigate, insurance companies can make disbursements, et cetera." However, weather forecasting in Africa is very limited due to a lack of weather stations—only one-eighth the density recommended by the World Meteorological Organization—and few trained meteorologists to interpret the data and make the forecasts, as well. As a result, what weather information the farmers could receive is much too broad, good for major severe weather events such as typhoons but not useful for their very localized daily needs, such as expected rainfall. SunCulture recognized its sensors-and-AI approach could be extended to fill this gap, too, but the company would need to build new weather prediction models, and for that it would need to expand its team—starting with Fabio Sato.

Modeling the weather with machine learning

Fabio Sato is a weather data scientist from Brazil, who had been working for a while on building neural networks (machine learning algorithms) to predict the weather based off publicly available real-time weather

station data and the Weather Research and Forecasting (WRF) model. With some of the Airband grant, SunCulture hired Sato to continue this development and create a robust prediction model that could work at a square-kilometer resolution—refined enough to be practical for the smallholder farms, which are generally around a hectare or two in size. (One square kilometer is equal to 100 hectares.) Drawing upon historical data from another Microsoft partner, aWhere, Sato ran simulations with the prediction model, compared its predictions to observed weather data from existing stations in Kenya, and used the calculated differences in data to correct the bias and further improve the model. Through this process, SunCulture reached a point of predicting the weather twice as accurately as the Kenyan government—but bringing the model to production would require further training, and a larger team to do that training. Here again SunCulture turned to Microsoft, this time for a grant from AI for Earth.

"The reason why we reached out to AI for Earth is that we realized for us to be able to do this in a big way, we have to have good weather recommendations," explains Ibrahim. Through the AI for Earth grant, SunCulture is expanding its neural network development team and continuing to work with AI and machine learning resources on Azure. Scaling up these efforts will allow the company to attain the all-important accuracy in weather prediction that will help improve the farmers' productivity and yields, and justify their faith in adopting the precision agriculture methods.

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Although SunCulture has been using third-party weather data sources for training its models, the goal is to transition to its own sensors to gather rainfall measurements in real time, essentially building its own network of weather stations. The company has already begun a pilot of the new system, deploying sensors to some farms in Kenya and delivering the weather-based irrigation recommendations in Swahili to farmers on their phones. In time, SunCulture could have the largest network of weather stations in Africa, and the most accurate weather prediction models as well—an unintended consequence of its original goal, simply to help this underserved group of people improve their lives.

Bringing farmers into the information age

With weather as the last piece of the puzzle, SunCulture will be able to offer smallholder farmers a complete package of precision agriculture recommendations. Having access to the tools that they need to make data-driven decisions about how to irrigate, fertilize, and manage pests means that farmers will produce more and earn more. It also massively decreases the risk and uncertainty associated with smallholder farming. As part of

its pilot, SunCulture is using the data from its sensors and machine-learning weather models to assess whether farmers qualify for e-commerce loans to purchase a variety of household and agricultural products. The same data that provides hyperlocal advisory recommendations to farmers also allows SunCulture to understand farm business key performance indicators and make the underwriting process much safer.

As Samir Ibrahim says, "We believe in the power of data to transform smallholder farming into a profitable and reliable livelihood, and whether that's through increasing productivity, decreasing risk, or unlocking access to finance, we'll work with our customers every step of the way to get there."

About SunCulture

SunCulture's vision is to build a world where people take control of their environment in rewarding, sustainable ways. The company does this by developing and commercializing life-changing irrigation and farming technology that solves the biggest daily challenges for the world's 570 million smallholder farming households.

Resources

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Websites

SunCulture home site

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