CGIAR
RESEARCH PROGRAM ON
Climate Change, Agriculture and Food Security
CCAFS

Better methods to measure the emissions of small-scale farming

Smallholder farmers and climate change: options and information

Smallholder farmers provide up to 80 percent of the food supply in sub-Saharan Africa and Asia. Yet very little is known about either the contribution of smallholder systems to greenhouse gas (GHG) emissions or the options for smallholders to mitigate their emissions and benefit from doing so. The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) is coordinating research to gather the basic data on emissions that smallholder farmers and national policy makers need in order to plan sustainable futures.

Better data more effectively measured

Leading the way is the Standard Assessment of Mitigation Potential and Livelihoods in Smallholder Systems (SAMPLES) project, where research is being carried out on four main fronts. Firstly, CCAFS is working with local partners to measure and document what farmers do and how those activities contribute to GHG emissions, with an eye to reducing emissions by changing farming practices, in two pilot countries. In Kenya, researchers are looking at a wide range of farm activities, from the crops people grow to the way they manage livestock and manure. For example, how different local breeds of cattle and different feeding regimes and forages affect methane emissions. Meanwhile, in the Philippines intensive rice farming is the target (see Box overleaf).

The second front of the SAMPLES project is focused on identifying hotspots: priority farming systems for action and research. The third front tackles one of the reasons information is scarce: making the measurements is technically demanding and expensive. SAMPLES is helping countries to develop the laboratories and facilities they need and to train the next generation of scientists. Finally, the fourth front addresses the issue of standard assessments. Too often, measurements in different places have employed different protocols and techniques, preventing wider applicability of the data. SAMPLES is developing new, lower-cost measurement methods and seeking consensus among researchers for their use, which will result in data being comparable across research sites and thus much more valuable.

A big step forward in building the scientific consensus was the publication early in 2013 of a special issue of the open-access journal *Environmental Research Letters*, sponsored by CCAFS and others. The articles offer a vision of an improved system for quantifying GHG emissions in smallholder agriculture, and show that targeted investments in improved methods to gather data could result in dramatic and quick improvements in GHG reductions, while also meeting global food needs.

Partners

Three CGIAR Centers – the World Agroforestry Centre (ICRAF), the International Livestock Research Institute (ILRI) and the International Rice Research Institute (IRRI) – have been involved with SAMPLES since its inception. Other centres, including the Center for International Forestry Research (CIFOR), the International Center for the Improvement of Maize and Wheat (CIMMYT), the International Center for Tropical Agriculture (CIAT), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and the International Institute of Tropical Agriculture (IITA) are now also contributing to SAMPLES.

The MIRSA project, led by IRRI, is funded by the Japanese Ministry of Agriculture, Forestry and Fisheries. Research partners include the National Institute of Agro-Environmental Science, Japan, and Hue University of Agriculture and Forestry, Vietnam. The Philippine Rice Research Institute is also closely involved in MIRSA projects.

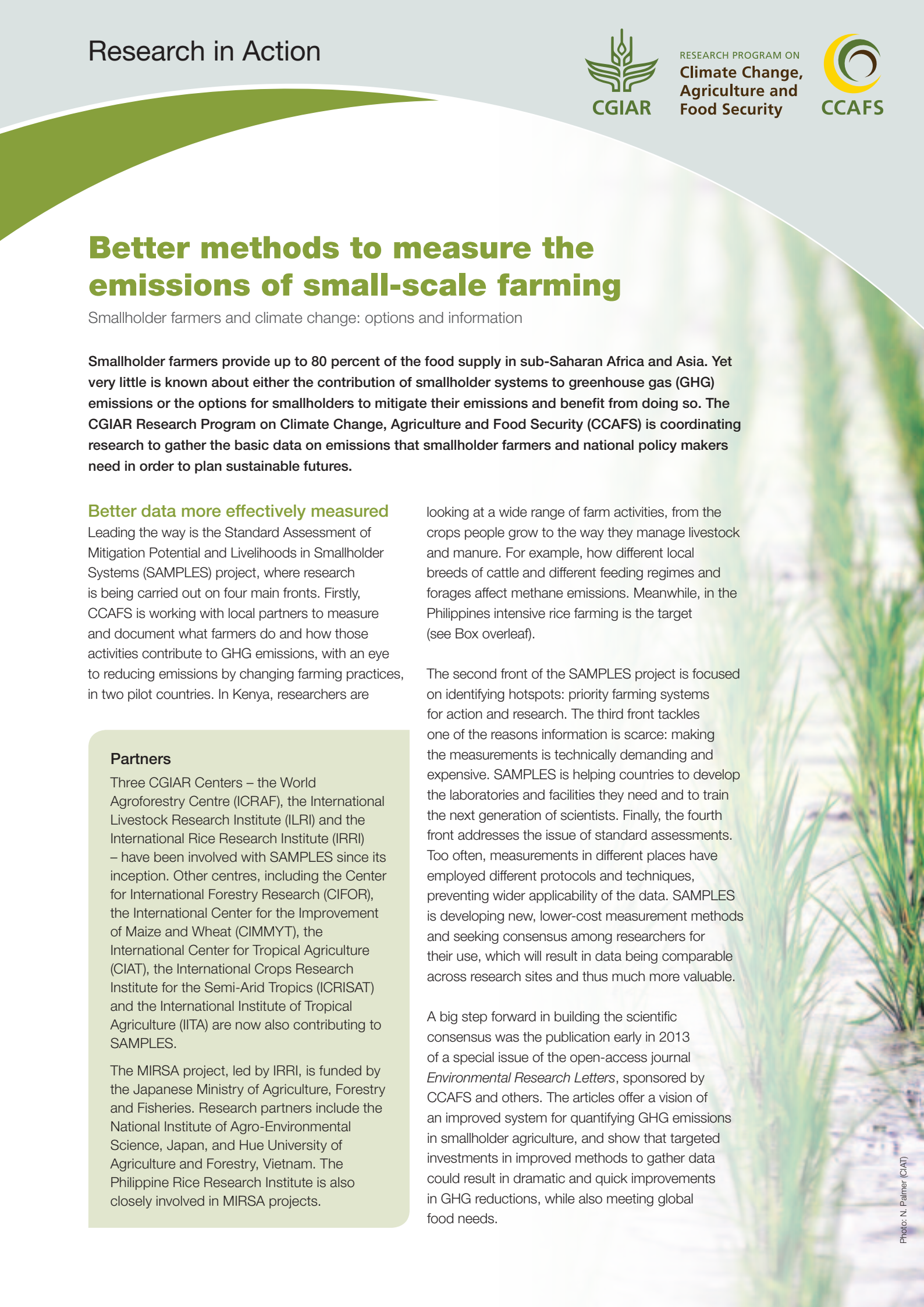

Photo: N. Palmer (CIAT)

More rice with fewer emissions

Small-scale intensive rice production is believed to be the source of considerable GHG emissions, because flooded soil encourages the production of methane. IRRI in the Philippines is researching ways to mitigate emissions from rice paddies, which requires measuring those emissions accurately and simply.

MIRSA (Mitigation in Irrigated Rice Systems: Guidelines from Measurement, Reporting and Verification) is a project looking closely at the effect on GHG emissions of a technique called alternate wetting and drying (AWD). As its name suggests, AWD involves farmers allowing the rice paddies to dry out from time to time. The aerobic conditions in dryer soil inhibit methane formation, and early results suggest that AWD fields contribute two-thirds less to global warming than normal fields of the same size. A secondary benefit of AWD is that it reduces the demand for water, which could help farmers to adapt to climate change if that alters their rainfall patterns.

Trade-offs, however, remain. In AWD fields there are fewer snails to damage the rice plants, but more rats, and while methane is lower, there are suggestions that nitrous oxide emissions increase. Further research with farmers is underway to develop an optimal package of measures that balances the trade-offs to deliver a rice-growing system that will both mitigate climate change and improve harvests.

From farm to landscape

Scale is crucial in studies of climate and agriculture, and to date small-scale farmers and their farms have been missing from these studies. To address this knowledge gap, CCAFS researchers are making measurements on individual farms and over the larger landscape in which those farms are embedded. This will allow them to account for interactions among different sources and sinks. For example, trees can be a source of GHG emissions if they are burned or eaten by livestock, and they can be a sink for carbon if they are allowed to stand and grow. In the past, researchers from different disciplines would study cattle and plants separately. Under this new approach, researchers will study how plants and cattle interact with one another to affect GHG emissions. Such studies will illuminate options for mitigation on individual farms.

> "In most smallholder systems, researchers believe, mitigation and good agricultural practices can go hand in hand, with fewer emissions per unit of production."

Smallholder farmers are unlikely to make their choices based on mitigation; mitigation will occur only as a co-benefit of practices that directly benefit their farms and families. Researchers believe that good agricultural practices and mitigation can go hand in hand, with fewer emissions per unit of production. Trees in agroforestry systems, for example, can physically protect the crops beneath them from the worst of violent weather. They can also sequester carbon, increase soil fertility, and provide forage for livestock and fuelwood for sale. And farmers who use fertilizers carefully can save themselves money while at the same time lowering emissions of nitrous oxide.

Information flowing in many directions

The same standard assessments of mitigation potential that will assist smallholder farmers directly will also help national policy makers to produce more effective plans to guide low-emissions development, because information derived from better measurements will feed into the larger-scale decision-support tools that CCAFS and partners are producing for them. High-level policy interest is crucially important, and the Global Research Alliance (GRA) on Agricultural Greenhouse Gases is taking a keen interest in CCAFS research. Because the GRA is a country-level organization it could help to ensure that the latest research results do inform national and regional policies.

To find out more about Tools for Measuring Emissions, please visit http://ccafs.cgiar.org/methods-for-mitigation-measurement

Photo: N. Palmer (CIAT)

About CCAFS

The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) is a strategic partnership of CGIAR and Future Earth, led by the International Center for Tropical Agriculture (CIAT). CCAFS brings together the world's best researchers in agricultural science, development research, climate science and earth system science, to identify and address the most important interactions, synergies and tradeoffs between climate change, agriculture and food security. www.ccafs.cgiar.org

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