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

Tools to balance increased food security with decreased emissions

Supplying decision makers with the information they need to plan for climate change mitigation

Almost every aspect of trying to reduce climate change involves weighing alternatives and then setting priorities. For example, you could plant trees to store carbon, but that might reduce the amount of food you can grow on the same land. Or you could add fertilizers to boost food production, but that might need more energy and could increase emissions of greenhouse gases (GHGs). Decision makers planning for climate change need to steer an optimal course that balances reducing emissions with sustaining future food production and protecting environmental health. Yet the information needed to plot that course is usually unavailable, especially in low-income countries, because models require huge amounts of data and hours of computer time. The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) is working to make information about the impacts of various mitigation measures available, so that policy makers can reach better-informed decisions.

Where to focus efforts

An overarching question is where efforts should be concentrated. In coming years emissions will grow rapidly in most developing countries, yet these are also the places where food insecurity and vulnerability will be highest as a result of climate change. At the moment, policy discussions around agriculture and mitigation generally do not consider the differences among countries or among types of farmers, but to set priorities requires us to understand where mitigation is likely to have the greatest impact and be most feasible. Would mitigation by many resource-poor farmers have more impact than by fewer larger-scale farmers? If mitigation by resource-poor farmers is essential to meet climate targets, what are the most important things they could do, and where would they have the highest impact? Brazil, China and India are the biggest emitters of GHGs, but are not currently obliged to reduce their emissions under the Kyoto Protocol of the UN Framework Convention on Climate Change. Yet these countries have both the capacity to invest in technological change and the infrastructure to support the extension services that farmers need. Would it be logical to target mitigation in the rapidly developing BRIC countries: Brazil, Russia, India and China?

To answer such questions CCAFS is working with the International Institute for Applied Systems Analysis (IIASA) in Austria and other partners to improve models that can map pathways to low-emissions agriculture. The ultimate users of the information will be policy makers at global, regional and national levels, and the goal is to make it easier for them to explore alternatives, so the project will also develop simplified tools to allow policy makers to manipulate the data and see the impact of their different choices.

IIASA plans to assess the impact of mitigation by different groups, for example BRICs and developed countries versus non-BRIC countries. Studies of large farms versus small farms in developed and developing countries will indicate whether resource-poor smallholders do need to participate in mitigation. The models will consider factors like fertilizer use and changes in land use, as well as shifts in diet and changes in farm practices, such as an increase in agroforestry. They also will examine nitrogen and phosphorus levels on farms and how that might influence changes in land use and biodiversity. For example, more efficient use of nitrogen fertilizers should help reduce emissions of nitrous oxide, while at the same time increasing the productivity of the land in ways that reduce the pressure to clear forests.

IIASA will then look around the globe at the most important sources of emissions and places with mitigation potential that are consistent with meeting food security needs. This work will focus on specific future scenarios and include an economic analysis of the different mitigation options, the goal being a global map of mitigation hotspots, organized by different mitigation activities. The final step will be to develop

Photo: N. Palmer (CIAT)

Uganda, coffee and climate change

Coffee brings in 20–30% of Uganda's foreign earnings and delivers smallholder farmers a cash bonanza once or twice a year. Banana is the most important staple and offers a steady year-round food supply with occasional sales. The two grow in similar conditions, but while some Ugandan farmers grow their coffee and their bananas on separate plots, others grow them together, planting coffee beneath the shade of the bananas. Is one a better choice than the other?

CCAFS scientists have been looking at the trade-offs, including the effects on climate change and mitigation. Preliminary results suggest that intercropping is better. It does not affect the coffee yield, and results in more food for the farm family and for sale. The bananas shelter the coffee bushes from the physical effects of extreme weather events, such as more violent storms, and help to prevent soil erosion. Better soil and shade decrease the coffee's susceptibility to drought. On the negative side, the combination of bananas and coffee requires more soil nutrients, which need to be replaced, and a mixed system requires more capital and labour, especially at the start. Effects on emissions are still being measured.

a tool with regional stakeholders to improve the relevance of the model for that region and to give national decision makers access to the key information produced by the model.

Linking adaptation and mitigation

Other partners are providing additional information for decision makers. Perhaps the biggest challenge is to identify places where mitigation can be compatible with practices that also allow farmers to adapt to climate change. Coffee, an important cash crop for many resource-poor farmers, offers an interesting example. Coffee is very sensitive to temperature, so as average temperatures increase with climate change the most suitable zones for coffee will move to higher altitudes. Those higher areas are often forested and therefore are areas that store carbon. If farmers adapt to climate change by moving to higher elevations, large amounts of carbon will probably be released back to the atmosphere and other amenities from the forest will be lost. What

> "CCAFS is working to make information about the impacts of various mitigation measures available, so that policy makers can make better-informed decisions to reduce emissions while supporting food security and climate change adaptation."

is the overall impact on climate change of replacing forests with coffee? And might there be opportunities for growing coffee and trees together?

The need for answers is urgent, because coffee is a perennial that takes some years to become productive and remains so for many more. Planning adaptation strategies is thus essential. To provide data to inform those strategies, CCAFS scientists from the International Center for Tropical Agriculture (CIAT) and the International Institute for Tropical Agriculture (IITA), along with several local and international research partners, have started looking in detail at coffee and cocoa systems in East and West Africa (see Box).

Answers are on the way

So far, CCAFS research to quantify trade-offs has been focused largely on identifying the questions that, when answered, will enable more accurate models to predict the consequences of various strategic options. Gathering the answers is well under way, and the expectation is that by early 2016 policy makers will have at their disposal decision-support tools that will allow them to ask – and answer – the much more difficult "what if" questions.

To find out more, please visit http://ccafs.cgiar.org/trade-off-tools

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

CCAFS is supported by CGIAR Fund Donors, Danish International Development Agency (DANIDA), Australian Government Overseas Aid Program (AusAid), Irish Aid, Environment Canada, Ministry of Foreign Affairs for the Netherlands, Swiss Agency for Development and Cooperation (SDC), Instituto de Investigação Científica Tropical (IICT), UK Aid, Government of Russia, The European Union, and with technical support from the International Fund for Agricultural Development (IFAD).

Writing, design and layout: Green Ink (www.greenink.co.uk)

Led by CIAT International Center for Tropical Agriculture
Since 1967 / Science to cultivate change

Strategic partner futureearth

2013

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