Farmers transformed how we investigate climate

To make my research more useful for people deciding how to plant crops and prevent flood damage, I asked for their help, says **Carolina Vera**.

People living in the Matanza River basin in eastern Argentina know where to expect floods. When they pooled their collective experience to make a flood-risk map, the result was essentially the same as what we scientists would make with hydrology and watershed measurements. With scientists and locals working together, we matched up past floods with the rainfall that produced them and pinned down how a small amount of precipitation can have a huge effect. Now we frame our research in that region around the potential for impact, alongside scientifically common measures (such as extreme precipitation).

Too often, we scientists assume that knowledge transfer begins with basic research, which then inspires an application that we expect others to use automatically. Experience has taught me how limited this linear model can be. Co-production — working with those who will actually use the outcomes of my climate research — can be circuitous and unpredictable, but ultimately is more worthwhile.

Over the past two decades, my research and that of my colleagues has helped to build a better picture of the climate of southern South America. Our models now account for the South American monsoon and other mechanisms associated with ocean–atmosphere–land interactions, such as how moisture moves from the tropical Atlantic Ocean to the Amazon basin and farther south.

Initially, we built tools to predict climate weeks or months in advance and set up a website to make that information freely available. We thought it could be valuable for decisions around generating hydroelectric energy, planning for floods, and scheduling plantings and harvests. We did plenty of outreach and encouraged feedback and questions. But few outside academia actually used this information. Why was it so hard to make our climate knowledge more useful?

In 2009, I was selected as a lead author on a report of the Intergovernmental Panel on Climate Change about how communities can manage the risks associated with extreme weather. That gave me the opportunity to work with social scientists, and I realized that making climate science useful also takes social, cultural, economic and even political knowledge. More than that, I needed a dialogue with those who might use or benefit from my research, and to work with them as equals.

In 2016, farmers, anthropologists and climate scientists embarked on a collaboration to develop climate information that would be useful for smallholders who raise cattle and grow vegetables, maize (corn) and potatoes. We had grasped by then that it is not enough to go to the countryside and start to talk. You have to get to know each other and build trust. Our work builds on two years of fieldwork carried out by anthropologists in the Bermejo region of Chaco province in northeastern Argentina. The doctoral students lived among farmers who must frequently contend with heavy rainfall, hail, frost, strong winds and floods with few resources for recovery.

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Our project merged concepts from three domains: climate science (climatic variability, uncertainty, monitoring, normality and predictions); anthropology (perception, confidentiality and participation); and the knowledge that farming communities have earned through experience (direct observation, the occurrence of certain meteorological events in a certain combination and rainfall thresholds that are relevant for production).

We were able to identify phenomena that are not considered extreme by statistical metrics but that have a high impact on the people who live with them. Our collaborators told us about an unusual sequence of more than 15 cloudy days in 2016 that caused winter production of peppers and tomatoes to fall greatly.

We also spotted surprise opportunities. We co-designed a network to monitor rainfall and learn how its spatial distribution determines floods and droughts. Students attending local schools have installed rain gauges on their family farms. They record the data on paper and then upload them at school to an online repository.

I have come to appreciate just how vulnerable communities are. In October 2017, we celebrated the first installations of our rain-observation network. The next month, we lost part of that work when a severe storm blew the roof off the school. Students had to attend classes in a fire station instead. But a year on, we have more rain gauges than before. We are also co-producing a smartphone app with local people (see go.nature.com/2nozw6k). They use it to see how temperature and precipitation have evolved in the region, along with predictions for the next days and weeks.

I must confess that I have often felt frustrated with the co-production process. The flexibility that enabled the rain-monitoring network and app also makes planning firm schedules and deliverables tough. Dialogue between academic scientists and those who provide weather forecasting or assist agricultural management can be slow, complex and difficult. And it has been hard for me to grasp that others struggle to accept the inherently chaotic nature of the climate, and the impossibility of predicting it precisely.

This experience has changed me as a scientist and as a person. Before, I was a climate researcher strongly motivated to contribute to society, but with hazy notions of how to do so. Now I am part of a process that truly benefits real people as they go about their daily lives. ■

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