RESEARCH PROGRAM ON
**Climate Change,
Agriculture and
Food Security**

CGIAR

CCAFS

Repurposing data for adaptation research

The AgTrials database collects decades of agricultural field experiments to help understand and adapt to climate change impacts.

If temperatures keep climbing decade by decade across Africa, what will the damage be for maize farmers, and what can they plant to protect themselves? How will rice crops react to new rain patterns in India, or potatoes to drought in the Andes? And which practices or technologies could soften the impacts? Scientists are rushing to model these scenarios accurately and plant breeders are working on future-proof strains. One thing these efforts have in common: they depend on basic facts about how crops react to a range of conditions.

Thanks to field experiments over the years, there is a vast amount of this information. Even some places that are usually considered data-poor, like Africa, have crop field trials going back decades. Unfortunately, almost all of the data has been inaccessible to other researchers, filed away on laboratory hard drives and sometimes lost completely. A scientist who performs an experiment to answer a specific question may not think about other potential uses for the raw data — and if labs do want to share results, they need a central hub.

With this in mind, the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) started an ambitious project in 2010 called the Global Agricultural Trial Repository, or AgTrials. AgTrials is an information portal that collects together thousands of evaluations of agricultural technologies for small-scale farmers, including crops, livestock, tools and practices. The logic of Big Data drives the initiative: "Pooling the information creates a resource for all kinds of new applications," says project leader Glenn Hyman.

Fast facts

▸ Routine field trials by plant and livestock breeders generate information that can boost efforts to model climate impacts and plan for adaptation. But the original data are often never published.

▸ CCAFS created the AgTrials information portal to gather and standardize these data sets. It now comprises 35,000 trials of 42 different crops, livestock and technologies.

▸ Through a partnership with the AgMIP modelling initiative, AgTrials data is helping researchers create detailed multi-scale models of agricultural production in a changing climate.

▸ Such models can be used to explore future scenarios and guide adaptive crop breeding.

Compiling the data

Studies by plant breeders form the bulk of the database. These data sets link weather statistics together with yields of specific varieties, their pest and disease susceptibility, and subtler metrics such as plant height and leaf area. Most of the information so far comes from eight CGIAR Research Centers, with additional contributions from academia and the private sector.

CGIAR instituted an open data policy in 2013 (http://www.cgiar.org/resources/open). Still, most of the CGIAR trials had published summarized or processed results rather than raw data, and the studies had never been aggregated together. Putting the information in one place doesn't necessarily make it useful, however. AgTrials also had to make sense of a confusing assortment of terminology and formatting. "If you've got five wheat breeders around the world and they all use different ways to manage their data and different

names for variables and phenotypes, then for a crop modeller it would be a lot more difficult to put it all together," says Hyman. So AgTrials partnered with an initiative called Crop Ontology that has developed tools for standardizing terms. "That's what makes the data usable beyond its original intent," Hyman explains.

The AgTrials website provides easy access to the database, which now comprises about 35,000 trials. Most of those (29,000) are maize studies, but 42 different crops, livestock and other technologies are represented, totalling around 89,000 varieties at 2,500 sites in 110 countries.

Applying it to adaptation

AgTrials should be valuable for anyone who needs to understand how environmental variables affect crops. Recently, for example, the AgTrials team started working with the Agricultural Model Intercomparison and Improvement Project (AgMIP), a major global modelling program where climate scientists are collaborating with crop modellers and economists to study climate threats to food security. AgMIP will use AgTrials data to test and calibrate crop models, improving their accuracy. With enough data from sites around the world, AgMIP could build a global model based on how crops actually respond to climate in specific locations.

What you can do with the AgTrials platform?

▸ **Share data and information:** The AgTrials team accepts and curates data from agricultural trials around the world. To contribute to the database, contact Glenn Hyman (g.hyman@cgiar.org).

▸ **Acquire data sets for your own research:** Data are standardized and cover 42 crops and technologies at about 2,500 sites.

▸ **Explore the geographic dimensions of agricultural research:** Metadata show what is being tested where.

To find out more about AgTrials please visit:
http://ccafs.cgiar.org/agtrials

Case study:
Using the data to measure climate sensitivity

Researchers from Stanford and the International Maize and Wheat Improvement Center (CIMMYT) used 123 field trials of maize in Africa to calculate that just 1°C of warming would harm yields in 65% of maize-growing areas—100% in a drought year. The authors point out, "data generated by international networks of crop experimenters represent a potential boon to research aimed at quantifying climate impacts and prioritizing adaptation responses, especially in regions such as Africa that are typically thought to be data-poor."

The portal, with its records of yields under diverse weather conditions and farming systems, can also help scientists evaluate which crops, livestock or technologies will work best for climate adaptation. And the same data can support the development of new adaptation technologies.

Case study:
Using the data to guide adaptive crop breeding

As part of the CCAFS-AgMIP partnership project, scientists from four different research institutions pulled together crop trials from West Africa, downloading about 250 data sets from AgTrials. From this data the team is building crop models specific to the region. They will then project impacts from regional climate change scenarios and figure out what characteristics need to be included in breeding programs for adaptation.

As more researchers use and contribute to the database, AgTrials will grow and become even more useful. Hyman estimates several hundred thousand more trials could one day be included. With that kind of comprehensiveness, the portal would become a go-to tool for improving crops and adapting agriculture to climate change.

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