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ACLÍMATE COLOMBIA

Open Data to Improve Agricultural Resiliency

By Andrew Young and Stefaan Verhulst

JULY 2017









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- * "Special thanks to Akash Kapur who provided crucial editorial support for this case study, and to the peer reviewers [odimpact. org/about] who provided input on a pre-published draft."
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SUMMARY

In Colombia, as in many other countries, the effects of climate change are increasingly evident. One sector that has been particularly hard hit is agriculture. In this sector, unanticipated weather shifts and extended drought periods have created major challenges for the country's farms, perhaps especially for small, independently owned farms. The Aclímate Colombia project is a cross-sector partnership led by the International Center for Tropical Agriculture (CIAT), a civil society organization, with private-sector industry groups and government actors. The platform (available at aclimatecolombia.org) leverages a diversity of data sources, including many open government datasets, to help farmers understand how to better navigate shifting weather patterns. Although still relatively young, Aclímate Colombia has already had a tangible impact and received widespread recognition. It is a powerful example of how data-sharing across sectors—along with the use of sector-relevant intermediaries—can take high-level data science insights and translate them into concrete, actionable information, in the process helping farmers increase their livelihoods.



CONTEXT AND BACKGROUND

PROBLEM FOCUS / COUNTRY CONTEXT

Agriculture is a very important sector in Colombia and in the tropics in general. As Ruben G. Echeverría, Director General of the International Center for Tropical Agriculture (CIAT) put it: "Parts of the humid tropics have the potential to become future breadbaskets for the world. They are where some 70 percent of the world's poor people now live, and they contain most of the world's biodiversity."¹ Colombia, in particular, holds tremendous possibilities as a provider of crops such as coffee, bananas and rice.

However, in order for countries like Colombia to achieve their potential, they must be able to adapt to the effects of climate change. As traditional growing processes are thrown into upheaval as a result of new weather patterns, global warming presents many challenges to the food-growing potential of Colombia. It represents a particularly serious challenge for small farmers, who constitute a large proportion of the crop growers in the country. As Echeverría notes: "Climate change poses a serious threat for these smallholder farmers, who already face significant challenges from poor soils, volatile rainfall patterns, lack of knowledge on best cultivation practices, and lack of investment in new technologies that can help them."²

1 CIAT Communicaciones, "A Powerful Voice for Climate-smart Agriculture in the Tropics," December 6, 2014, CIAT, https://ciat.cgiar.org/news-2-2/a-powerful-voice-for-climate-smart-agriculture-in-the-tropics. The example of rice is illustrative. Rice is of particular importance to the agriculture sector in Colombia, representing the primary source of income for small farms and a staple food for much of the population, in particular lower-in-come communities.³ The country's agriculture sector produced around 1.7 million tons of pad-dy rice in 2014 – around 65 percent of which was produced by lowland irrigated rice and 35 percent rainfed rice.⁴ Recent years, however, have been hard for the country's rice sector. A

decade of increases in irrigated rice yields was wiped out between 2007 and 2012 when yields dropped from 6 to 5 tons per hectare.⁵ Though explanations vary, climate change is seen as the likely cause of the decrease. As the global research partnership, Consultative Group on International Agricultural Research (CGIAR) puts it, "subtle shifts in rainfall as well as more extreme weather are forcing rice growers to toss aside old assumptions about when, where and what to plant."⁶

OPEN DATA IN COLOMBIA

In some ways, the state of open data in Colombia is quite encouraging. For example, in the 2015 Open Data Index, an assessment of data availability across a number of sectors put together by Open Knowledge International, the country ranked number four, up from 12 in 2014. This ranking is probably a reflection of the general openness of data relating to national statistics, procurement tenders, location datasets, and election results. However, despite the country's good performance on such measurements, our research and interviews with key players suggest several remaining shortcomings. While these shortcomings exist in many (perhaps most) countries that have experimented with open data, they are nonetheless important to understand for assessing the overall open data ecosystem.

One notable problem stems from the fact that Colombia's open data supply is fragmented, with little clarity on where and how to access the most useful datasets. As of August 2016, the government's official open data portal, Datos Abiertos Colombia (datos.gov.co), houses around 2,460 datasets and 70 visualizations. An additional data portal, Ciudatos (ciudatos.com), was established by the Corona Foundation in 2015, in collaboration with other civil society actors and funders across the region. The portal contains city-focused public datasets and data drawn from perception surveys conducted by Red Colombiana de Ciudades Cómo Vamos — "the network of city-level networks in Colombia dedicated to improving urban life."⁷

³ Elizabeth Stuart, Emma Samman, William Avis and Tom Berliner, *The Data Revolution: Finding the Missing Millions, Research Report 03*, Development Progress, 2015, https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9604.pdf

⁴ S. Delerce, et al., "Assessing Weather-Yield Relationships in Rice at Local Scale Using Data Mining Approaches," *PLoS ONE,* August 25, 2016, http://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0161620.

⁵ CTIAR and CCAFS, "Big Data for Climate-smart Agriculture," *Change for the Better: The CCAFS 2015 Annual Report*, https://ccafs.cgiar.org/bigdata#.V6jLT5ODGko.

⁶ Ibid.

⁷ Social Progress Imperative, "Contributing to Novel Open Data Platform in Columbia," March 27, 2016, http://www.socialprogressimperative.org/contributing-to-novel-open-data-platform-in-colombia/.

The existence of these two portals, while signs of a strong open data movement, also leads to a certain fragmentation. For example, users may be unsure where to search for data, and may have trouble combining information stored at the two locations for further analysis. Further complicating matters is the World Bank's Climate Change Knowledge Portal, which also hosts a number of Colombian open datasets, mostly on temperature and rainfall.⁸

Colombia originally expressed interest in joining the Open Government Partnership (OGP) in 2011.9 Many of its OGP commitments-and, perhaps as a result, much of the country's government innovation and data work more generally—is focused on fighting corruption. This points to a further weakness in the open data space-for all its availability, data has had relatively little impact on issues like economic development or catalyzing entrepreneurship and business.¹⁰ Overall, the lack of incentives for users in the business community to access and use open data has resulted in minimal demand for open data.¹¹

- 8 The World Bank Group, "Climate Change Knowledge Portal," 2016, http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_historical_climate&ThisCCode=COL.
- Open Government Partnership, "Columbia," 2015, http://www.opengovpartnership.org/ country/colombia.
- 10 GovLab interview with Oscar Montiel, Open Knowledge International, September 8, 2016.
- 11 GovLab interview with Daniel Uribe, Fundacion Corona, September 13, 2016.



KEY ACTORS

KEY DATA PROVIDERS

Government of Colombia

The primary government actor pushing forward Aclímate Colombia is the Ministry of Agriculture and Rural Development (MARD). MARD's mission is to "formulate, coordinate and evaluate policies that promote competitive, equitable and sustainable development of forestry, fisheries and rural development agricultural processes, criteria of decentralization, consultation and participation, to help improve the level and quality of life of the Colombian population."¹²

CIAT project lead Daniel Jimenez notes that the Colombian government, and MARD in particular, were the central funders for the project, and helped to facilitate communication between CIAT and important actors in the agriculture sector, enabling CIAT to access and analyze datasets held by stakeholders in other sectors.¹³

While MARD is the most important government collaborator on the project, the primary government data provider is the National Institute of Hydrology, Meteorology and Environmental Studies (IDEAM), which collects and—as a result of recent legislation¹⁴—opens climate data for the country.¹⁵

KEY DATA USERS AND INTERMEDIARIES

CIAT

The central actor in the development of Aclímate Colombia is the International Center for Tropical Agriculture (CIAT), "an agricultural research institution, nonprofit, focused on generating scientific solu-

¹⁵ GovLab interview with Daniel Jimenez, International Center for Tropical Agriculture (CIAT), August 23, 2016.





¹² Aclímate Colombia, "Quiénes Somos," http://www.aclimatecolombia.org/quienes-somos-2/.

¹³ GovLab interview with Daniel Jimenez, International Center for Tropical Agriculture (CIAT), August 23, 2016.

^{14 &}quot;Information Request," IDEAM, http://www.ideam.gov.co/ solicitud-de-informacion.

tions to combat hunger in the tropics." Originally established in 1970 as part of the Consultative Group on International Agricultural Research (CGIAR), CIAT plays the central data science and project management role in the initiative as part of its research program on Climate Change, Agriculture and Food Security (CCAFS). CCAFS seeks to "address the challenge of increased global warming and declining food security, agricultural practices, policies and measures.¹⁶

CIAT not only conceptualized and developed the data analytics capabilities that enabled the project but also worked closely with growers associations and other stakeholders to gain access to and analyze relevant historical datasets.¹⁷

Fedearroaz and Crop Growers Associations

Demonstrating the potential of cross-sector collaboration on open data projects, the other key piece of the Aclímate Colombia puzzle is the stable of crop grower associations in the country. The associations, which represent and advocate for farmers, exist in both the private and semi-public sectors. The crop grower associations in many ways act as the intermediary translating the insights and tools provided by CIAT to the individual-level farmers they represent. CIAT armed these associations with the know-how to "analyze information from big data tools and determine the most limiting factors in production for the crops in specific regions."¹⁸

Given the focus on spurring growth in the rice sector, Fedearroz (i.e., the Rice Growers Association) was CIAT's central collaborator. According to Miryam Patricia Guzmán García, the deputy director of technology for Fedearroz, the organization has three central missions. First, it represents rice farmers at the ministerial level to ensure that their interests are known to government decision-makers. Second, Fedearroz works to transfer technological capabilities with the ability "to better the productivity and cost effectiveness" of farming in Colombia. Finally, the association seeks to provide farmers with the services they need—from identifying sellers of needed supplies to establishing partnerships with relevant industry players to finding (or providing) new funding streams.¹⁹

Fedearroz was eager to collaborate on the project to help ensure that, as Guzmán García puts it, "the research that normally takes place in the research centers gets down to the level where it is really needed: to the farmers."²⁰ This involved both providing access to relevant data and insights on the country's rice growers to CIAT, and also transferring the end results and tools provided by Aclímate Colombia to those who can use it in practice.

KEY BENEFICIARIES

Associated Farmers in Colombia

While there are potentially massive public benefits of increased yields and sustainability in the agriculture sector, the most direct beneficiaries targeted by Aclímate Colombia are farmers affiliated with growing associations in the country. The project seeks to provide such farmers with the decision-making capability to consistently make the right planting choices and better react to the shifting impacts of climate change. As described in more detail in the Risks and Challenges sections, unaffiliated farmers, while theoretically an intended beneficiary of the initiative, are largely disengaged from its current iteration.

¹⁶ Aclímate Colombia, "Quiénes Somos," http://www.aclimatecolombia.org/quienes-somos-2/

¹⁷ GovLab interview with Daniel Jimenez, International Center for Tropical Agriculture (CIAT), August 23, 2016.

¹⁸ Ibid.

¹⁹ GovLab interview with Miryam Patricia Guzmán García, Deputy Director of Technology, Fedearroz, September 5, 2016. 20 Ibid.

PROJECT DESCRIPTION

INITIATION OF THE OPEN DATA ACTIVITY

The summer of 2013 was a particularly dry season in Colombia. An extended drought in many regions of the country had a major impact on agriculture and crops. In the northwestern department of La Guajira, for instance, the drought led to food and water scarcity, and the death of around 20,000 cattle.²¹ Farmers in the southern Casanare region also faced consistently high temperatures, ravaged plantations a nd exhausted water supplies.²² In response to these struggles, the Colombian government began exploring options for strengthening growers' associations. With this goal in mind, the Minister of Agriculture signed an agreement with CIAT aimed at "strengthening the capacity of Colombia's agricultural sector to adapt to climate vulnerability action." This agreement includes evaluations of seasonal forecasting and providing specific recommendations for increasing productivity.²³ The result of these recommendations is evident in many ways on the Aclímate Colombia website, for example through regular, targeted newsletters, context-specific information analysis tools, data-driven agriculture strategy reports, and a searchable data portal.

As a first step, CIAT developed a methodology for leveraging data to develop productivity-bolstering recommendations for farmers (i.e., which crops to grow, and when, depending on region). In this effort, CIAT was inspired by a number of previous data-driven agriculture projects initiated by other NGOs around the world; these included "the use of both supervised and unsupervised artificial neural networks to model Andean Blackberry (*Rubus glaucus*) yields, and the use of mixed models to determine optimum growing conditions of Lulo (*Solanum quitoense*)" in the Andes.²⁴ CIAT representatives then approached Fedearroz, the rice growers association, with the idea of using the association's data as well as existing open government datasets to improve farmers' decision-making capabilities.

Fedearroz readily agreed to share data gathered over the course of over twenty-five years, including an annual rice survey, harvest monitoring records and results from agronomic experiments.²⁵ As Guzmán García puts it, "we decided to be part of the project to enable better analysis of all the information we had and to improve practices and recommendations for farmers to reduce the risks they face."²⁶ Fedearroz was in part eager to collaborate on the project to help ensure that, as Guzmán García puts it, "the research that normally takes place

^{21 &}quot;Colombia: The Effects of Drought in La Guajira," World Food Programme, August 27, 2014, https://www.wfp.org/stories/ colombia-effects-drought-la-guajira.

^{22 &}quot;Drought threat to Colombia's southern farming belt," *World Bulletin,* April 3, 2014, http://www.worldbulletin.net/ news/132752/drought-threat-to-colombias-southern-farming-belt.

²³ GovLab interview with Daniel Jimenez, International Center for Tropical Agriculture (CIAT), August 23, 2016. 24 Silvain Delerce, et al., "Assessing Weather-Yield Relationships in Rice at Local Scale Using Data Mining Approaches,"

PLOS One, August 25, 2016, http://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0161620. 25 CTIAR and CCAFS, "Big Data for Climate-smart Agriculture," *Change for the Better: The CCAFS 2015 Annual Report*, https://ccafs.cgiar.org/bigdata#.V6jLT5ODGko.

²⁶ GovLab interview with Miryam Patricia Guzmán García, Deputy Director of Technology, Fedearroz, September 5, 2016.

in the research centers gets down to the level where it is really needed: to the farmers."27 This involved both providing access to relevant data and insights on the country's rice growers to CIAT, and also transferring the end results and tools provided by Aclímate Colombia to those who could really use it in practice: small farmers who lack the type of R&D capacity enjoyed by larger corporate farms. At a most fundamental level, Aclímate Colombia uses these diverse open data sources to "identify the most productive rice varieties and planting times for specific sites and seasonal forecasts."²⁸

The CIAT effort is just one manifestation of a growing global effort to leverage open data to benefit the agriculture sector. The Global Open Data for Agriculture and Nutrition (GODAN) network brings together nearly 500 cross-sector entities around the concept, and we examine the Esoko agriculture platform in Ghana in another case study from this series.²⁹

FUNDING

As Latin America continues to grow as a hotbed for open data activity and experimentation, international funding sources abound. Colombia, in particular, is seen by those in the field as receiving a notable amount of international funding for its data-driven projects, along with Mexico and Argentina.³⁰ Yet despite the apparent availability of grants from international organizations like the Inter-American Development Bank and others, the primary funding source for Aclímate Colombia is in fact the Colombian government. These funds are primarily targeted at supporting the continued technical development of tools and communications and training efforts to increase the uptake of data-driven insights. As the project continues to grow and mature, it is likely that more diverse funding options will be tapped.

27 Ibid.

²⁸ CTIAR and CCAFS, "Big Data for Climate-smart Agriculture," *Change for the Better: The CCAFS 2015 Annual Report*, https://ccafs.cgiar.org/bigdata#.V6jLT5ODGko.

²⁹ Francois van Schalkwyk, Andrew Young and Stefaan Verhulst, "Esoko – Leveling the Information Playing Field for Smallholder Farmers," Open Data for Developing Economies Case Studies, **DATE TBD**, http://odimpact.org/case-ghana-empowering-smallholder-farmers.html.

³⁰ GovLab interview with Mor Rubinstein, Open Knowledge International, September 8, 2016.

DEMAND AND SUPPLY OF DATA TYPE(S) AND SOURCES

Three types of data are primarily available on the Aclímate Colombia platform. The first is commercial crop data collected by Fedearroz, for example the previously mentioned annual rice surveys and harvest monitoring records. Much of this data was already accessible in anonymized form, but had to be centralized and digitized to be usable for Aclímate Colombia.³¹ As Guzman Garcia put it: the data was previously "public at a general level for each farm, without naming the saint" – i.e., free of personally identifiable information.³²

Second, the platform contains station-level daily weather data from the National Institute of Hydrology, Meteorology and Environmental Studies (IDEAM), as well as from a Fedearroz-led agro-meteorological network. This data helps provide insight on what CIAT considers the five most important climatic variables determining rice growth: minimum temperature, maximum temperature, precipitation, relative humidity and solar radiation.³³ Finally, perhaps the most important datasets on the platform actually contain a combination of data, and in particular a yield record for specific fields along with a record of "cropping events" essentially, everything that happened to a yield's crop between being planted and being harvested. Important elements feeding into cropping events include soil conditions and "management practices implemented by the farmer."³⁴

All this data can be downloaded in raw form by users of the platform. In addition, the platform itself subjects the data to a range of analytic methods that provide users with regionand crop-specific insights. The platform also subjects the data to more sophisticated, machine-learning driven analyses that, according to Daniel Jimenez, "explore non-linear functional relationships between various factors – temperature, radiation, rainfall and productivity," to the end of teasing out the most factors most directly influential to a given farming strategy.³⁵ The machine-learning algorithms used by CIAT were influenced by similar efforts in biology, robotics and neuroscience.³⁶

³¹ Silvain Delerce, et al., "Assessing Weather-Yield Relationships in Rice at Local Scale Using Data Mining Approaches," PLOS One, August 25, 2016, http://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0161620.

³² GovLab interview with Miryam Patricia Guzmán García, Deputy Director of Technology, Fedearroz, September 5, 2016.

 ³³ Silvain Delerce, et al., "Assessing Weather-Yield Relationships in Rice at Local Scale Using Data Mining Approaches," PLOS One, August 25, 2016, http://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0161620.
34 Ibid

³⁵ Elizabeh Stuart, "The Data Revolution: Finding the Missing Millions," *Development Progress, Research Report 03*, 2015, https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9604.pdf.

³⁶ CTIAR and CCAFS, "Big Data for Climate-smart Agriculture," *Change for the Better: The CCAFS 2015 Annual Report*, https://ccafs.cgiar.org/bigdata#.V6jLT5ODGko.

OPEN DATA USE

Open data feeds into all analyses conducted as part of the Aclímate Colombia suite of tools. So while open data is only one piece of the puzzle for the initiative—along with the industry- and NGO-provided data described above—distinguishing between the use of open data for the initiative and the initiative itself is impossible. In the simplest of terms, Aclímate Colombia could not exist without access to open data.

Aclímate Colombia uses its diversity of datasets to create a number of tools and information products, including newsletters related to farming (Figure 1) that are both informative and easily-digestible (Figure 2). The site also provides research topics, modeling, and information about the Convention agreement that launched the site in the first place. Most helpfully, though, the site offers a searchable data portal (Figure 3) and points visitors toward additional data-driven resources and datasets. The end result is that the project is able to communicate its methods, research, and findings in a clear and accessible manner to those who seek it out and have a positive impact.

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Figure 1: Aclímate Colombia Newsletter Sign Up





CLAVES PARA EL FUTURO DEL SECTOR ARROCERO ANTE LOS DESAFÍOS CLIMÁTICOS

La Federación Nacional de Arroceros, FEDEARROZ, hace parte del Convenio 'clima y sector agropecuario colombiano' desde su inicio en enero de 2013, buscando que los productores de arroz sean más eficientes y competitivos frente a los diferentes fenómenos climáticos que se vienen presentando en Colombia.

Para esto, se han desarrollado actividades como la realización de pronósticos climáticos específicos para las zonas arroceras – mensuales, a seis meses, con exactitud mes por mes – ; así como pronósticos de varios factores climáticos – precipitación, temperaturas máximas y mínimas, radiación solar -; la identificación por medio de herramientas estadísticas del factor climático y el manejo que determina la producción para las siguientes zonas y la identificación de la época de siembra y la variedad adecuada, teniendo en cuenta la predicción climática y los modelos del cultivo para algunas zonas arroceras del país.

Al respecto, Rafael Hernández, gerente de Fedearroz, manifestó que la participación en esta alianza de investigación ha sido "una experiencia muy positiva que nos ha dado acceso a un conocimiento que no teníamos y la posibilidad de tener una metodología que nos permite recomendarle al productor sus épocas de siembra para una mayor eficiencia".



Figure 2: Aclímate Colombia Newsletter

IMPACT

Impact is often difficult to measure, especially as many projects included in this series of case studies have been initiated relatively recently. The larger, systemic impact of open data can take many years to manifest, and in most countries open data is very much a work in progress. Nonetheless, several initial forms of impact from the Aclímate Colombia project can be identified.

One illustrative example of how Aclímate Colombia can work occurred about a year into the initiative. After the site's analysis predicted that a major dry period would disrupt the growing season and necessitate a delay in planting, Fedearroz broadcast a "simple, site-specific message," providing detailed, granular information to 170 farmers in Cordoba on the "ideal windows for planting or the best variety to grow."37 The combination of highly specific and actionable information broadcast by a trusted and reliable source (i.e., the farmers' growing associa-



tion) meant that uptake of the recommendation was significant. Many farmers avoided making premature, doomed-to-failure planting decisions, thus escaping significant losses.

Other initial markers of impact include:

NEW KNOWLEDGE AND INSIGHTS

One of the most impressive aspects of Aclímate Colombia is how quickly it has enabled the transfer of knowledge and research findings from the lab into the field. As CIAT representatives put it in a journal article about the project: "Whilst previous global and continental scale studies have successfully characterized the impact of climate variability on yields, they have limited direct relevance to farm-level decisions."38 The highly particular and localized nature of the project, as well as its use of intermediaries—i.e., growers associations—and user-friendly tools, helped Aclímate Colombia break that trend and advance new agricultural practice with real-world impact.

³⁷ Elizabeh Stuart, "The Data Revolution: Finding the Missing Millions," *Development Progress, Research Report 03*, 2015, https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9604.pdf.

³⁸ Silvain Delerce, et al., "Assessing Weather-Yield Relationships in Rice at Local Scale Using Data Mining Approaches," PLOS One, August 25, 2016, http://journals.plos.org/plosone/article?id=10.1371%2Fjournal. pone.0161620.

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Figure 3: Aclímate Colombia Data Portal

According to the previously mentioned article, these are some of the specific ways in which new forms of knowledge and data have changed agriculture in Colombia:³⁹

The type of analysis found on the platform showed that, in the Espinal region, rice yields are primarily influenced by "the average minimum temperature during the ripening stage." Armed with this knowledge, farmers can ensure that crop plantings are sequenced to ensure that ripening occurs when average minimum temperatures are high enough to positively benefit yields.

Analysis has also indicated that hotter regions of the country are not well-suited for planting the Cimarron Barinas rice variety; according to data included on the website, that crop variety is not suitable for growth in regions with temperatures typically exceeding 22°C. Farmers in the Saldaña region have also learned that (and why) the level of accumulated solar energy in irrigated rice has probably the largest impact on yield. In particular, the CIAT effort uncovered that the impact of solar radiation is most significant during the ripening stage. As a result, during the El Niño phenomenon, Saldaña faced significant risks because of the dry season. But, as Guzmán García recalls: "Fortunately, the district listened to us, and started rationing water, which, granted, caused less crops to be planted, but minimized the effects compared to another district next door that did not listen to us and had more losses."⁴⁰

In Villavicencio, the frequency of rainfall of over 10mm during the vegetative stage has the largest impact on yield. The team's findings in this area are particularly important because they show that the *frequency* rather than *total* rainfall is the key to growth. This insight "may foster

39 Ibid.

⁴⁰ GovLab interview with Miryam Patricia Guzmán García, Deputy Director of Technology, Fedearroz, September 5, 2016.

the development of water harvesting and complementary irrigation infrastructure in that area to adapt to unevenly distributed rainfall."⁴¹

One further piece of actionable insight (not included in the article) was indicated by Guzman Garcia. In Montería, an area with an irrigation district, Fedearroz and CIAT encouraged farmers to avoid year-round planting—despite farmers' desire to maximize potential yields surrounding stretches of time when many irrigation pumps were broken. Despite some pushback from farmers, Guzmán García recalls, "I really think we got through to them and people did not plant."⁴² Follow on evaluations estimate that losses of around 8 billion Pesos, over USD 300 million, were avoided among 179 farmers.⁴³

Considered more broadly, the project points to the potential of open data projects—perhaps especially those combining datasets from across sectors—to uncover highly granular insights. Far from just a tool for large-scale trends analyses and predictions, open data can provide truly useful and entirely different information to two individuals a mere town apart.

BENEFITS TO THE AGRICULTURE RESEARCH COMMUNITY

Although practitioners of agriculture have been the most direct beneficiaries of the project, it has also had a considerable impact on the wider agricultural research community. Indeed, the project has shown all those involved in agriculture how new forms of information and knowledge can spur progress in the field. This represents a potentially significant theoretical insight. As the scientists behind Aclímate Colombia put it in an article: "The added value of this effort is that it demonstrates how observational data can be used to efficiently generate actionable and contextualized information for on-farm decision making."⁴⁴ More broadly, one of the aims of the project is to make progress by "accelerating agricultural research, in terms of time taken and money spent."⁴⁵ The founders of the project hope that it can serve as a catalyst for the wider community to consider new forms of knowledge, and to think through more carefully the link between research and practice.

⁴¹ Silvain Delerce, et al., "Assessing Weather-Yield Relationships in Rice at Local Scale Using Data Mining Approaches," PLOS One, August 25, 2016, http://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0161620.

 ⁴² GovLab interview with Miryam Patricia Guzmán García, Deputy Director of Technology, Fedearroz, September 5, 2016.
43 Andrés Bermúdez Liévano, "Los arroceros aprenden a vivir en un mundo con menos agua," *La Silla Nacional*, January 17, 2016, http://lasillavacia.com/historia/los-arroceros-aprenden-vivir-en-un-mundo-con-menos-agua-52478.

⁴⁴ Silvain Delerce, et al., "Assessing Weather-Yield Relationships in Rice at Local Scale Using Data Mining Approaches," PLOS One, August 25, 2016, http://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0161620.

⁴⁵ Oluwabunmi Ajilore "Big Data, Big Prospects: Crunching data for farmers' climate adaptation," *Change for the Better: The CCAFS 2015 Annual Report*, September 12, 2014, https://ccafs.cgiar.org/blog/big-data-big-prospects-crunching-data-farmers-climate-adaptation#.V6jLZpODGkp.

FINANCIAL IMPACT

The economic benefits of Aclímate Colombia are already becoming clear, and bear testimony to the success of the project. According to an Open Data Institute study conducted in partnership with CIAT, in the year following the launch of the initiative, improvements to farmers' decision-making led to estimated savings of \$3.6m.⁴⁶ In addition to these broad, aggregate savings, the various insights described above have of course led to a number of localized cost efficiencies in specific areas of the country, and for specific farmers.

UN BIG DATA CHALLENGE AND THE VALUE OF A MODEL

While not a direct, on-the-ground impact of Aclímate Colombia, it is worth mentioning that the project was recognized as one of the 2014 winners of the United Nations Big Data Challenge.⁴⁷ This award represents a validation and recognition of the ingenuity and promise of the platform. In addition, the award and its attendant publicity could also help spur other, similar projects in Latin America and beyond. This is a pattern we see repeatedly in the case studies in this series: success leads to more success, and a single, successful project can open up pathways for many more similar projects that, together, have a much wider regional impact.

As noted, impact is often hard to measure. There have been some regional-level impact assessments and estimates of the types of economic losses avoided as a result of Aclímate Colombia performed. On the whole, though, Jimenez believes that, "we've been very clumsy in measuring impact."48 An understanding of impact is not only important for iterating on the tools and approach for the initiative, but also, as Jimenez highlights, essential for accessing new and sustained sources of funding. Going forward, CIAT and Fedearroz are looking to build an impact assessment component into the project, gaining better visibility into the number of farmers reached and the number of farmers who increased their productivity.49

⁴⁶ Global Open Data for Agriculture and Nutrition, *How Can We Improve Agriculture, Food and Nutrition with Open Data?* Open Data Institute, 2015, http://www.godan.info/sites/default/files/old/2015/04/ODI-GODAN-paper-27-05-20152.pdf.

⁴⁷ United Nations Global Pulse, "Big Data Climate Challenge," Press Release, September 2, 2014, https://www3.wider.unu. edu/sites/default/files/News/Documents/Big-Data-Climate-Challenge-press-release-5633.pdf.

⁴⁸ GovLab interview with Daniel Jimenez, International Center for Tropical Agriculture (CIAT), August 23, 2016. 49 Ibid.

RISKS

As evidenced by the example of Aclímate Colombia and various other case studies included in this series, open data holds tremendous potential for positive transformation. But, as we also see throughout this series, open data also poses certain risks. It is important to understand these risks in order to ensure that open data projects are implemented in a way that maximizes the potential upside and limits the downside.

EMPOWERING ONLY FARMERS CONNECTED WITH POWERFUL GROWERS ASSOCIATIONS

CIAT is well-positioned to engage farmers affiliated with growers' associations like Fedearroz. It has little capacity, however, to engage those farmers that are not similarly organized. As Jimenez notes, "this approach is totally feasible as long as farmers are well organized and associated."⁵⁰ But, of course, the farmers with no affiliations and support from growers' associations likely face the greatest risks as a result of climate change and stand to see the most benefit from gaining access to new tools for improving their decision-making. A move toward more technological and data-driven efforts to benefit the agriculture sector risks leaving behind those who need the most support.

This particular risk is representative of a larger struggle within the Colombian open data and civic technology sectors, and indeed within a number of open data and data projects around the world. While often aimed at eradicating or narrowing the digital divide, technical and governance innovation projects such as this one in fact often graft themselves on to (and can even exacerbate) existing divides. As Daniel Uribe of the Corona Foundation puts it: "We see there is a big gap in citizen engagement, taking into account the population pyramid where the poor are the largest group of population, but we believe that there is the potential in the population and access to ICT platforms to promote and achieve citizen engagement through civic tech in all the population, closing the digital divide."⁵¹

CIAT is currently exploring pathways for engaging these unaffiliated farmers through, as Jimenez puts it, "some hybrid between development and research."⁵² Developing concrete, implementable strategies for such engagement will likely be a key determinant of longer-term sustainability and success for the initiative.

50 Ibid.

⁵¹ GovLab interview with Daniel Uribe, Fundacion Corona, September 13, 2016.

⁵² GovLab interview with Daniel Jimenez, International Center for Tropical Agriculture (CIAT), August 23, 2016.

ENCOURAGING FARMERS WITH LITTLE ROOM FOR ERROR TO FUNDAMENTALLY CHANGE PRACTICES

Given the project's focus on arming smallscale farms with recommendations aimed at changing their traditional growing practices, the accuracy and reliability of those recommendations is highly important. If recommendations are not accurate, there is a risk not only of lower crop yields, but also that farmers who already operate near subsistence level may suffer great economic hardship. The organizers recognize this risk, noting that "farmers have different profiles in terms of risk management" and that some are "able to take risks to bet on good weather and outstanding harvest while others need to guarantee a minimum level of productivity to ensure adequate income."⁵³ Initial signs do point to Aclímate Colombia improving outcomes for farmers, but vigilance in this area is essential.

LESSONS LEARNED

Several important lessons with wider applicability emerge from this particular case study. These can broadly be categorized by considering the key enablers of the project, as well as the most important barriers or challenges to its success.

ENABLERS

For Jimenez and his team, perhaps the central lesson learned from the project was the realization that "information that is not shared is not information anymore."⁵⁴ The data used to create Aclímate Colombia had existed for years, sitting in databases held by different cross-sector stakeholders. Once that data was unlocked in service of a specific objective, it stopped being a series of numbers but instead became actionable information.

⁵³ Silvain Delerce, et al., "Assessing Weather-Yield Relationships in Rice at Local Scale Using Data Mining Approaches," PLOS One, August 25, 2016, http://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0161620.

⁵⁴ GovLab interview with Daniel Jimenez, International Center for Tropical Agriculture (CIAT), August 23, 2016.

ESTABLISH CREDIBILITY, A THEORY OF CHANGE AND PROOF OF CONCEPT

In order to move forward with the data analysis and dissemination of tools and insights that define Aclímate Colombia, CIAT first had to get grower associations like Fedearroz on board both to gain access to their data and in order to enable them to act as intermediaries between CIAT and the individual farmers. To make those partnerships a reality, Jimenez argues, "you have to think about the theory of change."55 The project's theory of change was clear from the start: that data analysis can help farmers make better planting decisions as a result of an improved understanding of how crops react to different weather patterns in different regions. Establishing and articulating this theory of change helped engage data providers and data intermediaries in an effective manner. Pushing for data access without a clear articulation of how that data will be used—and to what ends—can be a losing proposition.

In addition to a clear theory of change, a proof of concept can also help instill confidence in data providers and/or intermediaries. As much as a theory of change can lend conceptual clarity to a project, true confidence and credibility arise when tangible signs of impact and success emerge. Jimenez notes that, at the early stages, growers' associations tended to only share "a small piece of the database," and then as CIAT used the data available to draw meaningful insights, more and more information was made accessible. He adds, "they are skeptical in the beginning, but they start to believe as you demonstrate what you can do to support more informed decision-making."⁵⁶

KNOW YOUR AUDIENCE, ENGAGE INTERMEDIARIES AND BUILD A COMMON LANGUAGE

As the story of Aclímate Colombia's genesis and implementation makes clear, growers' associations played an essential role in enabling the creation of the initiative. In particular, they played a role through data provision and its use by acting as intermediaries between CIAT and individual farms. As Jimenez describes their role: "We work through them, we empower them and then through them we bridge this gap between scientists and farmers."⁵⁷ Even when working through a data-driven intermediary like Federarroz, CIAT quickly learned that to encourage engagement and use among the intended audience (i.e., individual farmers), it needed to gain a better understanding of that audience and build a common language. Rather than simply running one-off workshops with growers associations and farmers aimed at increasing data literacy, which have questionable impact, CIAT embedded sector-area

55 lbid. 56 lbid. 57 lbid.

experts from growers' associations within the organization. During these three-to-four-month engagements, CIAT was able to "empower them properly"—i.e., give them a grounding in how to put into practice the findings of different regional data analyses on optimal planting practices—and plant the notion that data-driven training and tools are truly worth the investment of time and resources.⁵⁸ These engagements not only helped to increase buy-in among the intended audience, but also helped increase the skills present in the growers' association, minimizing the resource and time burdens on CIAT and improving the project's potential for sustainability. Jimenez notes that a big driver of success was the identification of the data use

and translation processes that CIAT "just needs to supervise because [the associations] can do it by themselves."⁵⁹

Similarly, Jimenez found that demonstrating that Aclímate Colombia's organizers were working toward common goals and willing to build a common language with the user community (i.e., individual farmers) helped encourage greater uptake of their tools and research findings. In an interview with the Overseas Development Institute, he recalled that, "One farmer said to me that they acted on the research because it was based on their own data."⁶⁰ As such, Fabrizio Scrollini, chairman of Data Uruguay, labels Aclímate Colombia a clear example of "inclusive innovation."⁶¹

BARRIERS

INITIAL INACCESSIBILITY OF IMPORTANT DATASETS

Much of the value and utility of Aclímate Colombia arises from the aggregation and analysis of diverse datasets drawn from diverse sectors and institutions. Given the fact that "open access and data sharing is still in its infancy in many places," gaining access was a relatively slow and difficult process.⁶² As described above, the establishment of credibility, proof of concept and a willingness to build a common language with growers' associations and those they represent helped to—gradually—mitigate that challenge.

IMMATURE ECOSYSTEM

By working directly with growers' associations that could act as data providers and intermediaries passing its tools and insights onto individual-level farmers, Aclímate Colombia was able to avoid one of the major challenges faced by open data efforts around the world: the lack of a mature technology and innovation ecosystem.

⁵⁸ Ibid.

⁵⁹ Ibid.

⁶⁰ Elizabeh Stuart, "The Data Revolution: Finding the Missing Millions," *Development Progress, Research Report 03*, 2015, https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9604.pdf.

⁶¹ GovLab interview with Fabrizio Scrollini, September 13, 2016.

⁶² Oluwabunmi Ajilore "Big Data, Big Prospects: Crunching data for farmers' climate adaptation," *Change for the Better: The CCAFS 2015 Annual Report*, September 12, 2014, https://ccafs.cgiar.org/blog/big-data-big-prospects-crunching-data-farmers-climate-adaptation#.V6jLZpODGkp.

Actors in the civic technology and open source communities in Colombia are, as Oscar Montiel of Open Knowledge International (OKI) puts it, "really small and really disconnected from one another."⁶³ Esteban Peláez Gómez of Fundación Corona agrees, arguing that while there are some tech start ups and innovators in the country, "they are not part of a community that has the objective of having a social impact."⁶⁴

But while Aclímate Colombia does not require private sector civic tech actors to leverage its tools, Montiel argues that without such an ecosystem, there can be negative impacts on the types of data released by the government. He argues that the immature open data demand and use ecosystem feeds into issues like unwieldy data licensing frameworks that make the reuse of government data more difficult.⁶⁵

A LACK OF CIVIL SOCIETY COLLABORATORS IN COLOMBIAN OPEN DATA ECOSYSTEM

OKI's Montiel and Mor Rubinstein, both of whom worked with Colombia as part of the Open Data Index effort, note that, especially in comparison to other countries in the region, civil society in Colombia is fragmented and not playing a major role in pushing forward open data. As Rubinstein notes, Colombian civil society's role in advancing open data is "a big question mark in a way."⁶⁶ So while there are notable exceptions, like CIAT and Fundación Corona, Montiel argues that there is not widespread collaboration between government and civil society, and rather, government "just does what they can the way they know how."⁶⁷

REPLICABILITY

The potential for replication of Aclímate Colombia's analytical tools and algorithms appears promising as the algorithms and processes that inform the project's tools are not context-specific, and can be used wherever relevant data is available.68 As a result, steps are already being taken to scale the project across Colombia, as well as in Argentina, Nicaragua, Peru and Uruguay, in partnership with the Latin American Fund for Irrigated Rice (FLAR)⁶⁹

- 66 GovLab interview with Mor Rubinstein, Open Knowledge International, September 8, 2016.
- 67 GovLab interview with Oscar Montiel, Open Knowledge International, September 8, 2016.

⁶³ GovLab interview with Oscar Montiel, Open Knowledge International, September 8, 2016.

⁶⁴ GovLab interview with Esteban Peláez Gómez, Coordinator of Social Projects, Fundación Corona, September 13, 2016. 65 GovLab interview with Oscar Montiel, Open Knowledge International, September 8, 2016.

⁶⁸ Silvain Delerce, et al., "Assessing Weather-Yield Relationships in Rice at Local Scale Using Data Mining Approaches," PLOS One, August 25, 2016, http://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0161620.

⁶⁹ CTIAR and CCAFS, "Big Data for Climate-smart Agriculture," *Change for the Better: The CCAFS 2015 Annual Report*, https://ccafs.cgiar.org/bigdata#.V6jLT5ODGko.

LOOKING FORWARD

IMPROVING THE TOOLS AND EXPANDING THE DATA BEING USED

Beyond strategizing ways to engage unaffiliated farmers, as described above, the CIAT team is working to improve the functionality and expand the use of Aclímate Colombia through the integration of new datasets. Future research for the platform will explore how to leverage data

on "soils, pests, diseases, costs and other factors to increase explanatory power."⁷⁰

The team is also exploring the "emergent field of remote sensing and satellite energy," which Jimenez feels "could be a more efficient way to collect information in the field."⁷¹

SCALING TO OTHER COUNTRIES IN THE REGION

As described above, CIAT is partnering with the Fund for Irrigated Rice in Latin America. In addition, CIAT researchers plan also to partner with the Fund for Irrigated Rice in Latin America (FLAR), with the support of CCAFS and the World Bank, to introduce new approaches to rice growers' associations in other countries, especially Nicaragua, Peru, Argentina and Uru guay. CIAT is also partnering with the CGIAR-affiliated International Maize and Wheat Improvement Center (CIMMYT) to bring data-driven insight into maize production in Mexico. These new projects in Latin America will serve as additional case studies, potentially laying the groundwork for further replication and scaling.⁷²

70 Ibid.

⁷¹ GovLab interview with Daniel Jimenez, August 23, 2016.

⁷² CTIAR and CCAFS, "Big Data for Climate-smart Agriculture," *Change for the Better: The CCAFS 2015 Annual Report*, https://ccafs.cgiar.org/bigdata#.V6jLT5ODGko.

FOSTERING THE OPEN DATA ECOSYSTEM IN COLOMBIA

Looking beyond Aclímate Colombia, CIAT and the other data-driven actors involved in the project are well-positioned to help push forward the nascent open data ecosystem in Colombia. As Fabrizio Scrollini argues: "there is a niche for new organizations to emerge or for some organizations that are a part of the politics side, or from the more social side to jump into data on the market side. The niche is there."⁷³ Indeed, Scrollini argues that while the value of data-driven work is gaining a foothold in areas focused on wealth generation, there has not been a similar uptake in the use of data toward social ends. Aclímate Colombia could actually represent a powerful example of how open data can have positive impacts on both the public good and the pocketbooks of those leveraging the data (in this case, farmers).

As Scrollini puts it: "I guess it is time to get these people organized and get some more traditional NGOs that are more well behaved and engage the government and some punks as well so they can shake things up and get the party going. I know there are people in government willing to take that challenge, it's a matter of getting the dance started. That's what data hopefully will contribute."⁷⁴

CONCLUSION

With regard to open data's provision, use and impact, Colombia represents a fascinating case study in the developing world. Based on a number of international assessments, the country can be considered a leader among Latin American countries in the field of open data. A number of open data projects either already exist or may soon, although it is worth noting that the bulk of these are founded by international organizations, with relatively little activity in Colombia's private sector and among start-ups.

In this atmosphere of open data innovation, CIAT's Aclímate Colombia could act as a standard-bearer and catalyst. The platform is aimed at addressing a clearly defined problem, leverages partnerships across sectors to access data and push for its use, and provides benefits to a wide variety of private sector actors in the agriculture sector, regardless of their size. USAID notably selected Colombia as one of three initial countries to participate in the Climate Services for Resilient Development initiative, likely thanks in part to the innovative capacity demonstrated by the government and civil society actors that made Aclímate Colombia a possibility.75 While many questions and barriers remain-not the least of which is the challenge of engaging those farmers currently not involved with key intermediaries—if Aclímate Colombia continues to grow and evolve along its current trajectory. it could establish itself as a bright light in the emerging open data space in Colombia, and indeed throughout Latin America.

⁷³ GovLab interview with Fabrizio Scrollini, September 13, 2016.

⁷⁴ Ibid.

⁷⁵ Climate Services for Resilient Development, http://www.cs4rd.org/.