



Annual Report 2011

Groundwork For Success

CGIAR Research Program on Climate Change,
Agriculture and Food Security (CCAFS)

Led by the International Center for Tropical Agriculture (CIAT)



**CLIMATE
CHANGE**
AGRICULTURE AND
FOOD SECURITY



Earth System
Science Partnership



CIAT
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What we do



Photo: N. Palmer (CIAT)

Theme 1: Adaptation to progressive climate change

Building adaptive capacity and food systems that are more resilient to progressive climate change through the provision of technologies, practices and policies.

Theme 2: Adaptation through managing climate risk

Bringing promising innovations in climate risk management help protect and enhance food security and rural livelihoods in the face of a variable and changing climate.



Photo: J. Hansen (CCAFS)



Photo: N. Palmer (CIAT)

Theme 3: Pro-poor climate change mitigation

Identifying climate change mitigation strategies that reduce poverty among the rural poor in developing countries.

Theme 4: Integration for decision making

Providing an analytical and diagnostic framework for the whole CCAFS research programme, to ensure that research is grounded in the policy environment, incorporates biophysical effects, quantifies uncertainty where possible, and ensures effective engagement of rural communities and institutional and policy stakeholders.



Photo: Andrew Ainslie (CCAFS)



Global

Where we work

West Africa



East Africa



Indo-Gangetic
Plains



Message from the Program Director



Photo: A. Shady (CCAFS)

2011 was the first year of operation of the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). CCAFS brings together the work of all 15 international Centres in the CGIAR, and is a joint programme between the CGIAR and the Earth System Science

Partnership (ESSP). 2011 was a start-up year in terms of introducing a new way of working across Centres, but it was also a year of considerable research effort.

Work was initiated in the field at many sites, and baseline surveys were completed in three regions on two continents. Regional partnerships and learning platforms for climate-smart agriculture were established or strengthened in all regions.

CCAFS conducted or participated in a number of high-profile events in 2011 and set up the Commission on Sustainable Agriculture and Climate Change, chaired by Sir John Beddington. International policy engagement targeted various processes linked to the United Nations Framework Convention on Climate Change (UNFCCC). A significant achievement was recorded in the Durban Agreement from the 17th Conference of the Parties (COP 17), namely the inclusion of 'agriculture' for further negotiation. Many publications were produced in 2011, including over 50 journal articles and a number of books.

External communication and media activities in 2011 have helped communicate science results and positioned CCAFS as an expert source of knowledge in global agriculture–climate discussions. Blog stories attracted 25 670 unique visits from 204 countries. Our monthly AgClim letters reached people in at least 124 countries and were sent to over 5000 recipients.

2012 will be a crucial year for negotiations on agriculture and climate change in the UNFCCC and for deepening activities with farmers at the multitude of research sites. 2011 has laid the framework, and it is particularly exciting to see the CGIAR starting to work as one system.

Bruce Campbell



Photo: N. Palmer (CIAT)

Building blocks to policy change



One of the overarching objectives of CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) is to provide diagnosis and analysis that will ensure the inclusion of agriculture in climate change policies, and the inclusion of climate change issues in agricultural policies. Even in the first year of operation, small steps were taken to make this a reality.



A year to remember

Agriculture is a significant cause of climate change, directly responsible for some 12–14% of greenhouse gas emissions. It is also a victim, with farmers around the world already facing an uncertain future as a result of rising temperatures, changing patterns of rainfall and the shifting distribution of pests and diseases.

Despite its significance for climate change, attempts to include agriculture in the text of international negotiations failed in 2009 and 2010. However, there was a breakthrough in December 2011, when the 17th Conference of the Parties (COP 17) to the United Nations Framework Convention on Climate Change (UNFCCC) met in Durban, South Africa. Following intense deliberations, delegates agreed to include agriculture in future negotiations, and it was referred to the Convention's Subsidiary Body for Scientific and Technological Advice (SBSTA) for detailed discussion.

"Without all the preparatory work that was done prior to the Durban meeting, including all the input by CCAFS, we would never have had this outcome," says Patrick Verkooijen, the World Bank's Head of Agriculture and Climate Change.

Prior to the meeting in Durban, and during the meeting, many organizations called for the creation of a 'work programme' for agriculture, similar to one that already exists for forestry. Among other things, they argued that a work programme would help to create a much-needed stream of financial support to promote climate-smart agricultural practices and encourage research on agricultural adaptation and mitigation. (See box: Calling for a work programme.)

Although there was no decision to set up a work programme, Sonja Vermeulen, CCAFS Head of Research, believes that significant progress was made in Durban. "The fact that agriculture is now on the SBSTA agenda is a major step forward," she says. She identifies a number of activities involving CCAFS which helped to push agriculture to the heart of climate change negotiations.

Changing the agenda

During 2011, the Meridian Institute convened a process to assess policy options for agriculture and climate change, focusing in particular on issues that should be addressed by the UNFCCC. CCAFS Program Director Bruce Campbell and Vermeulen contributed as expert authors and the Institute's report was published as a policy brief during the Durban conference.

Discussions at Durban were also influenced by the findings of the Commission on Sustainable Agriculture and Climate Change, which had been convened by CCAFS in early 2011. The Commission was given the task of examining scientific evidence and exploring ways of achieving food security in the face of a changing climate. In its *Summary for policy makers*, released in November, it outlined seven key steps that need to be taken if farmers are to cope with climate change and deliver sufficient high-quality food to satisfy the needs of a growing population.



KEY ACTIONS FROM THE COMMISSION ON SUSTAINABLE AGRICULTURE AND CLIMATE CHANGE:

1. Integrate food security and sustainable agriculture into global and national policies
2. Significantly raise the level of global investment in sustainable agriculture and food systems in the next decade
3. Sustainably intensify agricultural production while reducing greenhouse gas emissions and other negative environmental impacts of agriculture
4. Target populations and sectors that are most vulnerable to climate change and food insecurity
5. Reshape food access and consumption patterns to ensure basic nutritional needs are met and to foster healthy and sustainable eating habits worldwide
6. Reduce loss and waste in food systems, particularly from infrastructure, farming practices, processing, distribution and household habits
7. Create comprehensive, shared, integrated information systems that encompass human and ecological dimensions

reference: www.ccafs.cgiar.org/commission/reports

During the course of the year, CCAFS provided support which enabled the Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN) to promote climate-smart agriculture and make the case for raising the profile of agriculture in international climate change negotiations.

CCAFS also helped to organize a science meeting on climate-smart agriculture in Wageningen, the Netherlands, and prepared background material for a ministerial meeting in Durban, as well as meetings of regional farmers' organizations in Africa.



Photo: C. Schubert (CCAFS)

CCAFS co-organised several global science and policy meetings around climate-co-organized agriculture.

All of these activities helped to inform the discussions which were held during Agriculture and Rural Development Day (ARDD), a side event at Durban co-convened by CCAFS. ARDD, which attracted almost 600 participants, brought together diverse interests – farmers, researchers, policy makers, the private sector, national and international donors – so that they could share examples of climate-smart agriculture and promote policies to strengthen the voice of farmers in climate change negotiations.

During ARDD, UK chief scientist Professor Sir John Beddington presented the recommendations of the Commission on Sustainable Agriculture and Climate Change. Other high-level speakers included Kanayo Nwanze, President of the International Fund for Agricultural Development (IFAD), Tina Joemat-Pettersson, South Africa's Minister of Agriculture, Forestry and Fisheries, Lindiwe Sibanda, Chief Executive of FANRPAN, and Mary Robinson, President of the Mary Robinson Foundation – Climate Justice, and former President of Ireland.



Photo: N. Palmer (CIAT)

Photo: N. Palmer (CIAT)

Sir John Beddington, Chair of the Commission on Sustainable Agriculture and Climate Change (L) and Tina Joemat-Pettersson, South Africa's Minister of Agriculture, Forestry and Fisheries (R) both spoke at Agriculture and Rural Development Day in Durban, South Africa.

Bruce Campbell summed up the aim of ARDD in these terms: “We want agriculture to have a voice, and we want leadership and investment in the innovations and policies that can help poor farmers adapt to climate change and achieve food security, while contributing to mitigation and healthy ecosystems.”

Campbell was one of many speakers who called for the creation of a work programme on agriculture. Although this didn't happen at Durban, there is reason to hope that substantive deliberations on agriculture will now take place, given that agriculture is now on the formal agenda of SBSTA.

“ARDD HELPED SHAPE THE
DEBATE AT THE UN CONFERENCE
IN DURBAN.”

Professor Tekalign Mamo,

Adviser to Ethiopia's Ministry of Agriculture



CALLING FOR A WORK PROGRAMME

At an international conference on climate change and food security, held in Beijing, China, in November 2011, scientists from the BRICS countries – Brazil, Russia, India, China and South Africa – and colleagues from Indonesia and the United States agreed on a set of priorities to tackle climate change. They called for a significant increase in the funding of climate-related agricultural research, highlighting 12 priority areas.

Following the meeting, which was organized by the International Food Policy Research Institute (IFPRI), the scientists issued a direct call to the UNFCCC. “We urge the delegates to approve a Subsidiary Body for Scientific and Technological Advice (SBSTA) work programme on agriculture,” said Elisio Contini, head of the Brazilian Agricultural Research Corporation's Office of International Affairs. “It would catalyze new research and be a central venue for the world's research community to report its findings and identify the highest-priority research on adaptation and mitigation to reduce the suffering of the world's poor and vulnerable.”

A formal UN climate change work programme for agriculture could help kickstart more on the ground initiatives.



Photo: N. Palmer (CIAT)

Promoting partnerships in East Africa



During 2011, CCAFS focused its field research in East Africa on six benchmark sites: two each in Uganda and Kenya, one in Tanzania and one in Ethiopia. Between them, they cover a wide range of agricultural systems, from intensively farmed hill country in Tanzania's Usambara Mountains to sparsely populated rangelands in Ethiopia. However, they all have one thing in common: they are host to a large number of research and development projects, which was one of the reasons why CCAFS chose to work there. “We believe that we can achieve far more by working in partnership with other organizations than by working alone,” says James Kinyangi, CCAFS Regional Program Leader for East Africa.

In each of the benchmark sites, CCAFS conducted baseline surveys – these are described more fully in ‘Getting to grips with the facts’ (see page 16) – to gather information about farming practices, diet, incomes, the risks faced by households and communities, the way in which communities are organized, and much more. At a later date, survey teams will revisit the same villages and households and ask the same questions. This will enable CCAFS to make valid comparisons about behavioural changes and the influence of research and development projects.

During the year, CCAFS launched several climate-related projects at its benchmark sites, working in partnership with a wide range of organizations. In Kenya's Lower Nyando Basin, for example, projects involved research on the evaluation of drought-tolerant sorghum, a breeding programme to improve the adaptation of local sheep and goats, and an agroforestry scheme to help farmers take advantage of the carbon market. All, in one way or another, are designed to help farmers increase their incomes, adapt to climate change and variability and, in the case of the agroforestry scheme, reduce their carbon footprint.

Adding value through partnership

Kinyangi and his colleagues were struck by the sheer number of organizations – research institutes, government agencies, farmers' organizations, non-governmental organizations (NGOs) – operating in the benchmark sites. “They were introducing all sorts of different technologies, asking different questions, and working in different ways,” reflects Kinyangi. “We saw this as an opportunity to establish a learning platform, so that we could share the lessons learnt and feed our findings into the broader policy arena.”

Before long, 16 organizations had joined the learning platform, which held three workshops during 2011 to

discuss the best ways of linking research and policy making. “By creating a platform, I believe we can help policy makers drive the demand for research,” suggested Sabrina Chesterman of OneWorld at the first workshop, held in Nairobi in April 2011. “We can find out what policy makers need and determine how we can frame our research to answer their needs.”

The learning platform is guided by four main precepts. First, the partners recognize the importance of setting priorities for research. “We want our research to be demand-driven,” says Kinyangi. “That means we need to address issues which are of concern to farmers and policy makers.”

Second, the learning platform acknowledges the importance of generating and sharing knowledge in a way that enhances the capacity of the partner organizations and the communities with which they are working. The amount of information generated will be vast, and an ‘evidence-filtering’ process ensures that farmers, extension agencies and policy makers get the information they need.

Finally, the partners have agreed that information must be packaged in such a way as to influence policy. Over the coming years, the learning platform will benefit from the CCAFS scenario work – this looks at different ‘what ifs’ for the future – which is currently being coordinated by the University of Oxford’s Environmental Change Institute.

At present, says Kinyangi, many agencies are failing to meet the needs of the agricultural community. He cites the example of national meteorological agencies, which tend to package their information to satisfy the needs of certain sectors, such as those involved in aviation, defence and health. Agriculture is very low on their agenda. The learning platform will seek to convince meteorological agencies of the importance of providing information in a way that becomes useful to farmers.

“Ultimately, this is all about sharing lessons and knowledge, and bridging the gaps between different organizations, so that we add value to what everybody is doing,” says Kinyangi.

“WE CAN ACHIEVE FAR MORE
BY WORKING IN PARTNERSHIP WITH
OTHER ORGANIZATIONS THAN BY
WORKING ALONE.”

James Kinyangi,

CCAFS Regional Program Leader for East Africa



Photo: L. Cramer (CCAFS)

In East Africa, CCAFS is bringing together diverse regional groups to share knowledge and experiences.

NEW OPPORTUNITIES FOR RICE FARMERS

During recent years, the International Rice Research Institute (IRRI) and its partners have developed a water-saving technology, alternate wetting and drying, which enables rice farmers to significantly reduce methane emissions from their fields without any fall in yields. This is a matter of considerable importance, as the anaerobic decomposition in irrigated rice systems is responsible for around 11% agricultural greenhouse gas emissions.

Prior to 2011, rice farmers could not take advantage of the Clean Development Mechanism (CDM) of the UNFCCC, which has the twin goals of promoting sustainable development and reducing greenhouse gas emissions. Of the hundreds of different CDM methodologies, only one dealt with cropping practices. However, in 2011, a new methodology – ‘Methane emission reduction by adjusted water management practice in rice cultivation’ – was added to the list.

In the future, as work progresses on transferring the methodology and on how it could be put into practice in other regions, rice farmers could get paid under the CDM for reducing their methane emissions.



Photo: M. Lusmore (WorldFish Center)

The technique of alternate wetting and drying helps grow rice with less water.



Influencing climate change policy in Sri Lanka

Over recent years, the International Water Management Institute (IWMI) has made a significant contribution to the development of Sri Lanka's climate change adaptation policies.

The partnership between IWMI and government agencies dates back to a national 'Water for Food' conference organized by IWMI, the Irrigation Department and the Department of Agriculture in Colombo in 2009. "We had decided to get more involved with government agencies as we wanted to make a greater contribution to the development processes in the country," recalls IWMI's Nishadi Eriyagama. "We invited officials from several ministries and water/agriculture agencies to the conference, and that helped to raise the profile of our research."

Eriyagama and her colleagues had recently embarked on a major review, shortly to be published as *Impacts of climate change on water resources and agriculture in Sri Lanka*. "I presented some of the material we were working on – focusing, in particular, on our analysis of vulnerability to climate change – and many people from government agencies and NGOs picked up on this," recalls Eriyagama. The timing was propitious. The Ministry of Environment had begun to prepare the National Climate Change Adaptation Strategy for Sri Lanka. It was also in the process of drafting the country's Second National Communication to the UNFCCC.

Eriyagama and her colleagues were subsequently invited to attend workshops organized by the Ministry of Environment, and they provided information and commented on draft reports. The National Climate Change Adaptation Strategy used IWMI's methodology for mapping vulnerability to climate change, while the Second National Communication presented information drawn from IWMI's research.

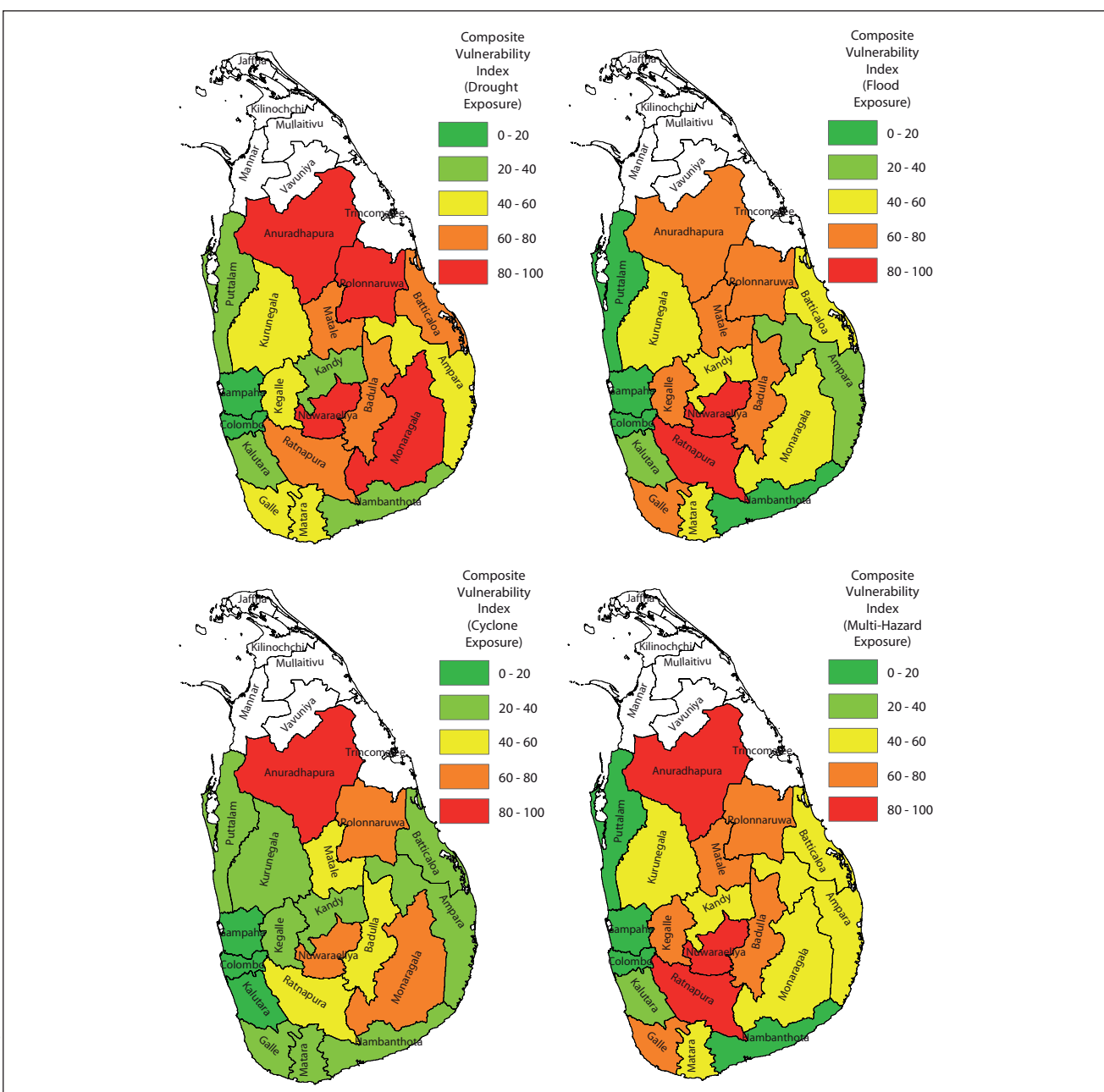
The IWMI 'Impacts of Climate Change' review indicates that mean temperatures are likely to increase by 0.9–4.0°C by the end of this century. Rising temperatures, and changes in the quantity and distribution of rainfall, could have a significant impact on farming activities. For example, they could lead to an increase in irrigation water requirements for rice and a decline in coconut productivity.

The study identified the country's agricultural vulnerability hotspots using an index which measures exposure, sensitivity and adaptive capacity. The vulnerability maps, which have been reproduced in a sub-report of the Second National Communication, indicate that certain farming districts are particularly vulnerable to climate change. "As the government itself initiated the strategy, I have no doubt that it will influence future policy, and encourage the government to formulate strategies which help farmers in the most vulnerable areas adapt to climate change," says Eriyagama.



Photo: Michael Mathiyalakan (Oxfam)

IWMI researchers are helping to inform Sri Lanka's climate adaptation strategies, and help farmers in the most vulnerable areas adapt to climate change.



Credit: Eriyagama N. et. al. 2010

Vulnerability maps reveal the districts of Sri Lanka that are most exposed to drought, flood, cyclone and other hazards.

IWMI's vulnerability study and the National Climate Change Adaptation Strategy have helped to raise awareness about the implications of climate change for the country. The media has certainly taken note: in 2011, the *Daily Mirror*, the country's leading English-language newspaper, commissioned IWMI scientists to write a series of five articles about the implications of climate change for Sri Lanka as a whole, and farmers in particular.

Further reading

Eriyagama, N.; Smakhtin, V.; Chandrapala, L.; Fernando, K. 2010. *Impacts of climate change on water resources and agriculture in Sri Lanka: a review and preliminary vulnerability mapping*. Colombo, Sri Lanka: International Water Management Institute. 51p. (IWMI Research Report 135). doi:10.3910/2010.

“RISING TEMPERATURES, AND CHANGES IN THE QUANTITY AND DISTRIBUTION OF RAINFALL, COULD LEAD TO AN INCREASE IN IRRIGATION WATER REQUIREMENTS FOR RICE AND A DECLINE IN COCONUT PRODUCTIVITY.”

Tools for climate change adaptation



Photo: P. Casier (CGIAR)

CCAFS aims to generate the tools needed to empower farmers, policy makers, researchers and civil society to successfully manage agricultural and food systems. An important example of this is the work on climate analogues.



In search of the future

Climate change will have a dramatic impact on the way we farm. Indeed, in some parts of the world, increases in temperature, changing patterns of rainfall and the shifting distribution of pests and diseases have already led to significant changes in farming practices. While some farmers may benefit from a warmer climate, others – and they will be the majority in many developing countries – will find their livelihoods under threat.

Until recently, we have relied on models to predict what will happen in any given location, but models, by definition, cannot be fully validated until the projected year arrives. Nor can they tell us how farmers will respond to climate change. “This means that discussions have tended to be abstract, about what might happen, not what will happen,” says Andy Jarvis, CCAFS Theme Leader. “But if you say: in 30 years’ time, the climate here, in this particular location, will be like it already is there, in another part of the world, then you can visit the place, explore what sort of crops they grow and see how farmers are coping with the climate.”

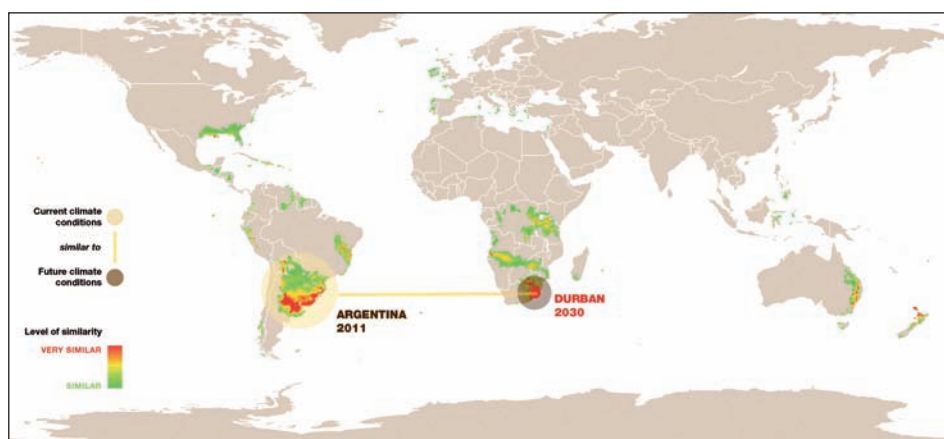
ABOVE: A farmer in Lawra village in Northern Ghana may soon experience climates similar to parts of West Africa the Indo-Gangetic Plains, and could potentially learn adaptation strategies from farmers in those areas.

A project managed by the International Center for Tropical Agriculture (CIAT) – *Climate analogues: Finding tomorrow’s agriculture today* – has devised a methodology that makes this possible. The project developed a web-based tool which connects sites with statistically similar climates, across both space and time. The tool allows users to choose from a variety of different climate models, scenarios and input data. The analogue methodology and concept of broad application were jointly developed by CIAT, the Walker Institute for Climate System Research at the University of Reading, and the Climate Change and Impacts Group at the University of Leeds, which is a core member of the Earth System Science Partnership (ESSP).

The benefits of time travel

The analogues team initially focused its attention on some of CCAFS’ benchmark sites. One of these is Lawra-Jirapa, Ghana, where climate projections predict higher temperatures and rainfall, coupled with a rising population and greater competition for water. The team identified a range of other sites in West and East Africa and the Indo-Gangetic Plains where the climate today is similar to the one projected for Lawra-Jirapa in 2030.

Some of the crops currently grown in Lawra-Jirapa, such as yam, were not grown in any of the analogue sites. This suggests that climatic factors may prohibit the production of these crops in Lawra-Jirapa by 2030. Farmers in most of the analogue sites were growing just one of three important crops – rainfed maize, rice and wheat – grown in Lawra-Jirapa, which suggests that the Ghanaian farmers may not be able to rely on the same three staples in the future.



Growing conditions today mirror future climates. The 2030 climate of a maize-growing area near Durban will correspond to the current climate of a major maize-growing area in Argentina. Growers in Durban can learn from these analogous climates how to adapt as their climate shifts.

Credit: Burness Communications

The research also identified crops currently grown in the analogue sites that might prosper in Lawra-Jirapa in 2030. In short, current practices in the analogue sites provide a glimpse of what could work best for the next generation of farmers in Lawra-Jirapa.

During 2012, Jarvis and his colleagues will organize a series of exchange visits between sites in East and West Africa and Southeast Asia to help farmers gain first-hand experience of the changes they are likely to face, and the sort of measures they will need to consider to cope with climate change.

“I’ve always found that farmers are incredibly adaptive – far more so than we give them credit for – and my hunch is that the farmers won’t be all that shocked by what they see at the analogue sites,” says Jarvis. “Our goal is to develop an inventory of local knowledge from around the world while linking regions that face similar challenges. In many ways, we’re turning the world into a laboratory for climate change adaptation.”

Sharing genetic resources

The analogues tool (<http://gismap.ciat.cgiar.org/analogues/>) has already attracted the attention of a range of organizations, including Bioversity International, which is playing a leading role in encouraging the implementation of the International Treaty on Plant Genetic Resources for Food and Agriculture. The treaty seeks to provide farmers, plant breeders and scientists with access to germplasm through its multilateral system of access and benefit sharing.

“Countries that have signed up to the treaty have agreed to the rules of the game, but so far they have been reluctant to share their genetic material and information about what they have,” explains Michael Halewood, a policy expert with Bioversity. “They’re waiting for others to do so first.”

There is considerable evidence that all countries benefit from what Halewood calls ‘the multiplier effect’ of participating in the multilateral system. Most countries get

more material – and far more diverse material – from the system than they deposit into it.

Bioversity is supporting research in eight countries to investigate the extent to which they are dependent on genetic resources from beyond their borders. In particular, the research focuses on identifying the shifting range of genetic resources that countries will need to adapt to climatic changes.

Halewood believes the analogues tool will be very useful in this regard. “It will help us to raise awareness about countries’ interdependence and the importance of sharing germplasm and information,” he says. “We will use the analogues tool to identify potential sources of useful germplasm for the countries concerned, based on predicted changes in their climates.” The research teams will also use the tool to identify other parts of the world where their germplasm might be useful.

“MAKING THESE LINKS MIGHT OFFER CLUES ABOUT PRACTICAL, PROVEN APPROACHES THAT COULD ENABLE POOR PEOPLE WHO DEPEND ON AGRICULTURE TO ADAPT THEIR FARMING TO CHANGES IN TEMPERATURE AND PRECIPITATION.”

Julian Ramírez, CIAT scientist

Further reading

Ramírez-Villegas J, Lau C, Köhler A-K, Signer J, Jarvis A, Arnell N, Osborne T, Hooker J. 2011. *Climate analogues: Finding tomorrow’s agriculture today*. Working Paper No. 12. Cali, Colombia: CCAFS.



Understanding the impact of climate change



Photo: N. Palmer (CIAT)

CCAFS devotes considerable effort to developing methods, datasets and platforms for monitoring and predicting the impact of climate change and climate fluctuations on food systems. These will help us to identify vulnerable populations and measures that will help them adapt to the changing climate.



Highlighting the hunger hotspots

A study coordinated by CCAFS has identified areas where food insecurity is likely to be exacerbated by climate change. This is an important subject as research organizations, governments and donors urgently need to work out where to focus activities that will help farmers adapt to a changing climate. *Mapping hotspots of climate change and food insecurity in the global tropics* is one of the first studies to provide this sort of guidance.

The research was led by a team of scientists from the International Livestock Research Institute (ILRI). They created a series of detailed maps illustrating different aspects of food security – and food insecurity – and some of the climate change thresholds that could threaten food production over the next 40 years. The maps also illustrate which areas and populations may be most vulnerable to climate change.

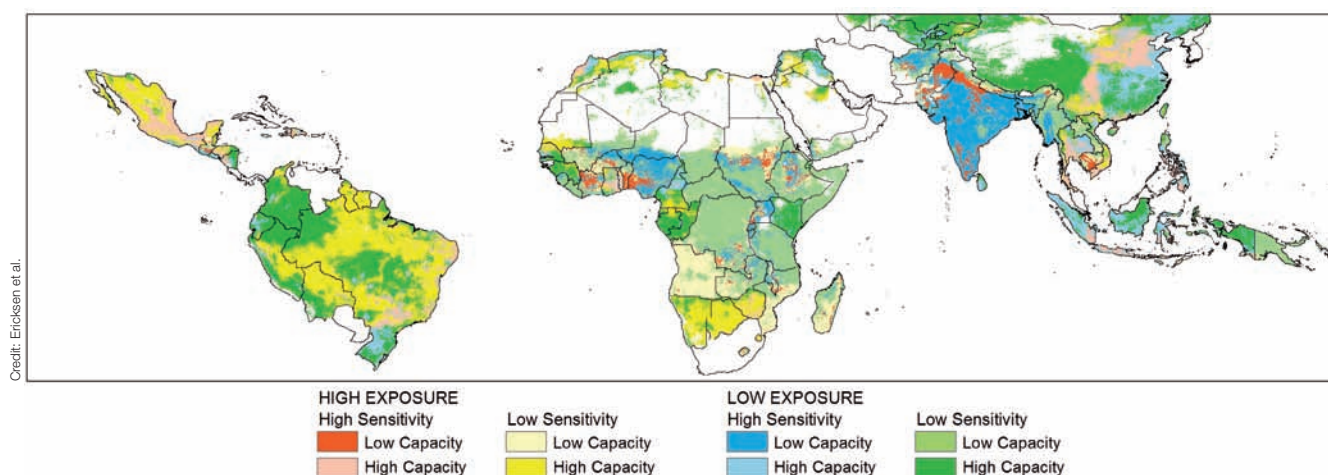
ABOVE: Beans are essential to the food security of large areas of Africa and Latin America. But according to CCAFS research, even the modest temperature and rainfall changes predicted for major bean-growing regions could significantly reduce the area suited for this crop.

“When you put these maps together, they reveal places where the arrival of stressful growing conditions could raise concern,” says ILRI’s Polly Ericksen, lead author of the study. “These are areas highly exposed to climate shifts, where livelihoods are strongly linked to crop and livestock yields, and where chronic food problems indicate that households are already struggling.”

The scientists began by identifying the components of food security that could be mapped at the global level, and the most appropriate indicators of climate change impact relevant to food security. They were then able to identify ‘hotspots’ where food-insecure populations face significant changes in rainfall, temperature and length of growing season.

Vulnerability to climate change was conceived as a function of three factors: the exposure to a hazard, such as rising temperatures; the sensitivity to the hazard – for example, areas with large areas of cropland will be more sensitive than those with less; and the ability of farmers to cope with change. “If a population is highly exposed to a particular hazard, such as rising temperatures, and has little ability to cope, then it may be vulnerable,” explains Philip Thornton, CCAFS Theme Leader.

Measuring vulnerability across the global tropics was a tall order, for a variety of reasons. For one thing, food insecurity is a function of a range of different factors, and the way it is measured varies between countries. For another, the scientists were obliged to use a ‘proxy’ as a measure of coping capacity. In this case, they used child malnutrition,



In this map, the red areas are food-insecure and intensively farmed regions that are highly exposed to a potential five percent or greater reduction in the length of the growing season. Such a change over the next 40 years could significantly affect food yields and food access for 369 million people—many of them smallholder farmers—already living on the edge.

for which there is comparable global data. “Despite these and other limitations, I think we have devised a semi-quantitative system for measuring vulnerability that provides a clear indication of where the greatest stresses may come in the future,” says Thornton.

The study found that the length of growing season declined by 5% or more across a broad area of the tropics, including heavily cropped areas of Mexico, Brazil, Southern and West Africa, the Indo-Gangetic Plains and Southeast Asia. In drier areas this may lead to a decline in crop yields and an increase in the number of people – many will be farmers – who have insufficient food for a healthy diet.

Higher temperatures could also cause severe problems in many areas. It is estimated that 170 million food-insecure and crop-dependent people in West Africa, India and China live in areas where maximum daily temperatures during the growing season could exceed 30°C by the mid-2050s. This is close to the maximum temperature that can be tolerated by beans, and maize and rice yields are likely to decline when temperatures exceed this level.

The ILRI team also found that some areas that are currently relatively food secure – this applies, in particular, to parts of Latin America – could suffer from higher temperatures and shorter growing seasons. By 2050, prime growing conditions are likely to drop below 120 days per season in intensively farmed parts of northeast Brazil and Mexico. This could reduce the yields of maize and several other staple crops, as well as the availability of livestock fodder.

“WE HAVE DEVISED A SEMI-QUANTITATIVE SYSTEM FOR MEASURING VULNERABILITY THAT PROVIDES A CLEAR INDICATION OF WHERE THE GREATEST STRESSES MAY COME IN THE FUTURE.”

Philip Thornton, CCAFS Theme Leader

Further reading

Ericksen PJ, Thornton PK, Notenbaert A, Cramer L, Jones PG, Herrero M. 2011. *Mapping hotspots of climate change and food insecurity in the global tropics*. CCAFS Report No. 5. Copenhagen: CCAFS.

WINNERS AND LOSERS IN CENTRAL ASIA

The impact of climate change on rural households in Central Asia is likely to vary from one place to another, with some benefiting from higher temperatures and others experiencing a significant decline in their yields and incomes. This was one of the findings of a research project – ‘Adaptation to climate change in Central Asia and the People's Republic of China’ – managed by the International Center for Agricultural Research in the Dry Areas (ICARDA) in collaboration with the International Food Policy Research Institute (IFPRI).

The research team, which included scientists from agricultural research organizations in Uzbekistan, Kazakhstan, Tajikistan and Kyrgyzstan, used crop simulation models, data collected from farm surveys and an economic risk programming model to predict the impact of climate change on different agro-ecosystems.

The study found that the impact could range from largely positive – for example, in the semi-arid regions of North Kazakhstan – to largely negative in more arid regions of the country. The research also found that small-scale farmers, especially those with a large proportion of female-headed households and poor access to agricultural extension services, were likely to suffer most. In contrast, larger farming operations run by men, with better access to extension services, will fare better in the future. In some areas, the impact of climate change may vary over time. For instance, farmers in Uzbekistan may experience a slight increase in their incomes between 2010 and 2040, but a decline towards the end of the 21st century.

According to the lead scientist, Aden Aw-Hassan of ICARDA, there is an urgent need for more comprehensive quantitative analyses of the way in which climate change will affect different socioeconomic groups in rural areas. “This research would help to strengthen efforts to empower farmers with the skills and services needed to adapt to climate change and reduce their vulnerability to its effects,” he says.

An uphill struggle for high-value crops?

Climate change threatens the future of some of the most important cash crops grown in developing countries, according to research published by CIAT in 2011. The studies predict that rising temperatures will change the face of cocoa farming in Ghana and Côte d'Ivoire, tea production in the highlands of Kenya and Uganda, and coffee growing in Colombia.

This has profound implications not just for large numbers of farmers, but for everybody associated with the processing, transport and sale of these crops. In Uganda, 60 000 small-scale tea farmers provide the raw material for a ‘value chain’ that supports 500 000 people. In Côte d'Ivoire, some 600 000 farmers grow cocoa, a crop which contributes 7.5% of the country's gross domestic product.

Cocoa futures

Between them, Côte d'Ivoire and Ghana produce over half the world's cocoa beans. The research anticipates that a temperature rise of 1°C by 2030 will make cocoa growing at low altitudes increasingly difficult; by 2050, when temperatures will have risen by 2.3°C, farmers in



Photo: N. Palmer (CIAT)

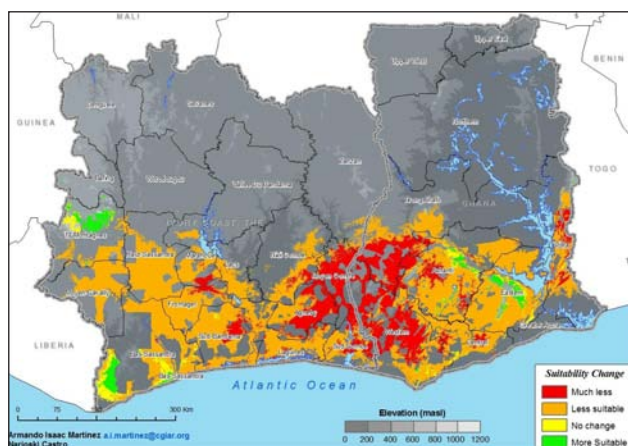
Photo: N. Palmer (CIAT)

New studies predict that rising temperatures will change the face of tea production in the highlands of Kenya and Uganda (above), and coffee growing in Colombia (below).

major cocoa-growing areas, such as Moyen-Comoé in Côte d'Ivoire, may no longer be able to grow the crop. The ideal growing areas will shift to higher altitudes, where the temperatures in 40 years' time may be similar to those in the lowlands today.

But this poses problems too. "Much of West Africa is relatively flat and there is no 'uphill'," says CIAT scientist and lead author Peter Laderach. He warns that the search for new cocoa-producing sites at higher elevations, where these exist, could trigger the clearance of forests. "For these reasons, it's essential that we focus on increasing the resilience of existing production systems as much as possible," he says.

A similar story can be told for tea in Uganda and Kenya. In a separate study, the CIAT scientists found that average temperature rises of 2.3°C by 2050 could wipe out tea production in some of the most profitable tea-growing regions of Uganda. Rising temperatures will lead to declining yields and an increase in the prevalence of pests and diseases. This could encourage farmers to move to higher altitudes – threatening forests and areas of importance for wildlife.



Suitability change for cocoa-growing regions in Ghana and Ivory Coast in 2050. Source: CIAT

In search of solutions

Laderach points out that there is always a degree of uncertainty when predicting how the climate will change; it is even more difficult to predict how farmers will react to change. "However, I believe that these results, when combined with other authoritative studies, should help to ensure that the need for action is taken seriously," he says.

The Cafédirect Producers' Foundation, which commissioned the study on tea production, has already met farmers' groups in Uganda and Kenya to discuss the implications of these findings. The Ghana Cocoa Board, having initially dismissed the findings of the CIAT report,

subsequently commissioned a study to explore how the country's cocoa farmers could adapt to the changing climate.

Laderach and his colleagues have identified a number of options. In West Africa, farmers should consider improving shade management, as this will reduce the temperatures experienced by the cocoa pods. At present, many farmers are almost entirely dependent for their income on cocoa. It would make sense for them to spread their risk by investing in other crops, such as oil palm and cashew. Similarly, tea farmers in East Africa should consider diversifying their farming enterprises.

Just as importantly, the scientists recommend that farmers should be encouraged to plant more drought-tolerant varieties of cocoa and tea. If this is to happen, it is essential that research institutions devote greater efforts to developing new varieties and making them available to farmers.

“MANY FARMERS ARE ALMOST ENTIRELY DEPENDENT FOR THEIR INCOME ON COCOA. IT WOULD MAKE SENSE FOR THEM TO SPREAD THEIR RISK BY INVESTING IN OTHER CROPS, SUCH AS OIL PALM AND CASHEW.”

Further reading

[CIAT] International Center for Tropical Agriculture. 2011. *Future climate scenarios for Uganda's tea growing areas*. Cali, Colombia: CIAT.

[CIAT] International Center for Tropical Agriculture. 2011. *Predicting the impact of climate change on the cocoa-growing regions in Ghana and Cote d'Ivoire*. Cali, Colombia: CIAT.



POOLING KNOWLEDGE

During 2011, CCAFS scientists published a series of studies on 'climate-proofing' crops that are critical to food security. These include potatoes, beans, bananas and cassava. "We've brought together the best climate science with the best knowledge of crop improvement to spell out how crops will be affected, and what plant breeders can do to avert, or at least cushion, potentially devastating blows," says Julian Ramírez, CIAT scientist and one of the authors.

The studies suggest that the most direct impact on yields will come from changes in temperature and rainfall, but climate change could also alter the prevalence of pests and diseases. Among the crops that are likely to suffer most is the potato. Higher temperatures are projected to reduce the growth of the tubers and the formation of starch; they could also encourage the potato tuber moth, a major pest, to spread northwards and to higher elevations. In contrast, cassava might actually benefit from higher temperatures. But this is the exception rather than the rule, and there is an urgent need to develop new climate-proof varieties of potatoes, beans and other crops.

The research has been made available on the website of the recently launched Adaptation and Mitigation Knowledge Network (AMKN) (www.amkn.org). This platform brings together a large volume of knowledge from a wide range of sources about climate change mitigation and adaptation, with links to interactive maps. "By combining on-the-ground realities with cutting-edge research outputs, and making key information freely and easily available for the first time, the AMKN should greatly enhance our understanding of the threat that climate change poses to food security, and ultimately our ability to curb the threat," says Osana Bonilla-Findji, CCAFS Science Officer based at CIAT.



Photo: N. Palmer (CIAT)

Photo: P. Casler (CGIAR)

Higher temperatures spell bad news for potatoes (L), as risks of pests increase. Cassava (R), on the other hand, may actually thrive in a hotter climate.

Getting to grips with the facts



In Lower Nyando, Kenya, 80% of households interviewed during a recent survey reported that they had made changes to the way in which they farm. They had introduced new crop varieties, planted fruit orchards, adopted new forms of pest management, or introduced other changes. They were responding to a range of challenges, some related to changes in the weather, others to the demands of the market or the availability of farm labour.

There is nothing unusual about this: farmers across the developing world are continually fine-tuning the way in which they farm. What is new, however, is the scale and nature of the research which elicited this information. The Lower Nyando farmers were among over 5000 households who took part in baseline surveys conducted by CCAFS in East Africa, West Africa and the Indo-Gangetic Plains.



Photo: W. Foerch (CCAFS)

CCAFS researchers and villagers join for the Lower Nyando baseline survey activity.

"We want to be able to track behavioural change over time, at the household and community level," says Philip Thornton, CCAFS Theme Leader. "At a later date, we will be able to revisit the same families, in the same villages, and find out what they have done, and why they have done it." Few research programmes have ever attempted this by asking the same questions and using the same survey methodology across such a broad range of different agricultural systems.

Gathering the data

CCAFS worked closely with other organizations – and especially Centres belonging to the CGIAR – to identify sites where there was already considerable research activity. "We then developed a standardized set of survey and analysis tools so that we can make valid comparisons between the different sites," explains CCAFS Theme Leader Patti Kristjanson, who co-led the surveys.

At the household level, questions were designed to gather information about food security, farming practices, incomes and a whole range of issues relating to the well-being of the farm and the family. The survey teams conducted separate interviews, with a different set of questions, at the community level; they also collected data about the institutions, organizations and networks active within the villages.

The process of analysis has only just begun, but some interesting trends have emerged. It seems that the least food-secure households are those that make the fewest changes to their farming practices. According to Kristjanson, there are two ways of interpreting this. On one hand, it suggests that very poor households simply can't afford to adopt new practices, which involve more labour and other costs. "So if you want to reach these households, governments need to think about creating safety nets – for example by improving access to food through food-for-work and other programmes – before they will be in a position to adopt new farming practices," she says.



Farmers in Madyapur village, Punjab, India, have planted poplar trees on the edge of their fields to boost their income without interfering with crops. The baseline surveys are finding that farmers already have many tools for building their resilience, which will be key for climate adaptation.

There is also another way of looking at it: households that have adequate food may be the most innovative. But if that's the case, then why? "This will be one of the challenges we face, coming up with answers to questions like this," says Kristjanson. She stresses that it is all too easy to say that such-and-such a change has been made, or practice adopted, in response to climate change. Frequently a range of factors encourage farmers to adopt new practices, variability in the weather being just one of them.

Taking the long view

Kristjanson believes that one of the main achievements of the project has been its openness: all the data that have been gathered, and the subsequent analyses, have been made available on the Internet, using Harvard University's Dataverse Network. "Scientists are often very reluctant or unable to share their data soon after they are collected," she says. "We've shown that it's possible to gather large quantities of data and swiftly make them available." CCAFS is encouraging its research partners to make full and immediate use of the data.

The management of the baseline survey was a major logistical feat, with Kristjanson and her colleagues providing training for 12 survey teams – one team for each of the 12 countries involved – 100 enumerators and 24 'trainers of trainers'. The latter are responsible for training much larger teams, many of which will continue to have a role in the future.

One of the great constraints for many research endeavours is lack of time, with many projects lasting just three years. "It's very difficult to study changes in behaviour if your time horizon is so short," says Thornton. He anticipates that the survey teams will revisit the households and villages that took part in the 2011 baseline surveys in five years' time, and again in 10 years. "This gives us a realistic opportunity to understand what changes people have made to their farming practices, and how they're adapting to changes in the climate," he says. It will also provide researchers with an opportunity to reflect on the influence of the various projects that are currently taking place at the survey sites.

“WE’VE SHOWN THAT IT’S POSSIBLE TO GATHER LARGE QUANTITIES OF DATA AND SWIFTLY MAKE THEM AVAILABLE.”

Patti Kristjanson, CCAFS Theme Leader

Further reading

<http://ccafs.cgiar.org/resources/baseline-surveys>



Photo: S. Majumder/Drik CIMMYT

Gender and social differentiation



Gender and social differentiation have an important bearing on how we will transform our farming and food systems in response to climate change. An ambitious gender strategy was initiated in 2011.



Closing the gender gap

“Climate change affects men and women differently,” says CCAFS Theme Leader Patti Kristjanson, “and their response to the impact of climate variability and change also differs.” This is why we need to start thinking about specific strategies and approaches which will ensure that interventions aimed at making households more resilient to a changing climate will benefit women as well as men.

“There is much talk about climate-smart agriculture, but are climate-smart practices also women-smart?” asks Kristjanson. She cites the example of payments made to farmers to reduce their carbon emissions or sequester carbon. If the money goes to the landowners— who, in many developing countries, will be the men— then the women will lose out. Likewise, women may find themselves doing all the hard work of planting trees, but may not share the rewards in terms of the income derived from the sale of fruit and timber. Righting these wrongs is essential if women are to get a better deal.

During 2011, CCAFS worked on a major research programme with the UN Food and Agriculture Organization (FAO) to develop a training guide for gender and climate

Rural men and women will experience climate change differently, due to existing social and economic divisions. CCAFS is working to ensure that climate change adaptation and mitigation measures deliver benefits to all.

change research. Much of the climate-related research on agricultural and farming systems has examined a range of options that come under the heading of climate-smart agriculture, such as conservation agriculture and agroforestry. In contrast, little emphasis has been placed on understanding the different strategies adopted by men and women who are trying to cope with climate change.

The approach that FAO and CCAFS developed in the guide – *Gender and climate change research in agriculture and food security for rural development* – was tested in the field in Bangladesh, Ghana and Uganda.

“In many of these places, women farmers face a range of challenges which are different from those confronting men,” explains Moushumi Chaudhury, a CCAFS Science Officer based at the World Agroforestry Centre. “For example, in Ghana, the research team found that both men and women learn about promising agricultural practices when they visit other villages. But women tend to travel less frequently and less far than men, so they don’t have the same access to knowledge about the strategies and new opportunities that can help them deal with changes in weather patterns, as well as various other socioeconomic changes.”

The first part of the training guide provides users – researchers, NGOs, development agencies, government extension services – with the resources and participatory action research tools they need to gather, analyse and share gender-related information about individuals, households and communities who are facing agricultural-production and food-security challenges.

The second part of the guide focuses on three key CCAFS research areas. It provides information that will enable organizations to facilitate the exchange of knowledge between farming communities about 'In search of the future' areas (see page 10). The guide also provides guidance on how to help farmers make best use of daily and seasonal weather forecasts, and how to understand and encourage climate-smart agricultural practices that provide benefits for women as well as men.

"It is important that the consequences of climate change should not lead already marginalized sections of society into further deprivation," says Jesse Naab, a scientist at the Savanna Agricultural Research Institute in Ghana who was involved in research for the training guide. "It's equally important that policy makers and others understand the differing vulnerability to climate change that men and women face."

“WOMEN MAY FIND THEMSELVES DOING ALL THE HARD WORK OF PLANTING TREES, BUT MAY NOT SHARE THE REWARDS IN TERMS OF THE INCOME DERIVED FROM THE SALE OF FRUIT AND TIMBER.”



Photo: J. Hansen (CCAFS)

Further reading

[CCAFS, FAO] CGIAR Research Program on Climate Change, Agriculture and Food Security, Food and Agriculture Organization. 2012. *Training guide: Gender and climate change research in agriculture and food security for rural development*. Copenhagen: CCAFS; Rome: FAO. (Available from www.fao.org/climatechange/micca/75949/en/) (Accessed on 1 June 2012)

SMALL GRANTS TO RESEARCH BIG ISSUES

In 2011, CCAFS established a competitive small grants programme to encourage gender-related climate change research, with funds being awarded to five female researchers. The programme is helping to expand CCAFS gender research in its three priority regions; it is also building research capacity among young women scientists.

The women are studying a broad range of topics. In Uganda, Annuciate Nakiganda is focusing on how climate change is affecting men and women who are involved in livestock farming, and identifying adaptation strategies that will help women. In Bangladesh, Gulsan Ara Parvin is examining what microfinance institutions are doing to help women in rural areas cope with climate change. Nani Raut, an expert on watershed management, is assessing the role of gender in crop intensification in the Nepalese hills. In Burkina Faso, Some Laetitia, a human rights expert, is exploring ways of promoting gender perspectives in national climate change adaptation policy and practice. Finally, Senegalese researcher Arame Tall is examining whether there are gender-specific needs for climate information in communities at risk of flooding and drought. Her story is told in full on the following page.

Research which will benefit women

Over the past decade, Senegal's 'peanut basin' has suffered an increase in severe weather events, such as droughts and floods. Over 85% of the population in this predominantly arid region depend on natural resources for their livelihoods and survival – most being farmers, cattle herders or fishers – and the changing climate poses a significant threat to their welfare. Women, it seems, are particularly vulnerable, according to research conducted by Arame Tall, one of five women scientists to benefit from the CCAFS gender grants programme in 2011.



Photo: J. Hansen (CCAFS)

Farmers in Senegal learn how to collect rainfall data as part of climate information training.

A consultant at the International Federation of the Red Cross with a PhD from Johns Hopkins School of Advanced International Studies, Tall is working with three communities in Kaffrine. "I decided to focus on this district because it is highly prone to floods and droughts, and a good place to explore their impact on women, and the sort of climate services they need," says Tall. She is also benefiting from the fact that Kaffrine is one of the sites where CCAFS has conducted baseline studies (see page 16).

The main objective of Tall's research is to establish whether there is a need for climate services, tailored specifically to women's needs, in communities which are at risk of floods, droughts and other climatic shocks. And if there is, what form should they take, who should they be for, and how can they be communicated at the local level to improve the communities' ability to manage climate-related risk?

Gathering information in the field proved a serious challenge, not least because travel was difficult during the rainy season. Fortunately, Tall was able to enlist the help of the Senegalese Red Cross Society, which provided transport and the services of 24 volunteers, who were trained to carry out the 'Vulnerability and Capacity Assessments'. The assessments provide information about the respective vulnerability of men and women to climate changes, their ability to cope, the availability of climate change services, and the specific needs of women.

"Initially, it wasn't easy to get women to speak out about their lives and the challenges they face," explains Tall. "Getting tongues untied, even as a woman speaking the local language and within women-only focus groups, was a tough challenge." Nevertheless, Tall gradually gained the trust of the local women and began to gain an insight into how the climate was affecting them.

A story of disadvantage

Tall found that one of the main problems faced by women in this area is that they don't control the means of production. The carts and draft animals which are used to cultivate the fields all belong to the men. When the first rains come, normally in early July, the men use their horses and donkeys to cultivate and sow their own land, much of which is devoted to the main cash crops, peanuts and millet. As a result, it may be a month or more before they get round to sowing crops for the women on the plots of land which they manage.

"In the old days, when the rains were reasonably plentiful and predictable, this may not have been a problem," says Tall. "But nowadays, with greater climatic variability, late planting can be a disaster, especially if the rains finish early, as they did in 2011. This means that it's the women who tend suffer most from the erratic climate."

The National Meteorological Office of Senegal provides forecasts warning of heavy rainfall, and possible flooding, using a range of different methods, one of the most effective being SMS texts. Tall discovered that these were being provided in French, a language which many people cannot read, and both men and women expressed a preference for receiving texts in the local language, Wolof. Measures are now being taken to ensure that this happens in the future.

"Our early analysis suggests that climate forecasts are reaching men much more easily than they are women, so we are designing a number of strategies to overcome this," says Tall. One of these involves setting up blackboards near water wells, where women tend to gather. These will carry climate warnings taken from SMS services.

During 2012, Tall will continue to work with the women in Kaffrine to design climate services which will provide them with the information they need to safeguard their farms and their families. The research findings could also help government agencies to formulate policy to improve climate-change adaptation strategies.

“GETTING TONGUES UNTIED, EVEN AS A WOMAN SPEAKING THE LOCAL LANGUAGE AND WITHIN WOMEN-ONLY FOCUS GROUPS, WAS A TOUGH CHALLENGE.”

Arame Tall, Senegalese scientist



Photo: N. Palmer (CIAT)

Working with farmers



A fundamental principle of CCAFS is that we need to work from the bottom up, identifying appropriate technologies and practices with farmers. In 2011, we established benchmark sites in three regions, and initiated a programme of action research.

Creating climate-smart villages on the Indo-Gangetic Plains

There are dozens of different activities that could help farmers adapt to climate change, or reduce their emissions. Little wonder, then, that farmers are sometimes bewildered by the advice they receive. On the Indo-Gangetic Plains, CCAFS has come up with a concept that should make the prospect of adopting climate-smart activities less daunting. This is being done under the banner of 'climate-smart villages'.

The process begins with meetings at which the farmers discuss the sort of activities in which they would be interested. "We then offer them a portfolio of different projects and strategies for tackling current climatic variability," explains Pramod Aggarwal, CCAFS Regional Program Leader for the Indo-Gangetic Plains. "We talk them through all the costs and benefits of different activities, then it's up to them to identify the ones that interest them."

During 2011, CCAFS and its local partners established strong relationships with six villages in the Indian states of

Farmers in the Indo-Gangetic Plains are embracing information and communication technologies like mobile phones, which could help spread information and build their resilience to changing conditions.

Punjab and Bihar, and began discussions in three villages in Nepal. Work in Khulna District, on the southern coast of Bangladesh, was scheduled to begin in 2012.

The process is always the same. A steering group, led by CCAFS and its partners, identifies a list of possible activities to be tested in the village. A farmers' group, including village officials, is then introduced to the concept of climate-smart villages and the portfolio of activities on offer. After a series of discussions, the group decides which activities they favour and enter into an agreement with CCAFS and its partners. This stipulates that the farmers will keep a detailed diary of all the activities, thus providing CCAFS researchers and their colleagues with a rich source of data. This will enable them to assess the relative merits of different climate-smart practices.

Among the activities that are being promoted are carbon-sequestering practices such as agroforestry, conservation farming and better manure management. Farmers are being encouraged to improve their nutrient management, for example through the use of leaf colour charts. In some villages, farmers are particularly keen to improve water management through better irrigation and by setting up rainwater harvesting schemes. The project is also encouraging the use of information and communication technologies (ICTs), such as mobile phones, and rainfall and temperature insurance. Mobile phones can be used to receive accurate weather forecasts, as well as information about climate-smart practices and markets.

Several women farmers from the climate-smart villages attended the first of a series of a capacity-enhancement workshops on 'Gender and climate change adaptation' organized by CCAFS. The two activities – the climate-smart villages and the capacity-enhancement workshops – complement each other. In the end, says Aggarwal, it's all about identifying activities that enable farmers to address current climatic variability and make a decent living at the same time. "They are interested in everything that will help them to increase their profits," he says.



Taking the heat out of farming

Until recently, a number of obstacles have made it difficult, if not impossible, for small-scale farmers to take advantage of the carbon market, which is based on organizations or individuals selling the carbon they capture – for example, through planting trees – to countries or companies that wish to offset their own carbon emissions.

"They can't produce the minimum volume required to enter the market, their landholdings are small and scattered, and they conduct all sorts of diverse activities to feed themselves and make a living, which makes measuring carbon stocks a complicated business," explains Pal Singh, the World Agroforestry Centre's Regional Coordinator for the Indo-Gangetic Plains. Furthermore, the costs of registering projects, drawing up contracts and monitoring carbon stocks are prohibitively high for smallholders acting alone or in small groups.

To get round these problems, the World Agroforestry Centre devised a project – 'Enabling smallholders to improve their livelihoods and benefit from carbon finance' – which has encouraged large groups of farmers to adopt activities which improve their yields and incomes and, at the same time, either reduce their emissions or sequester carbon. By mid-2011, over 5000 farming households in four areas that are home to poor tribal communities had adopted

SHAPING MEXICO'S CLIMATE-SMART FUTURE

During recent years, farmers in many parts of Mexico have been affected by an increase in the frequency of droughts, abnormal frosts and other severe weather events. Matters could soon get worse, with some experts predicting that climate change could reduce the country's crop production by more than 25% – unless farmers change the way they farm.

In April 2011, the Mexican President, Felipe Calderón, launched a major new research and development initiative – Sustainable Modernization of Traditional Agriculture, or MasAgro – at the headquarters of the International Maize and Wheat Improvement Center (CIMMYT). The initiative is designed to help small-scale farmers significantly increase their yields of maize and wheat. The measures being promoted will also help farmers adapt to the changing climate and reduce their carbon footprint.

"MasAgro is based on a combination of our bread-and-butter research – developing improved varieties – and introducing climate-smart farming practices such as conservation agriculture," says Jonathan Hellin, an economist at CIMMYT. "The project recognizes that there is no point in providing farmers with excellent heat- and drought-resistant varieties of wheat or maize if they're going to be grown on poorly managed land."

Conservation agriculture is based on three principles: reduced tillage, the retention of cover all year round, and the rotation of crops, including nitrogen-fixing legumes. Between them, these activities can significantly reduce water and nutrient losses, boost crop yields, and help farmers cope with greater climatic variability.

CIMMYT is playing a lead role as the 'network broker', bringing together over 150 different organizations and interests – private seed companies, extension services, research institutes, farmers' organizations – to promote the adoption of new 'climate-proofed' varieties of maize and wheat and conservation agriculture. MasAgro is being run through a series of decentralized hubs, which enable partners to test and adapt technologies to suit their local conditions. By early 2012, over 2500 farmers were running more than 3000 implementation plots.

MasAgro will also improve the efficiency of value chains, reduce post-harvest losses and research the best ways of scaling up innovative technologies, such as conservation agriculture. The 10-year project aims to increase Mexico's annual maize production by 5–9 million tonnes in rainfed areas and annual wheat production by 350 000 tonnes. The project will raise the incomes of tens of thousands of poor farmers and make a significant contribution to Mexico's food self-sufficiency.



The smallholder carbon project is helping to reduce the consumption of fuelwood. Many families use crop roots as cooking fuel.

measures that fell into three main categories: planting trees to sequester carbon; switching to agricultural practices that reduce emissions, such as ploughing crop residues back into the soil rather than burning them; and reducing energy consumption by using fuel-efficient stoves and energy-saving compact fluorescent lamp (CFL) bulbs.

"At the household scale, these measures may sound trivial," says Singh. "But when you add together the activities of many thousands of farming families, they become highly significant, both for the environment and for the farmers."

In Andhra Pradesh, for example, it is estimated that farmers where the project is operating could save the equivalent of 11 500 certified emission reductions (CERs) per year. Assuming a value of USD 5 per CER, the households here would receive over USD 55 000 a year – a huge sum of money in a remote tribal area. Even if they don't, farmers say they will continue to adopt measures that reduce their carbon footprint because they make financial, as well as environmental, sense.

One of the strengths of the project is that nothing other than technical advice has been given free of charge. Farmers who receive fuel-efficient stoves, CFL bulbs or tree seedlings pay a share of the costs, generally around 50%. Money raised this way is placed in the bank accounts of organizations, run by the villagers, which have been established to handle all the financial aspects of carbon management.

A number of companies, including Danone, the Ambuja Cement Foundation and Sony, have expressed an interest in buying carbon credits from the project. International donors have also been impressed. The German agency GIZ recently commissioned a similar scheme, which will be managed by the World Agroforestry Centre in a heavily degraded, drought-prone part of Rajasthan. "The way the carbon project works, taking a grid of 1000 hectares or more with 700 or 800 households, makes a lot of sense to us," says Sanjay Tomar of GIZ.

"Scaling up these kinds of activities so that they reach tens of thousands of households will involve matching institutional design, future activities and implementation partners with local conditions and international climate-funding regimes," says Henry Neufeldt, Head of the Climate Change Unit at the World Agroforestry Centre. "This is something we will be working on in future, together with our national and international partners."

“AT THE HOUSEHOLD SCALE, THESE MEASURES MAY SOUND TRIVIAL, BUT WHEN YOU ADD TOGETHER THE ACTIVITIES OF MANY THOUSANDS OF FARMING FAMILIES, THEY BECOME HIGHLY SIGNIFICANT, BOTH FOR THE ENVIRONMENT AND FOR THE FARMERS.”

Pal Singh, World Agroforestry Centre

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The impact of climate change on the Mekong's fish farmers

In 2011, the WorldFish Center led a study to explore the impact of climate change on the aquaculture industry in Vietnam's Mekong Delta. Climate change is likely to lead to a rise in sea level, which in turn could lead to an increase in flooding and intrusion of seawater into coastal areas. The study looked at the vulnerability of two species that are important for export – the freshwater striped catfish and the brackish-water tiger shrimp – and the costs and benefits of measures to help aquaculture enterprises adapt to climate change.



Photo: CGIAR Challenge Program on Water and Food

Fish and shrimp farmers in Vietnam's Mekong Delta will feel the impacts of sea level rise. Local authorities could help by building dykes to control floods and salt water intrusion.

The results suggest that shrimp farmers will be able to bear the cost of adaptation over a longer time frame than catfish farmers. In both cases, the costs of introducing various practices and mitigation strategies to help adapt to climate change could be reduced or offset through the construction of coastal and river dykes to control flooding and salinity intrusion. These could also provide benefits for other sectors of the economy.

The preliminary study, which was the first of its kind in the region, was based on secondary data and consultations with farmers and policy makers. "We now need an interdisciplinary approach that uses both qualitative and quantitative methods to gain a better understanding of farmers' preferences and their willingness and ability to adapt to climate change," says WorldFish scientist Nhuong Tran. "We also need to refine the methodology used to assess the economics of climate change impact in the aquaculture sector in order to inform and support better policy analysis."



Photo: T. Wolday (Bioversity International)



New technologies and practices



Much of the work in CCAFS is focused on developing and trialling new technologies and practices with farmers.



Testing times in Ethiopia

How will Ethiopian farmers cope with the climatic conditions that are likely to prevail in 20 or 30 years' time? Bioversity International's 'Seeds for Needs' project provides one of the answers: by making use of the genetic diversity of crops stored in the country's gene banks.

The project, implemented jointly with Ethiopia's Institute of Biodiversity Conservation and the National Agricultural Research Institute, has developed a tool to help farmers choose varieties to suit their future needs. The research initially focused on providing new varieties of barley and durum wheat to 100 women farmers at three sites of varying elevation.

During the first phase of the project, information about more than 12 500 samples of seed of different varieties was screened to identify the ones collected from areas currently experiencing the climatic conditions – in terms of rainfall and temperature – which are projected to occur at the pilot sites in a generation's time. The most promising 100 varieties of each crop were then tested on-farm by the women, using their land and labour.

Ethiopian farmers winnowing orange lentils. Bioversity International's Seeds for Needs project in Ethiopia is working with farmers to pre-select crops and varieties that are likely to perform well under future conditions.

After the first growing season, the women selected the varieties with the traits they considered most valuable. These were then distributed to other women within their communities to be grown during the next cropping season. Even though the women did not choose varieties for their ability to cope with future climatic conditions, the initial selection provided them with a range of seeds, and options, they didn't have before. "If they grow a few varieties that are tolerant of climate change, then they will be in better shape to face the future than they would be otherwise," says Laura Snook of Bioversity.

Traditionally, gene banks have been established to store material for plant breeders to use when developing new varieties, not for direct distribution of seeds to farmers. However, this project is reconnecting farmers with landraces – unimproved varieties developed by farmers over millennia – that have been largely lost from the landscape, and frequently replaced by improved varieties. "It's also drawing the attention of agricultural ministries and research institutions to the important role gene banks can play in climate change adaptation strategies," says Snook.

In Papua New Guinea, farmers and scientists are using a similar methodology to identify varieties of sweet potato and yam – both clonally reproduced crops that can't be stored or sown as seed – that will help farmers cope with climate change. 'Seeds for Needs' projects have also been launched in Mali and India.

COPING WITH CHANGE IN THE MEKONG

Over the past 30 years, farmers in the Mekong Delta, Vietnam's main rice-growing area, have adapted to changing environmental conditions by modifying their farming practices, changing the way they manage water, and diversifying their production systems. However, the viability of their farms – and the country's food security – is now threatened by climate change.

In March 2011, IRRI launched a major new project: 'Climate change affecting land use in the Mekong Delta: adaptation of rice-based cropping systems' (CLUES). The four-year project, funded by the Australian Centre for International Agricultural Research (ACIAR), builds on work already undertaken by IRRI and its Vietnamese and Australian research partners on improving the resilience of rice production and on numerous nutrient-cycling projects in the region.

Scientists used advanced hydrological models to simulate water levels – sea levels are likely to rise – and concentrations of salinity under different climate change scenarios. They also modelled the effect of different water control systems, such as canal excavation and water extraction, on water levels and salinity. The results suggest that water levels will be strongly affected throughout the entire Mekong Delta if the sea level rises. In contrast, salinity is likely to be affected in specific locations, according to the season and annual fluctuations.

To cope with these changes, the CLUES project is developing varieties of rice capable of coping with rises in water level and increases in salinity. Modern breeding methods are helping speed up the delivery of these improved new varieties. Farmers will be actively involved in choosing the varieties that suit local conditions. This will help to facilitate their rapid and widespread adoption.

The CLUES project will also develop a range of different management options, explore the factors determining farmers' ability to adapt to climate change, improve the capacity to analyse soil nutrient cycling and greenhouse gas emissions, and provide information which will benefit land-use planning in coastal areas.

New rice varieties will withstand rising water levels and salinity, helping rice farmers adapt to climate change.



Photo: International Rice Research Institute (IRRI)



Encouraging smallholders to be climate-smart

Agriculture is directly responsible for 12–14% of human-generated greenhouse gas emissions, with farmers in the developing world being responsible for around three-quarters of these. "We know farmers can reduce agricultural emissions with a range of existing practices," says CCAFS Theme Leader Lini Wollenberg, who is based at the University of Vermont. "The challenge is how to make the practices attractive to farmers, especially on large scales and in ways that improve their economic options and food security."

CCAFS' collaboration with the Mitigation of Climate Change in Agriculture (MICCA) programme, which is managed by the UN's FAO, is addressing this challenge. During

2011, CCAFS and its participants explored what sorts of incentives are required to encourage smallholders to adopt agricultural practices that reduce their impact on the climate. Ideally, these incentives will help farmers to increase their productivity and incomes, reduce emissions and adapt to the changing climate.

In search of incentives

At present, the international financing mechanisms that enable organizations and individuals to take advantage of the emerging carbon market – worth USD 120 billion by 2010, according to *The Economist* – have been largely inaccessible to smallholders. A report commissioned by CCAFS and presented at a MICCA workshop in Rome – *Mechanisms for agricultural climate change mitigation incentives for smallholders* – describes the difficulties smallholders face in accessing the carbon market and the

potential sources of funding which could support more climate-friendly agricultural production. The study was led by Tanja Havemann.

Another CCAFS report – *Towards policies for climate change mitigation* – describes the findings of a study led by Charlotte Streck. This explores how to use climate finance at the national and international level to promote climate-friendly agricultural practices. Examples include the setting up of transition funds to reimburse the cost of adopting climate change mitigation activities, public support through payments for environmental services, and schemes that support specific activities, such as those associated with getting large numbers of smallholders together to take advantage of the carbon market.

Wollenberg believes that the workshops, and the research papers prepared for the workshops, helped to advance our understanding of how to design measures which will encourage smallholders to reduce their emissions. “It’s a question of providing the right forms of support,” she says. “Whether smallholders can take advantage of the carbon market is just one part of this. If we want to reduce emissions from farmers’ crops, livestock and fisheries, we have to find solutions that also improve their livelihoods.” Climate change mitigation cannot occur at the cost of development or food security.

Measuring progress

If policy makers, governments and farmers are to make climate-smart agriculture a priority, they need to prove that it is possible. They need to know which activities reduce greenhouse gas emissions and by how much. Farmers need clear evidence that the activities which they are urged to adopt – such as conservation agriculture and agroforestry – are profitable as well as climate friendly.

In 2011, the MICCA programme launched four pilot projects to measure the performance of different agricultural systems in terms of food production, reducing emissions and helping farmers adapt to climate change. In Kenya, the project is working with smallholder dairy producers in the Rift Valley; in Tanzania, it is evaluating the benefits of conservation agriculture in the Uluguru Mountains. In each of these sites, the World Agroforestry Centre is evaluating the impact of

different farming practices, and developing and refining methodologies to measure greenhouse gas emissions.

One of the key outputs of the MICCA projects will be a protocol that forms the scientific basis for estimating the mitigation potential of smallholder systems to reduce their carbon footprint while achieving the goal of food security. “We need to come up with affordable, replicable ways of measuring greenhouse gas emissions that can be used over large areas,” says Wollenberg. This is important for two reasons. First, it will provide clear evidence about the climate-smart benefits of different farming systems.

Second, it will provide smallholders and others who seek access to climate finance with a means of quantifying the benefits of mitigation activities.

In October 2011, CCAFS organized a MICCA workshop in Rome on the landscape approach to quantifying greenhouse gas emissions. This brought together scientists working on the subject from across the world, and enabled them to provide an update on their activities in the field. “I think this is one of our most important

roles – bringing together people who are working on the same research issues, but who haven’t had the time or the means to get together,” says Wollenberg. By creating these ‘communities of practice’, she believes that CCAFS can help a wide range of different organizations and individuals achieve more than they could by working on their own.



Photo: N. Palmer (CIAT)

Smallholder farmers can help reduce agricultural greenhouse gases through practices such as agroforestry, but incentives need to be right.

“IF WE WANT TO REDUCE EMISSIONS FROM FARMERS’ FIELDS, WE HAVE TO ENCOURAGE THEM TO ADOPT ACTIVITIES THAT HELP THEM TO INCREASE THEIR PRODUCTIVITY AND INCOMES AT THE SAME TIME.”

Lini Wollenberg, CCAFS Theme Leader

Further reading

Havemann T, Muccione V. 2011. *Mechanisms for agricultural climate change mitigation incentives for smallholders*. CCAFS Report No. 6. (Available from <http://ccafs.cgiar.org/sites/default/files/assets/docs/ccafsreport6-mechs incentives mitigation.pdf>) (Accessed on 1 June 2012)

Streck C, Burns D, Guimaraes L. 2012. *Towards policies for climate change mitigation: Incentives and benefits for smallholder farmers*. CCAFS Report No. 7.

(Available from http://ccafs.cgiar.org/sites/default/files/assets/docs/ccafsreport7-smallholder_farmer_finance.pdf) (Accessed on 1 June 2012)

HOW TO MITIGATE CLIMATE CHANGE THROUGH AGRICULTURE: NEW BOOK OFFERS PRACTICAL GUIDANCE

A new edited volume, *Climate change mitigation and agriculture*, offers practical guidance on implementing agricultural emissions reductions initiatives, based on experience and best practice from around the world. The book reviews the state of agricultural climate change mitigation globally, with a focus on identifying the feasibility, opportunities and challenges for achieving mitigation among smallholder farmers. The purpose is ultimately to accelerate efforts aimed at mitigating land-based climate change.

Climate change mitigation and agriculture

Edited by Lini Wollenberg, Maja-Liisa Tapio-Biström,

Maryanne Grieg-Gran and Alison Nihart

Published by Routledge, December 2011





Photo: J. Hansen (CCAFS)



Capacity enhancement



Adapting to climate change and developing mitigation strategies are knowledge intensive. Our approach to capacity enhancement encourages co-learning between researchers and others, building on and enhancing knowledge and skills through collaboration.



Forecasts for farmers

At present, farmers living in the West African Sahel have little or no access to seasonal forecasts that provide predictions of precipitation for the next growing season. At best, they receive short-term weather forecasts that cover large areas rather than specific locations. “As the climate grows increasingly unpredictable, farmers will need seasonal forecasts to help them plan their cropping cycle and reduce the impact of weather variability,” says Ousmane Ndiaye of Senegal’s ANAMS.

Ndiaye was a member of a team of climatologists, researchers, extension agents and development workers who ran a climate communications workshop, supported by CCAFS, for farmers in Kaffrine, a district in Senegal’s ‘peanut basin’, in June 2011. One of the main aims of the workshop was to teach farmers how to use probabilistic seasonal forecasts.

Unlike weather forecasts, which predict what will happen at a particular time over the next few days – for example,

that it will be 32°C and dry at 11am on Monday – seasonal forecasts provide information about the probability of there being more or less rain, lower or higher temperatures, and other weather events over a long period of time. In short, they provide the sort of information that should help farmers to decide which crops to plant and when, and what farm inputs to use.

During the two-day workshop, 33 farmers, chosen from six randomly selected villages around Kaffrine, were introduced to probabilistic seasonal forecasts. However, this was a two-way learning process, with the team of experts from the extension and meteorological departments discussing forecasts and local management responses in the six villages to gain a better understanding of local knowledge and the sort of climate information farmers consider useful.

Making a difference

After the participatory training workshop, ANAMS sent the farmers the probabilistic seasonal forecast for their region. Six months later, Ndiaye and his team returned to Kaffrine to run another workshop, to which they invited 15 of the farmers who had attended the June training and 13 others who hadn’t received any information about seasonal forecasting. This enabled the team to assess whether farmers had benefited from the use of seasonal forecasts.

The year was marred by the lateness of the first rains and a long dry spell, which meant crop yields were lower in 2011 than they had been the previous year. Nevertheless, farmers who had received the seasonal forecast clearly benefited. Twelve of the 15 who had attended the first workshop had

ABOVE: Training farmers on the interpretation and application of seasonal rainfall forecasts in our Kaffrine, Senegal.

planted short-cycle crops to cope with the erratic rains that were forecast.

The three who decided to ignore the seasonal forecast did not change their farming practices, and they suffered as a result. Amy Ndiaye said that she did not adopt different practices because her husband, who had not attended the workshop, was sceptical about the forecasts. "That prevented me from using a short-cycle variety," she recalled. "But after we had a low yield, he agreed that next time we will use seasonal forecasts."

The 13 farmers at the workshop who had not received probabilistic seasonal forecasts behaved as though 2011 would be similar to 2010. As a result, their yields suffered. They expressed their desire to receive seasonal forecasts in future.

"It is often claimed that farmers would have difficulty understanding probabilistic forecasts," says CCAFS Science Officer Kevin Coffey, based at Columbia University's International Research Institute for Climate and Society (IRI), "but our research in Senegal – and on a similar project in Kenya – has shown that this simply isn't the case. They understand the forecasts and they know how to use them to plan their farming practices." The project has also shown the virtues of a participatory approach, where meteorological services, such as ANAMS, work together with farmers to determine what sort of information they need.



CLIMATE-PROOFING CASSAVA

In sub-Saharan Africa, cassava is grown by many millions of small-scale farmers, who sell their surplus production in local markets, and it is estimated that 37% of Africa's dietary energy comes from this edible root. Anything – including climate change – which threatens cassava poses a direct threat to the food security of the continent.

Over the past three decades, the International Institute of Tropical Agriculture (IITA), which has its headquarters in Nigeria, the world's largest cassava producer, has devoted considerable energy on developing improved varieties that are resistant to pests and diseases, low in cyanide content, drought-resistant and high yielding.

Climate change will almost certainly affect the distribution and prevalence of many pests and diseases, those that affect cassava. During 2011, IITA conducted research on the impact of climate change a species of whitefly which transmits viral diseases cassava, and on a range of other pests and that threaten the crop. Using innovations in breeding methods, coupled with a strong testing programme, IITA seeks to develop varieties cassava which will help farmers cope with threats from pests and diseases, as well as with drought.

In all of IITA's research projects, there is a strong of capacity building, without which the could never have achieved so much. To give just example, IITA has trained more than 9000 and technicians in at least 25 African countries processing high-quality cassava flour. This has led an increase in production and consumption droughts, when other staple food crops have IITA's current climate-related cassava research is benefiting from its partnerships with a wide range different organizations.

New varieties of cassava could help farmers cope climate threats.



Photo: N. Palmer (CIAT)



Photo: N. Palmer (CIAT)

Communicating climate change



The impact of climate change, and the measures needed to counter climate change, must be carefully communicated, given the large number of uncertainties involved and the politics surrounding climate scepticism. Part of the vision of success for CCAFS is that it becomes a 'go-to' resource, providing relevant evidence, knowledge and tools to formulate options and strategies for tackling food insecurity in the face of climate change.

Communicating, together

Good communication is essential for the CCAFS programme's success. And as a cross-cutting research programme that includes 15 CGIAR Centres and several university partners, collaboration is key for good communication.



Photo: N. Palmer (CIAT)



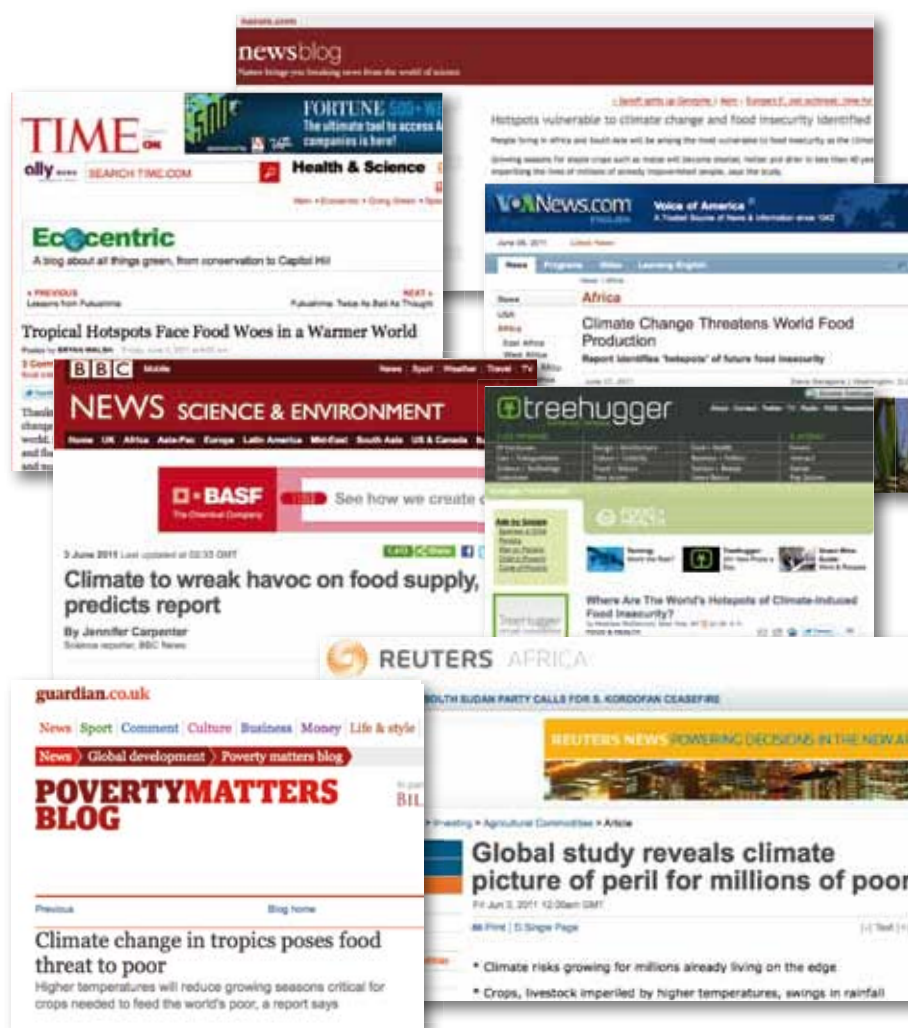
Photo: N. Palmer (CIAT)

In 2011 CCAFS published a report on climate change 'Highlighting the hunger hotspots' (see page 12), identifying areas that are food insecure and highly vulnerable to the impacts of climate change. Early on, the study was identified by researchers involved in the analysis – which was carried out by scientists from ILRI and coordinated by CCAFS – as an important research output that carried key messages for a range of audiences. Before the report was finalized, the researchers and communicators from ILRI and CCAFS met to discuss those key messages and audiences, and to identify opportunities for outreach and dissemination.

The group worked together collaboratively to draft a press release and develop a media outreach strategy. Communicators from CIAT were also involved, and assisted by translating the press release into Spanish, contributing multimedia resources to the press room, and helping reach out to Latin American audiences.

Scientists from across the CCAFS programme supported media outreach for the story, giving interviews in four languages. Additional CGIAR Centres and partners joined in by helping to disseminate the story via social media and other online channels.

These joint efforts were successful in securing high-profile media coverage, including in the *Guardian*, on the BBC, in *TIME* magazine's 'Ecocentric' blog and on the *Nature* website. This resulted in over 2300 report downloads in 2011 and significantly boosted traffic to CCAFS' website, which peaked at over 1700 visitors in one day (300% above average). Moreover, the campaign set a precedent for joint communications from the CCAFS programme, serving as a model for all communications in the future.



Organization for success

Independent Science Panel

The Independent Science Panel (ISP) of CCAFS was established to ensure independence of the programme's direction. The ISP is accountable to, and appointed by, the Board of Trustees of CIAT. The ISP replaced the CCAFS Steering Committee, which operated until the end of June 2011.

Steering Committee

1 January to 30 June 2011

- **Thomas Rosswall**, Chair (France)
- **Takeshi Horie**, National Agriculture and Food Research Organization (NARO) (Japan)
- **Pramod Joshi**, National Academy of Agricultural Research Management, Hyderabad (India)
- **Thierry Lebel**, Laboratoire d'étude des Transferts en Hydrologie et Environnement (LTHE) (France)
- **Holger Meinke**, Tasmanian Institute of Agriculture (TIA) and the School of Agricultural Science at the University of Tasmania (UTAS) (Australia)
- **Mary Scholes**, School of Animal, Plant and Environmental Sciences, University of the Witwatersrand (South Africa)
- **Rik Leemans**, *ex officio*, Earth System Science Partnership (ESSP) (The Netherlands)
- **Stephen Hall**, *ex officio*, CGIAR (UK)
- **Bruce Campbell**, *ex officio*, Program Director, International Center for Tropical Agriculture (CIAT) (Colombia)¹

Independent Science Panel

1 July to 31 December 2011

- **Fatima Denton**, Program Leader for Climate Change Adaptation in Africa, International Development Research Centre (IDRC) (Senegal)
- **Ariel Dinar**, Department of Environmental Sciences, University of California (USA)
- **Takeshi Horie**, National Agriculture and Food Research Organization (NARO) (Japan)
- **Thierry Lebel**, Laboratoire d'étude des Transferts en Hydrologie et Environnement (LTHE) (France)
- **Holger Meinke**, Tasmanian Institute of Agriculture (TIA) and the School of Agricultural Science at the University of Tasmania (UTAS) (Australia)
- **Thomas Rosswall**, Chair (France)
- **Mary Scholes**, School of Animal, Plant and Environmental Sciences, University of the Witwatersrand (South Africa)
- **Lindiwe Majele Sibanda**, Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN) (South Africa)
- **Ram Badan Singh**, National Academy of Agricultural Sciences (India)
- **Christof Walter**, Unilever (UK)
- **Lisa Schipper**, *ex officio*, International Center for Tropical Agriculture (CIAT) Board of Trustees (USA)
- **Rik Leemans**, *ex officio*, Earth System Science Partnership (ESSP) (The Netherlands)
- **Bruce Campbell**, *ex officio*, Program Director, International Center for Tropical Agriculture (CIAT) (Colombia)

¹ Bruce Campbell was hosted by the International Livestock Research Institute (ILRI) (Ethiopia) until 30 June 2011

Internal organization and personnel

Program Management Committee

- **Pramod Aggarwal**, Regional Program Leader (Indo-Gangetic Plains), International Water Management Institute (IWMI) (India)
- **Andrew Jarvis**, Theme Leader (Theme 1), International Center for Tropical Agriculture (CIAT) (Colombia)
- **James W. Hansen**, Theme Leader (Theme 2), Columbia University (USA)

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Coordinating Unit

- **Bruce Campbell**, Program Director, International Center for Tropical Agriculture (CIAT) (Colombia)
- **Torben Timmermann**, Head of Program Coordination and Communications, University of Copenhagen (Denmark)
- **Sonja Vermeulen**, Head of Research, University of Copenhagen (Denmark)
- **Gloria Cecilia Rengifo**, Senior Manager, Finance, Contracts and Liaison, International Center for Tropical Agriculture (CIAT) (Colombia)
- **Misha Wolsgaard-Iversen**, Program Manager, University of Copenhagen (Denmark)
- **Ratih Septivita**, Events and Program Support Consultant (Indonesia)
- **Vanessa Meadu**, Manager, Communications and Knowledge Management (UK)

Theme Leaders

- **Andrew Jarvis**, Theme 1, International Center for Tropical Agriculture (CIAT) (Colombia)
- **Andrew Challinor**, Theme 1, University of Leeds (UK)
- **James W. Hansen**, Theme 2, Columbia University (USA)
- **Eva 'Lini' Wollenberg**, Theme 3, University of Vermont (USA)
- **Philip Thornton**, Theme 4, International Livestock Research Institute (ILRI) (Kenya)
- **Patti Kristjanson**, Theme 4, World Agroforestry Centre (ICRAF) (Kenya)
- **Gerald Nelson**, Theme 4, International Food Policy Research Institute (IFPRI) (USA)

- **Eva 'Lini' Wollenberg**, Theme Leader (Theme 3), University of Vermont (USA)
- **Philip Thornton**, Theme Leader (Theme 4), International Livestock Research Institute (ILRI) (Kenya)
- **Bruce Campbell**, *ex officio*, Program Director, International Center for Tropical Agriculture (CIAT) (Colombia)

Regional Program Leaders

- **Pramod Aggarwal**, Indo-Gangetic Plains, International Water Management Institute (IWMI) (India)
- **James Kinyangi**, East Africa, International Livestock Research Institute (ILRI) (Kenya)
- **Robert Zougmore**, West Africa, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) (Mali)

Scenarios Leader

- **John Ingram**, Oxford University (UK)

Science Officers

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- **Kevin Coffey**, Theme 2, Columbia University (USA)
- **Michael Misiko**, Theme 3, World Agroforestry Centre (ICRAF) (Kenya)
- **Moushumi Chaudhury**, Theme 4, World Agroforestry Centre (ICRAF) (Kenya)
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- **International Center for Tropical Agriculture (CIAT):**
Andy Jarvis and Peter Läderach
- **International Crops Research Institute for the Semi-Arid Tropics (ICRISAT):** Peter Craufurd
- **International Food Policy Research Institute (IFPRI):**
Mark Rosegrant
- **International Institute for Tropical Agriculture (IITA):**
Piet van Asten, Paula Bramel and David Watson
- **International Livestock Research Institute (ILRI):**
Mario Herrero
- **International Maize and Wheat Improvement Center (CIMMYT):** Bekele Shiferaw
- **International Potato Center (CIP):** Roberto A. Quiroz
- **International Rice Research Institute (IRRI):**
Reiner Wassmann
- **International Water Management Institute (IWMI):**
Vladimir Smakhtin
- **World Agroforestry Centre (ICRAF):** Henry Neufeldt
- **WorldFish Center:** Eddie Alison and Neil Andrew

CCAFS 2011 Financial Highlights

CCAFS got off to a strong start, releasing high profile scientific results and helping achieve, in collaboration with multiple partners, a significant outcome in the global climate change negotiations.

The major challenge for implementation was the uncertainty of funding which resulted in reporting a slow start and having significant under spending in some of the participating Centres.

Financial Results for 2011

CCAFS 2011 budget was US\$62 million including funds from the CGIAR Fund (\$41 million) and other bilateral grants (\$21 million).

Only towards the end of the year CCAFS received firm confirmation of the proposed budget. The first tranche of funds from the Fund Council (30%) was received early in August and the second tranche (58%) was received in December.

By the end of the year 85% of the CGIAR Funds (including Window 3 funds) were executed while the execution of bilateral funds was in the order of 102%.

In the following two tables the financial execution by Natural Classification and by Centre are shown, expressed in US\$ Thousands:

Table 1: Execution as of December 31st 2011 per natural classification

Categories	Budget	Executed	Execution %
Personnel Costs	18,542	19,636	106%
Travel	2,725	2,796	103%
Operating Expenses	8,512	8,687	102%
Training & Workshop	2,027	1,082	53%
Collaborators/Partnership Costs	19,028	14,662	77%
Capital and other equipment	1,120	807	72%
Contingency	582	87	15%
Subtotal	52,536	47,757	91%
Indirect costs	9,402	8,503	90%
TOTAL	61,938	56,261	91%

Table 2: Execution as of December 31st 2011 per Centre

Centre	Centre Activities			Theme and Regional Leaders Activities			TOTAL CENTRE		
	Budget	Execution	%	Budget	Execution	%	Budget	Execution	%
Africa Rice	785	348	44%	–	–		785	348	44%
Bioversity	5,565	6,142	110%	–	–		5,565	6,142	110%
CIAT	3,261	4,421	136%	3,572	3,150	88%	6,833	7,571	111%
CIFOR	500	140	28%	–	–		500	140	28%
CIMMYT	5,472	5,511	101%	–	–		5,472	5,511	101%
CIP	2,955	2,003	68%	–	–		2,955	2,003	68%
ICARDA	2,020	2,120	105%	–	–		2,020	2,120	105%
ICRAF	4,915	5,768	117%	1,966	2,026	103%	6,881	7,794	113%
ICRISAT	2,614	2,164	83%	1,801	1,801	100%	4,415	3,965	90%
IFPRI	2,631	2,026	77%	1,400	607	43%	4,031	2,633	65%
IITA	985	1,064	108%	–	–		985	1,064	108%
ILRI	4,514	3,780	84%	3,838	3,098	81%	8,352	6,878	82%
IRRI	1,092	466	43%	–	–		1,092	466	43%
IWMI	3,116	2,028	65%	2,391	1,623	68%	5,506	3,651	66%
World Fish	2,000	1,980	99%	–	–		2,000	1,980	99%
CU & and Mgmt				–	–		4,546	3,996	88%
Total	42,425	39,960	94%	14,967	12,304	82%	61,938	56,261	91%

CCAFS Financial Outlook for 2012

The original 2012 CGIAR Fund budget for CCAFS as approved by the CGIAR Consortium and Fund at the inception of CCAFS amounts to \$55 million. However the finally allocated budget is \$41 million. This required the CCAFS Program Management Committee to make various reallocations amongst Theme Leaders/ Regional Program Leaders and Centre Activity Plans. Despite the significant reduction in allocated CG funds to CCAFS, the funding certainty seems to be much improved in 2012. Thus, hopefully all the elements are in place for implementation at a much faster pace in 2012 than in 2011.

A key success factor will be to obtain additional bilateral grants in order to deliver on the promised impact, therefore a major effort is needed to reach out to donors.

Donors

In 2011, the programme was carried out with funding from the following agencies:



Canadian International
Development Agency

Agence canadienne de
développement international

The Canadian International Development Agency (CIDA)



The Danish International Development Agency (DANIDA)



European Commission

The European Union (EU)



The CGIAR Fund

The programme is carried out with technical support from:



The International Fund for Agricultural Development (IFAD)

Key publications

In 2011, CCAFS published 69 international peer-reviewed journal papers, 3 books, 25 book chapters, 22 policy briefs, 51 conference papers, 9 issues of AgClim letters in English and French, and over a hundred other publications, including field reports, working papers and site characterizations.

The programme produced 36 non-journal publications in-house, including 3 peer-reviewed CCAFS reports, and 4 peer-reviewed CCAFS policy briefs. Topics included a global survey of climate change and food insecurity hotspots, and policy recommendations for closely integrating agriculture, forestry and food security. These were disseminated online via targeted outreach, including some media campaigns, as well as via e-newsletters, at key events and workshops, and via partners. The programme produced 152 blog stories covering topics from all the CCAFS research themes, and from all three target regions (East Africa, West Africa and the Indo-Gangetic Plains). Many stories were produced in collaboration with CGIAR Centres and other partners. These stories attracted a total of 25 670 unique visits from 204 countries.

CCAFS policy briefs

Available from <http://ccafs.cgiar.org/resources/reports-and-policy-briefs>

Kissinger G. 2011. *Linking forests and food production in the REDD+ context*. CCAFS Policy Brief No. 3.

Negra C, Wollenberg E. 2011. *Lessons from REDD+ for agriculture*. CCAFS Policy Brief No. 1.

Wollenberg E, Campbell MB, Holmgren P, Seymour F, Sibanda L, von Braun J. 2011. *Actions needed to halt deforestation and promote climate-smart agriculture*. CCAFS Policy Brief No. 4.

Wollenberg E, Negra C. 2011. *Next steps for climate change mitigation in agriculture*. CCAFS Policy Brief No. 2.

CCAFS reports

Available from <http://ccafs.cgiar.org/resources/reports-and-policy-briefs>

Ericksen PJ, Thornton PK, Notenbaert A, Cramer L, Jones PG, Herrero M. 2011. *Mapping hotspots of climate change and food insecurity in the global tropics*. CCAFS Report No. 5.

Havemann T, Muccione V. 2011. *Mechanisms for agricultural climate change mitigation incentives for smallholders*. CCAFS Report No. 6

Negra C, Wollenberg E. 2011. *Lessons from REDD+ for agriculture*. CCAFS Report No. 4.

CCAFS working papers

Available from <http://ccafs.cgiar.org/resources/working-papers>

Barbier EB, Tesfaw AT. 2011. *Overcoming tenurial constraints to carbon forestry projects in Africa*. CCAFS Working Paper No. 10.

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Carbon footprint reduction initiative

In 2011 the estimated greenhouse gas emissions of the CCAFS Coordinating Unit were 110 tCO₂-eq; this includes staff travel, major events and office emissions. Air travel is the main source of greenhouse gas emissions, with a total emission of 88 tCO₂-eq. This is followed by events (9% of emissions), office electricity and heating (4% each) and other office use (less than 1%).

To tackle its emissions, the Coordinating Unit has begun to implement the following measures:

- **Air travel:** Reduce travel and increase the number of online conferences. Offset options will be proposed to every participant of events organized by CCAFS.
- **Events:** Look into options for environmentally friendly hotels and restaurants for events. One mandatory vegetarian meal will be served per event to increase awareness and reduce by 50% the meal emissions. Conference packs will be replaced by USB sticks and will be available online. A checklist for reducing the footprint of events has been developed which includes essential points and actions that can be taken during an event; this will be integrated as a tool in the planning of future events.

- **Electricity, heating and office supplies:** A green code of conduct will be implemented in the Coordinating Unit in July; staff will voluntarily agree to improve their behaviour in the office to reduce their daily emissions. This code of conduct will be drawn up in partnership with the University of Copenhagen's Green Campus initiative.

All remaining emissions will be offset twice a year via the purchase of credits from the agroforestry project 'Emiti Nibwo Bulora', in partnership with the Plan Vivo programme, with an estimated cost of €850 per year.

The Coordinating Unit's performance in reducing its carbon footprint will be assessed annually, via a report that includes a full description of greenhouse gas accounting, an assessment of measures taken, and an action plan for the coming year.

The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) is a strategic partnership of the CGIAR and the Earth System Science Partnership (ESSP). 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 trade-offs between climate change, agriculture and food security. The CGIAR Lead Centre for the programme is the International Center for Tropical Agriculture (CIAT) in Cali, Colombia.

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