



A green thumbs up for Agrolly

Helping smallholder farmers adapt
to climate change

by Karen Boush
10-minute read

I magine you are a household farmer in eastern rural Mongolia, where like many other families you grow fruit trees and vegetables, including barley, potatoes, lentils and beans.

Climate conditions for small-scale agriculture are traditionally tough in your region. Spring is chilly and windy, summer hot and dry, and winter extremely cold. If you plan ahead carefully and work hard, you can harvest enough food to help keep your family fed and then sell any remaining produce at local marketplaces.

Passionate about farming, you know your land and how to tend it properly to ensure productive crop yields. You rely on generational knowledge and adapt to seasonal weather conditions. However, the climate crisis is testing you and your community like never before. Temperatures and rainfall are becoming more extreme and unpredictable, and pest outbreaks and crop diseases harder to control. Your annual crop yields have declined.

You own an older model mobile phone and can connect on social media with other local farmers to discuss crop successes and failures, but you simply don't have time when planting and harvesting. What's more, you can't find any long-term weather forecasts for your farm, anywhere, in your language. That makes it difficult to demonstrate to financial institutions that you can manage your crops effectively over time. Even though the Mongolian government has set aside green funds to help farmers buy tools, seeds and fertilizer, banks can't help you obtain loans without first knowing your credit risk.

Your situation is not unique. Farmers everywhere, particularly in emerging countries where subsistence farming and cash crops are critical to survival, face similar challenges resulting from climate shifts.

A globally dispersed team of four developed a minimum viable project (MVP) in

25

days

Farmers can access crop-risk analyses by location and growth stage for

50+

crops

Once launched, global and localized apps quickly attracted

> 1,600

active users

“We just knew that we wanted to help other people. That was our dream.”



Manoela Morais, Cofounder and Chief Executive Officer, Agrolly

Dreaming big

The 2020 [Call for Code](#) Global Challenge winning solution was developed for this reason. Short for “agricultural ally,” the Agrolly farming assistance app can help anyone who grows food take a more agile, data-driven approach to their work. Powered by open-source software on IBM technologies, the app provides short- and long-term weather forecasts, crop risk management insights, and an online environment for knowledge sharing and networking.

The team that built the app started out with one simple objective: to help others.

“We didn’t know exactly what to build and what challenges we would face. Call for Code is a competition with more than 400,000 participants, so we were scared,” says Manoela Morais, Cofounder and Chief Executive Officer of Agrolly. “We just knew that we wanted to help other people. That was our dream.”

Having met as students at Pace University in New York City, the four Agrolly cofounders came from different parts of



the world. Morais was from Brazil; Ajinkya Datar, Chief Technology Officer, was from India; Chimegsaikhan [Chimka] Munkhbayar, Chief Operating Officer, was from Mongolia; and Helen Tsai, Chief Information Officer, was from Taiwan.

Inspired by the 2020 Call for Code competition’s theme of climate change, the



team brainstormed a potential solution. Munkhbayar, who grew up helping her grandmother farm a small plot of land in the Sukhbaatar province of eastern Mongolia, talked about how farmers in the area struggled. The rest of the group shared similar scenarios from their home countries.

In India, for instance, agriculture is the primary source of livelihood for about 58% of the population, including Datalkar's relatives. "In the Latur region in Maharashtra and other parts of India, farmers face droughts every few years, and the government is delivering water on trains. Many farmers end up committing suicide," he says.

Known as the "Kingdom of Fruit," Taiwan experienced its worst drought in more than half a century in 2020. In addition, seasonal rains are arriving earlier and later than usual, disrupting the flowering of trees.

In Brazil, small-scale farmers often can't depend on farming insights handed down through their families quite like they used to, or even on last year's personal experiences.

Learn more about the
[Call for Code Global Challenge.](#)

Divide and conquer

The Agrolly team quickly found its calling, deciding to build an app for farmers in their and other countries. Then, the team members drew on their individual expertise to help make the project a success.

Munkhbayar, who earned an MBA in entrepreneurship at PACE on a Fulbright scholarship, took the helm on strategic business development. Using social media, she connected with several farmers and other agricultural experts in eastern Mongolia so that the team could gain a deeper understanding of their needs.

The team learned that the farmers had access to only short-term regional weather forecasts, and then only in document and PDF formats on scientific websites. The farmers needed yearly forecasts and multiyear trends specific to their farms. They also required easy-to-read weather data they could quickly download on their mobile devices, such as while in the field.

These and other insights helped guide the Agrolly team as it outlined the app's core functions and technical requirements,



including the ability to support older mobile phones, diverse languages and image uploads.

Next, the team got to work building the app. Datalkar, who had just completed graduate work in computer science and software development, designed the solution architecture and wrote the code.



“We were working 24x7. At one point, I was coding so much we made two major updates in one day,” he explains.

Morais, who is a chemical engineer with experience in agriculture risk management, handled the data analysis and project management. She helped the team adapt agile methodologies to fast-track their work.

“We had a list of priorities, and every day we met to assign tasks. Every one of us was responsible for one task, and if someone encountered a problem, we were all there to help him or her progress. Very tight planning helped make this project happen,” she says.

Datalkar agrees. “It was agile methodologies on an ultra-scale,” he says. “If I encountered a problem, such as with the design, I would just start calling the team and sending them screenshots, saying, ‘Take a look and tell me what you think.’”

Tsai has a background in business finance and is earning a graduate degree in computer science. She helped ensure the app presented information in a visually intuitive way so that users could quickly get the insights they needed to make educated decisions.

An MVP in 25 days

Working steadily, the team took advantage of IBM resources made available for Call for Code participants, including an [IBM Cloud](#) account credit, [IBM Watson](#) and other starter kits, a dedicated Call for Code Slack workspace monitored by mentors, and a technical content library.

“The IBM online product documentation is well done,” says Datalkar. “We saved a lot of time by using it. Also, mentors were always available on Slack to answer our questions.”

They developed and launched their MVP in 25 days. “It was intense, because Manuela, Chimka and I graduated on May 16. Then, on May 28 we all began working on the solution and had the MVP ready on June 26. It immediately went into the [Google Play app store] marketplace, where anyone in the world can download it for free,” says Datalkar.

They achieved their goal despite working during COVID-19 lockdowns and across vast distances. At the project’s start, all four team members were still in New York City, but shortly afterward Tsai traveled home to Taiwan and Munkhbayar visited Mongolia.



Flexibility was key, says Tsai. She recounts how sometimes she forgot about the time differences and texted the others when they normally would have been sleeping.

“It was two or three in the morning for them, and they would still respond and be supportive. I was like, ‘Oh, sorry, you’re still awake?’ There was no sleeping the whole month,” she laughs.

How the app works



Finding an affordable way to deliver long-term weather data proved more challenging. The team talked to agronomists and data scientists and extensively researched relevant data sets. They ultimately decided to write their own algorithm and pull five-year historical data from the NASA Global Precipitation Measurement database to predict long-term forecasts.

The second module enables smallholder farmers to perform automated risk assessments, representing a first-time industry innovation. It combines Agrolly's long-term weather forecasts with crop water requirements published by the Food and Agriculture Organization (FAO) of the United Nations, which are based on location, type of crop and stage of growth. Using the Agrolly crop-risk model, it then delivers insights to help farmers determine what to plant and when to plant it. Farmers can also use the results to help qualify for loans and credit from local financial institutions.

The Agrolly app can deliver the insights smallholder farmers need to effectively plan crop production and minimize risks caused by unpredictable climate conditions.

First, the weather module provides a range of forecasts for the user's village and province. The app displays hourly and weekly forecasts by connecting to technologies from [The Weather Company](#)®.

“When a farmer accesses our app and selects a crop type, the planting date will begin and the location. The app then calculates all the location-specific risks related to climate, such as temperature and water needs, for that specific crop over the plantation period,” says Morais. “With this information, the farmer can make better

crop decisions, such as selecting the best crop type according to the risk factors, or plan ahead for the necessary resources to deal with these risks—and with that obtain better productivity.”

The third module is an online forum where farmers can easily interact with others to learn what they are planting and share agricultural tips, either by texting or uploading images. This capability is highly valued in places such as Mongolia, where young household farmers starting out can learn from experienced elders. The team also anticipates launching an Ask an Expert module, which farmers can use to directly consult with agricultural extension specialists and access materials on best practices.

Initially, the team didn't have access to server or cloud infrastructure to run and store statistical regressions for its algorithms. After further research, Datalark found that the team could build the solution using the [IBM Cloud Kubernetes Service](#) platform and run regressions with the [IBM Watson Studio](#) model automation solution. It could then store the results on the [IBM Cloud Object](#)



[Storage](#) platform before caching them on the Agrolly server. The Agrolly app also employs the [IBM Watson Assistant](#) solution, which help users locate app tools and manage their to-do lists. The team will also use it to build the Ask an Expert function.

From concept to company



The team's hard work paid off. Announced in October, the [2020 Call for Code Global Challenge grand prize](#) went to the Agrolly solution. As the winner, the Agrolly team received a USD 200,000 grant; tools to test and build out the platform; and ongoing

support from IBM Service Corps, other technical experts and the Linux® Foundation.

Since then, the Agrolly team has formed its own business and is blossoming. "Winning the competition was a major transformation for Agrolly, because it gave us a real chance to form a business," explains Morais. "We did it with help from IBM, who has provided many people to coach and support us. Also, publicity around the prize is helping make us more relatable in the industry."

Eventually, in collaboration with the Linux Foundation, Agrolly will enable people around the world to help improve the app. "I'm building an interface and functions through which developers and others can make contributions," says Tsai. "Even farmers will be able to share things like their crop knowledge and what challenges they face."

The team learned from early user feedback that agricultural advancements, key crops and weather conditions vary across geographies, requiring the global app to be localized for Mongolia, Brazil and India.

Tsai is also taking the lead on working with IBM to build a web-based interface for use in Taiwan. Expected to launch by early 2022, the new interface will enable Agrolly to test the effectiveness of web-based over mobile solution delivery.

Having tested localized apps in Mongolia, Brazil and India, the team is launching each country's respective app, which can be downloaded for free on app marketplaces. Despite growing use of smartphones in emerging Asian countries, the Agrolly solution is the first farming app available in Mongolia. To encourage app adoption by local farmers in the eastern provinces, Munkhbayar works with regional agricultural specialists to provide group and in-house training sessions, conduct field research and respond to user feedback.

In Brazil, Morais is establishing relationships with universities and government agencies willing to help roll out the app in their regions. These organizations can more easily identify and address barriers to adoption among farmers in their communities, including poor digital literacy skills and internet access.

Furthermore, the Agrolly team continually tests and improves the long-term weather forecasting model. Datalark is also moving the solution to a new architecture built entirely



on IBM Cloud, which will allow Agrolly to affordably scale the app based on usage.

Other planned enhancements will allow financial institutions to calculate farmers' credit scores and facilitate loan approvals. Farmers will also be able to use the app to move paper-based records to the app, such as for crop production and sales and for pest management.

Increasing food security



Farmers using the app can currently run crop-risk analyses by location and growth stage for more than 50 crops, and Agrolly continues to add information on more crops. More than 1,600 people have downloaded the apps to date, including 500 people using the global app, 1,000 people using the app localized for Mongolia and 100 people using the app localized for India.

The farmers report that with longer-term weather forecasts and reliable risk

assessments, they can make more informed decisions about field irrigation and other aspects of resource utilization. They can also more easily collaborate with banks to secure loans.

In addition, farmers appreciate that they can consult with agronomists and study new crops and agricultural practices, including by viewing photographs, while in their fields. Some farmers also anticipate using the app's forum to

mobilize into agricultural cooperatives, which can compete more effectively in marketplaces.

While locally relevant, the app can have larger impacts, too. Productive yields enable farmers to not only better care for their families but also contribute to national economic growth and food security. At a global level, helping small-scale farmers deal with climate change is crucial to driving several UN Sustainable Development Goals, including climate action, no poverty and zero hunger.

“We want to make agriculture more sustainable, so farmers can use their country's water, soil and other natural resources more effectively,” explains Munkhbayar.

Honored to win the competition, the team continues to work hard toward helping farmers take greater control of their own destinies. “What I appreciate most is farmers' gratitude, when you come through with valuable insights on how to help improve their future and proactively reduce their risks,” says Morais.

Winning advice

The four Agrolly cofounders share additional insights for people interested in participating in the Call for Code competition.

**Manoela Morais***Chief Executive Officer, Agrolly*

Identify and talk with potential end users and listen carefully to their needs. “If you can pinpoint the real problem, developing the solution might not be as difficult as you think,” says Morais. After that, plan well, implement features one at a time, then test and improve—again and again.

**Chimegsaikhan [Chimka] Munkhbayar**
Chief Operating Officer, Agrolly

Take time to assemble a team of people from different backgrounds and disciplines so that you can capitalize on each other’s strengths. Also, be sure that everyone has the same end goal in mind and is willing to put the time in to understand the core problems. “It’s most important that you’re all moving in the same direction and understand what you want to accomplish,” Munkhbayar says.

**Ajinkya Datalkar***Chief Technology Officer, Agrolly*

Think about how you can apply your unique talents to help solve real-world problems. When Datalkar was growing up, his father taught him how televisions, radios and other electronics worked, inspiring him to study computers, networks and software development. “When I met the other team members and we started talking about farming,” he recalls, “I thought, ‘Why not put my skills to use?’ I always knew that farmers in India faced major issues that somewhere down the line had to be addressed.”

**Helen Tsai***Chief Information Officer, Agrolly*

Find people whom you trust and know will work hard to do the best job possible. Also, be willing to learn new things to help out. Even though Tsai came from a business background, she found herself jumping into coding. “For me, it was like ‘Just do it,’” she explains. “Do whatever you can to help.”



About Agrolly

Based in New York City, [Agrolly](#) (external link) provides a farming assistance app that offers farmers worldwide insight into weather, water and soil conditions required for productive crop yields. Agrolly aims to fill in the information gap so that farmers with fewer resources available to them can make more educated decisions, obtain the necessary financing and improve their economic outcome.

Solution components

- IBM Cloud® Kubernetes Service
- IBM Watson® Assistant
- IBM Watson Studio
- The Weather Company®

About Call for Code

The [Call for Code](#) initiative offers developers, data scientists and problem solvers the opportunity to build and contribute to sustainable, open-source technology projects that address social and humanitarian issues. Founded by IBM with Creator David Clark Cause, Call for Code seeks to help deploy solutions that can make a demonstrable difference in communities with greatest need.

About The Weather Company

[The Weather Company](#), an IBM Business, delivers more than 25 billion personalized and actionable forecasts globally each day to millions of consumers and thousands of marketers and businesses. It accomplishes this through The Weather Company's API, its business solutions division, and digital products from [The Weather Channel](#) (external link) and [Weather Underground](#) (external link). Its products include the world's most downloaded weather app, a network of 250,000 personal weather stations, a top-20 US website, one of the world's largest Internet of Things (IoT) data platforms, and industry-leading business solutions.

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