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CGIAR Annual Report 2013

Featuring Climate-Smart Agriculture

CGIAR

Science for a food-secure future

CGIAR is a global partnership that unites organizations engaged in research for a food-secure future. CGIAR research is dedicated to reducing rural poverty, strengthening food security, improving human health and nutrition, and sustainably managing natural resources. It is carried out by the 15 Consortium Research Centers in collaboration with hundreds of partner organizations, including national and regional research institutes, civil society, academia, and the private sector. For more information, visit www.cgiar.org.

This report, and additional associated content, is available online at www.cgiar.org/AR2013.

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CGIAR at a glance

Our focus

- Rural poverty
- Food security
- Health and nutrition
- Natural resources

CGIAR

Partners and Stakeholders
Work with us for a food-secure future. Consulted through the Global Conference on Agricultural Research for Development.

Consortium
Integrates and coordinates researchers and funders. The Consortium consists of the Consortium Board, Consortium Office and 15 Research Centers.

Independent Evaluation Arrangement
Evaluates the work of the CGIAR Research Programs.

Fund
Ensures funds for the research of the Consortium. The Fund consists of the Funders Forum, Fund Council and the Fund Office.

Independent Science and Partnership Council
Advises the Fund on research priorities and funding.

OVERARCHING THEMES

GENDER

PARTNERSHIPS/STAKEHOLDER ENGAGEMENT

CAPACITY STRENGTHENING

CGIAR RESEARCH PROGRAMS

GENEBANKS	MAIZE	AQUATIC AGRICULTURAL SYSTEMS	CLIMATE CHANGE, AGRICULTURE AND FOOD SECURITY
DRYLAND CEREALS	RICE	DRYLAND SYSTEMS	FORESTS, TREES AND AGROFORESTRY
GRAIN LEGUMES	ROOTS, TUBERS AND BANANAS	INTEGRATED SYSTEMS FOR THE HUMID TROPICS	AGRICULTURE FOR NUTRITION AND HEALTH
LIVESTOCK AND FISH	WHEAT	WATER, LAND AND ECOSYSTEMS	POLICIES, INSTITUTIONS AND MARKETS

OUTCOMES

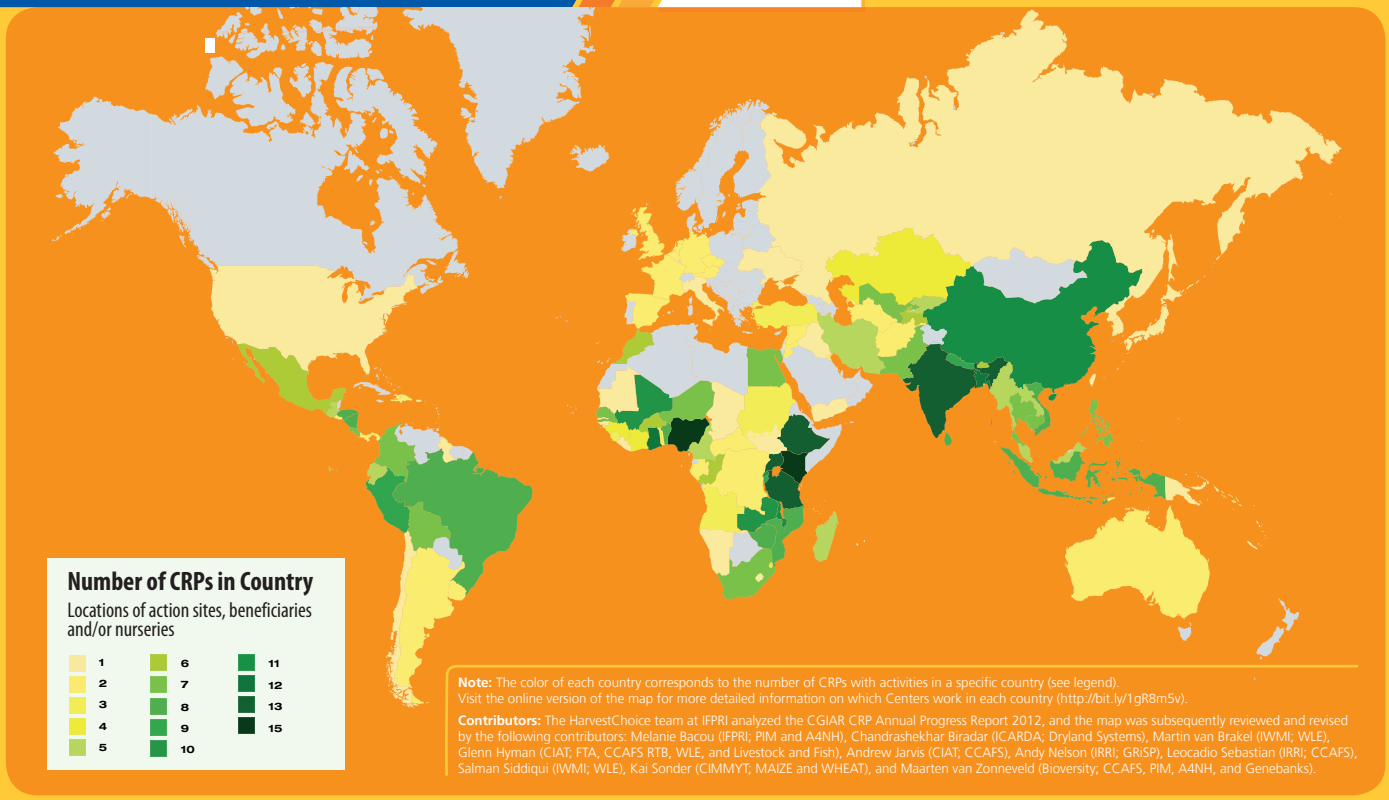
REDUCED RURAL POVERTY

INCREASED FOOD SECURITY

IMPROVED NUTRITION AND HEALTH

SUSTAINABLY MANAGED NATURAL RESOURCES

Number of **CGIAR Research Programs** **16**



Note: The color of each country corresponds to the number of CRPs with activities in a specific country (see legend).
Visit the online version of the map for more detailed information on which Centers work in each country (http://bit.ly/1gR8m5v).

Contributors: The HarvestChoice team at IFPRI analyzed the CGIAR CRP Annual Progress Report 2012, and the map was subsequently reviewed and revised by the following contributors: Melanie Bacou (IFPRI; PIM and A4NH), Chandrashekhar Biradar (ICARDA; Dryland Systems), Martin van Brakel (IWMI; WLE), Glenn Hyman (CIAT; FTA, CCAFS RTB, WLE, and Livestock and Fish), Andrew Jarvis (CIAT; CCAFS), Andy Nelson (IRRI; GRiSP), Leocadio Sebastian (IRRI; CCAFS), Salman Siddiqui (IWMI; WLE), Kai Sonder (CIMMYT; MAIZE and WHEAT), and Maarten van Zonneveld (Bioversity; CCAFS, PIM, A4NH, and Genebanks).

>10,000 Staff

Present in 90+ countries

Number of **CGIAR Research Centers** **15**

FOREWORD

In 2013, CGIAR's progress was marked by significant programmatic success, financial milestones and systemic developments to improve the efficiency, efficacy and impact of its research. The section of this report entitled "Scientific Progress" highlights some of the steps forward in scientific research for development from our CGIAR Research Programs, and provides links to more detailed reports as necessary.

This year's annual report focuses on climate change and features work on climate-smart agriculture, which contributes to the "triple win" of increased productivity, improved resilience and greater mitigation through reduced greenhouse gas emissions and increased carbon storage. Climate change threatens to undo years of economic growth, with the most severe consequences falling on developing countries and the poor. To meet the complex global challenges posed by the unprecedented effects of climate change and the growing demand for food, CGIAR is scaling up research on climate-smart agriculture with a comprehensive and integrated landscapes approach, factoring in both geographic and socioeconomic aspects of managing land, water and forest resources. A special climate change section of this report showcases how research-for-development is helping rural communities to achieve a triple win. Included in this section are case studies about "climate-smart villages"; conservation agriculture; climate-smart gender initiatives; and climate-smart crops.

2013 also marked significant financial and operational progress. CGIAR reached a historic milestone in 2013 as its total revenue surpassed $1 billion, having risen by 14% over 2012, thanks to the financial commitments made by valued investors. The benefits of this growth are far-reaching and will allow CGIAR to lead the global effort to enhance food and nutrition security in the face of climate change, and to continue to demonstrate value for money.

A number of improvements made within CGIAR over the past year are strengthening the impact of its work. The CGIAR Open Access and Data Management Policy was approved, committing the system to make all of its data and knowledge accessible for public use. The Independent Evaluation Arrangement completed its first year of operation, working to keep CGIAR accountable to its investors and reinforcing an impact-oriented culture. A set of measureable indicators and intermediary targets were defined for CGIAR Research Programs to document how effectively their research yields tangible results in line with the institutional mission to reduce poverty, improve food security and nutrition, and sustainably manage natural resources.

CGIAR is committed to accelerating the momentum achieved in 2013, so that with its partners it can continue to achieve critical advances toward sustainable, resilient agricultural systems and a food-secure future.

Rachel Kyte
Chair
CGIAR Fund Council

Carlos Pérez del Castillo
Chair
CGIAR Consortium Board

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SCIENTIFIC PROGRESS

Smallholder farmers, fishers, foresters and herders in developing countries face a multitude of constraints, including environmental degradation, limited access to new technologies and knowledge, prohibitively costly inputs, and the ever-increasing effects of climate change, which trap them in a vicious cycle of poverty and hunger. In response, CGIAR's ambitious and comprehensive research agenda was developed to tackle these challenges holistically and to sustainably meet the needs of poor smallholders and protect the ecosystems in which they live and work. Its 16 global research programs are designed to advance four critical development outcomes: reduced rural poverty, strengthened food security, improved nutrition and health, and sustainably managed natural resources.

The evolving partnerships and scientific discoveries developed through these research programs were vital to generating innovative solutions to improve the lives of the poor. This report selects examples that demonstrate the breadth of CGIAR's work in 2013. For a comprehensive report on the whole research portfolio, as well as individual annual reports of the CGIAR Research Programs, please visit www.cgiar.org/AR2013.

> "One global challenge is to feed a growing population. The Sida support to CGIAR is an efficient way to ensure more relevant research in agriculture with a specific focus on food security and poverty reduction in developing countries. This is an innovative way to increase cooperation with other relevant international research funding partners, and allows for an increase of the knowledge base in this field. The global research programs define various scientific issues of importance, targeting the goals for poverty alleviation, access to and conservation of natural resources, food security, improved nutrition and health, and economic development."
>
> **Charlotte Petri Gornitzka,** Director General, Swedish International Development Cooperation Agency (Sida)

CGIAR Research Programs

- Agriculture for Nutrition and Health
- Aquatic Agricultural Systems
- Climate Change, Agriculture and Food Security
- Dryland Cereals
- Dryland Systems
- Forests, Trees and Agroforestry
- Grain Legumes
- Integrated Systems for the Humid Tropics
- Livestock and Fish
- Maize
- Managing and Sustaining Crop Collections
- Policies, Institutions and Markets
- Rice (Global Rice Science Partnership)
- Roots, Tubers and Bananas
- Water, Land and Ecosystems
- Wheat

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BETTER CROPS THROUGH BETTER SCIENCE

Building upon decades of previous work, CGIAR and its partners expanded their portfolio of improved crop varieties to increase farmers' harvests, incomes and household food security. Many crops were bred for higher yield; resistance to pests and disease; tolerance of heat, flooding, salinity and other environmental stresses; and improved nutrition. As of December 2013, staple food crops that were bred to rich in the key micronutrients iron, zinc and vitamin A had reached half a million farmers worldwide, helping to combat malnutrition among the poor. As a global research partnership, CGIAR is well positioned to deliver benefits to poor farmers and consumers by strengthening the ability of basic staple crops to flourish under a variety of challenging circumstances, including the negative effects of climate change.

For example, the 44 new rice varieties released in 2013 included 9 salt-tolerant varieties in the Philippines (of 29 varieties released in Southeast Asia), 3 flood-tolerant varieties in South Asia (of 8 varieties released), and 7 varieties in Sub-Saharan Africa. As part of this work, a milestone was reached with the launch of a new brand: Advanced Rice Varieties for Africa (ARICA). Researchers hope ARICA will repeat in Africa the successful experience in South Asia with Sahbhagi dhan, a drought-tolerant variety that has earned the name Wonder Rice since its release in India in 2009. Last year saw the continued spread of Sahbhagi dhan to create what have been dubbed "rice oases" in drought-stricken areas. The improved variety yields 4-5 tons per hectare under normal conditions in which traditional varieties yield only 2.5 tons. Under drought so severe that most varieties yield nothing, Sahbhagi dhan can still yield 1-2 tons per hectare — a huge advantage as drought becomes more frequent and acute under climate change, especially in South Asia and Sub-Saharan Africa.

Underpinning CGIAR's vital crop improvement programs are its genebanks, which safeguard the world's largest and most diverse seed collections of crops, their wild relatives and other plant genetic resources. Containing genes for various desirable traits such as tolerance to heat or pests, the seeds in the genebanks are freely available to plant breeders, researchers and farmers worldwide to help breed more productive, resilient and nutritious crops.

Using modern genomic tools such as marker-assisted selection, which helps scientists identify genes for desired traits, it is now possible to more fully exploit the potential of the genebanks' vast genetic diversity. Genomics research, bioinformatics and advanced phenotyping provide the bases for innovations over the long term. Precise and efficient phenotyping that applies modern automated methods to characterize plant structure and performance has the potential to accelerate breeding progress and is essential to meeting future challenges posed by climate change, rising demand for food and degraded natural resources.

An initiative with India's National Food Security Mission to breed improved heat tolerance into chickpea refined screening techniques to

"The world is currently facing the huge challenge of achieving sustainable food and nutrition security for a growing population with more diverse consumption patterns in the face of increasingly scarce natural resources and the impacts of climate change. This challenge is most severe in developing countries where rates of poverty remain high and 170 million children still suffer from stunting. Public investment in agricultural research is an essential part of the solution. As the major international public research institution focused on developing countries, CGIAR is well positioned to develop the key new technologies and approaches that are needed. We welcome the adoption of poverty reduction, food security, nutrition and sustainable natural resource management as overarching goals for the reformed CGIAR, noting that these closely correspond to our development priorities in the European Union. CGIAR needs to work with partners to ensure the public goods are appropriate and are accessible to the farmers and decision makers so that genuine sustainable impacts can be realized. Running this last mile is often the most challenging part."

Klaus Rudischhauser, Deputy Director General, Development and Cooperation Directorate-General – EuropeAid, European Commission

identify heat-tolerant genotypes, studied the genetics and physiological mechanisms of heat tolerance, accelerated breeding for improving heat tolerance, and evaluated heat-tolerant varieties and breeding lines in farmers' fields. Progress was also made in improving sorghum varieties grown after the rainy season to meet expanding demand there for sorghum grain and fodder, the latter product equal to fully two-thirds of the value of the grain. Scientists began to breed into six popular sorghum varieties so-called "stay-green" drought-tolerance genes, demonstrating that they can improve in predictable ways grain and fodder yield, as well as fodder quality traits, with no tradeoffs among these traits. Improved varieties showed exciting synergy between fodder productivity and fodder quality, which researchers are pursuing in the second phase of the project.

Research was launched to increase the productivity of direct-seeded rice by incorporating genes that allow rice to germinate under water. Whereas traditional rice cultivation depends on seedlings sprouted in a nursery and then transplanted into standing water that inhibits weed germination, direct seeding features rice seed sown and sprouted in the field, eliminating the laborious transplanting of seedlings by hand.

Another initiative aims to identify crop varieties that are better suited to existing or projected conditions and to strengthen local seed systems, so that they provide farmers with information about varieties and access to seeds that meet their changing needs. Adopting a crowdsourcing approach developed by CGIAR and its partners, it recruited 6,000 smallholder farmers in Cambodia, Ethiopia, Honduras, India, Kenya, Laos, Papua New Guinea, Rwanda, Tanzania and Uganda to act as local scientists by testing, observing and comparing different crop varieties. Participants also try new farming techniques and experiment with different crop rotations before reporting their results to project researchers. The project has used modern geographic information systems to develop an atlas identifying genebank accessions that have high potential for adaptation under current and future climate conditions.

CGIAR scientists are helping to draw molecular atlases that capture the genetic diversity of maize and wheat and help identify novel sources of variability. In wheat, researchers characterized more than 20,000 genebank accessions for morphology and grain-quality traits, 27,000 for responses under drought and high temperature, and 4,500 for disease resistance. In maize, researchers characterized 20,000 accessions. They further analyzed the world's most comprehensive mapping panel for discovering new genes and identified novel markers potentially valuable to breeders. The initiative has produced the most comprehensive dataset to date on maize genetic resources and has set up several populations of maize for marker-assisted breeding and pre-breeding for genomic selection.

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EXPANDING REACH THROUGH INNOVATIVE PARTNERSHIPS

To ensure that the outcomes of research get into the hands of those who need them most, CGIAR engages in diverse partnerships to disseminate new technologies and knowledge at greater speed and scale. In fact, partnership is fundamental to the success of CGIAR Research Programs, which bring together hundreds of partners, such as public development partners and private companies, to tackle global development challenges, including constraints on the delivery and adoption of research.

One example of an important public-private partnership is the African Orphan Crops Consortium (AOCC), which launched the African Plant Breeding Academy to help improve the livelihoods and food security of Africa's smallholder farm families and boost the continent's food supply. Using the latest scientific equipment and techniques, the partnership aims to genetically sequence, assemble and annotate the genomes of 100 traditional African food crops that do not attract international attention because they are not economically important on the global market. Its purpose is to guide the development of more robust and nutritious produce.

Another public-private consortium launched a new vaccine initiative to tackle East Coast fever, a deadly cattle disease in Africa. In parallel with this consortium, which builds on earlier collaboration with research institutions in Malawi, the United Kingdom, Belgium and the United States, CGIAR is facilitating a global public-private partnership for scaling up vaccine production and launching vaccination campaigns. So far, it has provided vaccine to distributors in Kenya, Malawi, Tanzania and Uganda. The current vaccine campaign released over 1 million doses in the region, benefiting 50,000 households.

Another fruitful initiative in the region is Drought-Tolerant Maize for Africa, which continued to make impressive progress toward its goal of reaching more than 30 million farmers by the end of 2016. In 2013 alone, the project produced 30,000 tons of drought-tolerant maize seed, including 17,000 tons from new varieties, with yield advantages of 20-30% over farmers' traditional varieties.

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It did so in 13 African countries: Angola, Benin, Ethiopia, Ghana, Kenya, Malawi, Mali, Mozambique, Nigeria, Tanzania, Uganda, Zambia and Zimbabwe. As a result, some 3 million households planted over 1 million hectares with drought-tolerant varieties. Much of this success can be attributed to the project's partnership with African seed companies, 110 of which have adopted the improved varieties for production and sale to farmers.

A joint working group with the Alliance for a Green Revolution in Africa was established to ensure that seed companies and agricultural dealerships are able to stock enough seed and build good distribution networks to reach farmers across the continent. Other such networks include the Wheat Yield Consortium, Sustainable Modernization of Traditional Agriculture, and hybrid rice consortia in Latin America and Asia. These partnerships facilitate 1 million smallholders' testing of novel varieties and adoption of improved agronomic practices.

"Agricultural research investment has high economic and social rates of return. Greater investments in agricultural research will help to boost global food production, build resilience in the food supply system, protect the environment, and assure household and national food security. Focusing on agriculture as a business and powering this with a market-driven research system are crucial for lifting hundreds of millions out of poverty into wealth, while creating jobs for millions of youths. Nigeria is proud to partner with CGIAR and invest in our shared mission to boost food production in Africa and turn Africa into a food basket for the world."

Dr. Akinwumi Adesina, Minister of Agriculture and Rural Development, Federal Republic of Nigeria

LEVERAGING AGRICULTURE TO IMPROVE NUTRITION AND HEALTH

While agriculture has made remarkable advances in the past decades, progress in improving the nutrition and health of poor farmers and consumers in developing countries is lagging behind. Research can help by evaluating integrated agriculture, nutrition and health programs and documenting what's working, and what isn't. Improving collaboration between researchers, policymakers, and development practitioners is also critical to ensuring that research outcomes are relevant and timely and ultimately lead to results on the ground.

Researchers worked with various governments and the Codex Alimentarius Commission to improve national food safety regulations and nutrition plans. In particular, they achieved significant results toward controlling aflatoxin, a deadly contaminant of stored grain. Research partnerships for biocontrol are advancing in nine African countries; a workshop identified research gaps and opportunities, paving the way for greater scientific synergy and efficiency, as well as greater impact; and a set of related policy briefs was produced. While much of the focus of this work is currently on aflatoxin in Africa, a scoping study on public health risk was initiated in South Asia and scheduled for completion in early 2014.

CGIAR scientists developed training manuals and new protocols for food products that are bred to be rich in key vitamins or minerals, and contributed papers to *The Lancet's* second seminal series on maternal and child nutrition. The papers show that the critical underlying determinants of malnutrition — including income, food security, women's time, empowerment, and access to nutritious food and diet quality — need to be addressed simultaneously, taking into account the diverse dimensions of the agriculture-malnutrition-nutrition nexus.

One of the newly released nutrient-rich food crops is the pearl millet Dhanashakti, which boasts, in addition to an 11% increase in yield, a 9% increase in iron content in grain, as well as greater zinc content. The nutritional benefits of Dhanashakti are potentially most significant in countries with endemic anemia.

In India, for example, where the new variety was released, 52% of women, 80% of pregnant women and 74% of children under the age of 3 suffer from anemia induced by iron deficiency. Product diffusion, marketing and processing are also addressed to effectively reach consumers.

In Bangladesh, small freshwater fish that live in rice paddies are typically consumed whole, greatly enriching local diets with animal protein, calcium for bones, and highly bioavailable forms of vitamin A, iron and zinc. Researchers are working to enhance the productivity and diversity of fish in flooded paddies by improving and catalyzing local techniques to equip them with microhabitats in which fish can shelter during short periods of low water. Farmers dig into their paddies concrete rings that create low-water sanctuaries some 75 centimeters in diameter and a meter deep, from which fish emerge when rainfall restores paddy flooding. More than 180 rings have been set in Bangladesh to test the strategy, which contributes to improved nutrition and health, the sustainable management of natural resources, and poverty reduction.

As fruit plays an important role in nutrition, efforts have been made to conserve fruit tree diversity in Central Asia, the center of origin for many temperate fruit species. Extreme climatic variability has helped Central Asian farmers produce strains of apple, apricot, peach, pear, plum, grape, almond, pistachio, pomegranate and fig that tolerate drought and other environmental stresses.

As threats to this rich agricultural biodiversity became evident in the 1990s, CGIAR led a project that analyzed legislation and policy toward strengthening legal and policy frameworks to conserve the genetic diversity of horticultural and wild fruit, culminating in the landmark publication *Conservation of fruit tree diversity in Central Asia*: *Policy options and challenges*. The project renewed farmers' interest in planting local fruit varieties to replace aging trees and expand their orchards into degraded areas. As a bonus, landscapes thus restored provide improved grazing for animals, whose meat and dairy products further enrich diets.

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IMPROVING GENDER EQUITY FOR GREATER IMPACT

Knowing that it will not achieve lasting impact unless it takes gender disparities into account in all aspects of its work, CGIAR mainstreams gender research and analysis throughout its portfolio and is committed to closing the gender gap in agriculture. Researchers continued to roll out training on the Women's Empowerment in Agriculture Index to over 1,000 participants, undertook participatory technology evaluation and gender audits to establish benchmarks and assess new tools and technologies for likely gender implications, promoted sex-disaggregation in surveys, published findings on strategies that narrow the gender gap in productive assets for agriculture, and studied gender-related constraints.

The Gender, Agriculture and Climate Change Research Network was established to strengthen research on the gender aspects of climate change adaptation and mitigation. Scientists in the network explore how their research can help address the different needs and interests of men and women. One of the network's main strategies is to strengthen the ability of national and local partners to conduct gender-sensitive research. With this in mind, 50 professionals took part in a gender training and strategizing workshop to learn how to design studies that capture the different perspectives of male and female stakeholders.

A survey analysis found that women receive significantly less information about climate-smart agriculture than do men but, once informed, are equally likely to adopt these responses to climate change. The analysis identified institutional and policy constraints that limit the benefits for women from climate-related finance and used this information to guide low-emissions development. Researchers integrated gender into the design of innovation platforms on water management, identifying crosscutting gender constraints on women's participation in income generation and using this result to benchmark and identify targets for future work.

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Studies analyzed how to facilitate the sustainable scaling up of results through innovation platforms or hubs, with the goal of reaching significant numbers of farmers in a manner that promotes gender equity. In the polder zone of Bangladesh, for example, progress was made to improve system productivity by helping households produce vegetables, providing higher-quality fish seed at scale, and training men and women on aquaculture. These improved practices reached half a million farmers, including 48,000 men and 52,000 women trained to manage disease-resistant shrimp. Farmer field days expanded these numbers by fostering learning within and across communities.

Related research showed that volunteer farmer trainers (VFTs) offer a very effective way to reach farmers, women and men alike, with new knowledge. VFTs have deep knowledge of local conditions, live in the community and instill confidence in other farmers. They train on average 20 other farmers per month, with the backing of trained extension agents and specialists on subject matter. Using the results of this research, a project implemented by Heifer International is using the VFT approach to reach 315,000 dairy farmers in four countries in East Africa. The proportion of women VFTs in the region was 33% in 2011, when fewer than 10% of professional trainers and extension staff in the project were female. The study showed that female trainers were as effective as their male counterparts.

In contrast, a review of gender relevance across various research projects found that seed multiplication training in Malawi disadvantaged women, enabling men to dominate profitable sweet potato vine multiplication even in communities where sweet potato had previously been produced by women. Results will inform the development of seed systems frameworks and projects under development. Meanwhile, an assessment of 20 value chains and their contributions to consumer health and nutrition concluded that gender roles were more important determinants of health risk than were biological constraints.

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IMPROVING LIVELIHOODS THROUGH BETTER RESOURCE MANAGEMENT

Just as gender equity leads to greater impact, better agricultural practices and resource management can improve productivity, incomes and livelihoods. In Indonesia, for example, an initiative works directly with farmers to improve their livelihoods through better forest management. Halfway into the 5-year project, it had taught more than 8,000 farmers and local government staff about sustainable natural resource management, established 78 community tree nurseries benefiting 9,000 farmers, trained nearly 1,000 farmers and other stakeholders on how to get agroforestry products to market more efficiently and with better returns for farmers, and worked with villagers, farmers and local government staff to develop better ways of governing the landscape to sustainably improve productivity.

In Jepara District of Central Java, a project aiming to improve livelihoods helped small-scale local furniture makers overcome short supplies of high-quality teak and mahogany, poor cash flow and other constraints. The project founded a furniture producers association, 78% of whose members improved production, sales and income, increased timber use efficiency by 10-15%, and helped some producers attain national certification for green furniture, improving their access to European markets. Fast-growing teak trees were planted, increasing carbon storage, improving sustainable natural resource management and increasing climate change mitigation.

Fifteen innovation platforms were set up in arid areas of Africa and Asia to identify priority entry points for system improvement: land degradation, crop-livestock integration, maintaining system productivity while shrinking the environmental footprint of agriculture, and improving access to markets. This new "integrated agro-ecosystem and livelihoods approach" aims to sustainably intensify agriculture in arid areas, as articulated in a paper published in the journal *Food Security*.

In India, more than 185,000 farmers have adopted sustainable intensification technologies through an initiative implemented throughout South Asia. The initiative has developed information and communication technology tools for site-specific nutrient management that are expected to significantly improve profitability for farmers while shrinking the environmental footprint of fertilizer use in South Asia. The Nutrient Expert® decision-support tool for maize and wheat, for example, will help farmers apply just enough fertilizer to ensure high productivity while minimizing costly waste, water pollution and greenhouse gas emissions.

In East and Southern Africa, a CGIAR-led partnership provided farmers with high-quality chickpea seed for planting on approximately 660,000 hectares. As chickpea – a key source of protein for the poor – fixes more than 50 kilograms of nitrogen per hectare, by conservative calculation, and as the

average price of urea fertilizer that is 50% nitrogen is $340/ton, chickpea provided by the partnership would contribute through nitrogen fixation alone some $23 million in benefits to famers along with significant environmental benefits.

After reviewing the investment monitoring needs of African stakeholders, researchers started using Hubbard's Decision Research tools to assess the risks and returns from large investments in natural resource management. The framework was applied to eight cases, and the results are being used to develop a model to guide intervention decisions globally. The analyses have had signicant impact on recommendations for interventions, assessing some to be marginal or negative and others to be positive. The Routledge publication *Wetland management and sustainable livelihoods in Africa* demonstrates how sustainable wetland agriculture and fisheries can contribute to livelihoods without threatening wetlands, as is widely feared.

CGIAR is also bringing together scientists to address the challenge of seed degeneration in environments afflicted by pathogen buildup. In partnership with Kansas State University, they developed a new model that integrates different options for managing the problem, builds upon existing knowledge of virus ecology and evolution, and incorporates variability in environmental and biological systems. Initial results indicate that seed degeneration in banana, potato, sweetpotato, yam and cassava can be arrested using on-farm management and host plant resistance. This integrated approach appears to be far more effective than the usual wholesale replacement of planting material. Field studies to confirm preliminary results are now under way in 11 countries: Burundi, Cameroon, China, Colombia, Ecuador, Ethiopia, Kenya, Nigeria, Peru, Tanzania and Uganda.

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LOOKING AHEAD

As this report shows, in 2013 CGIAR and its partners achieved significant scientific progress that brought real impact on the ground and positive change in people's lives. Building on this work, the research-for-development agenda is firmly on track to contribute further to reducing poverty, hunger and malnutrition while promoting gender equity and climate change mitigation and adaptation. The portfolio also has the potential to shrink the environmental footprint of agriculture, forestry, livestock and fisheries, as well as to strengthen productive systems' resilience and sustainability.

To date, most research on sustainable intensification focuses on one or another dimension of sustainability, such as agronomy, rather than exploring the tradeoffs between the ecological, social, economic and agronomic dimensions of sustainability in different biophysical and socioeconomic environments. In 2014 and beyond, recently launched programs that take a systems or landscapes approach to research are expected to contribute interesting and significant results, adding value to outputs from the rest of the CGIAR portfolio by applying them in their target agro-ecosystems for the benefit of the poor and the planet. There is an urgent need to develop and disseminate locally appropriate technologies and knowledge to support climate change adaptation and mitigation through climate-smart agriculture, the topic to which this report now turns.

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FEATURE: CLIMATE CHANGE AND CLIMATE-SMART AGRICULTURE

Key to the success of agricultural interventions is their durability under climate change, which threatens to roll back decades of progress. A modest 2°C rise in global temperature by 2100 — in line with the optimistic low-emission scenario posited by the Intergovernmental Panel on Climate Change — is enough to destabilize current farming, forestry and ecosystems, even as the world struggles to sustainably produce 70% more food by 2050 to meet growing global demand. This is alarming for Africa and South Asia, two regions that are particularly vulnerable to climate change and home to most of the 850 million undernourished people who already suffer as worsening weather extremes pummel food production.

Agricultural research must do more to safeguard the progress achieved so far toward ending hunger, poverty and environmental degradation. In addition to raising productivity and yields, rural communities of smallholder farmers, fishers, foresters and livestock keepers need to strengthen their climate resilience by adapting to change. Further, they must contribute to climate change mitigation by curbing the 32% of greenhouse gas (GHG) emissions currently caused by agriculture. Taken together, better productivity, resilience and mitigation add up to the "triple win" promised by climate-smart agriculture.

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CLIMATE CHANGE

Adaptation and mitigation

CGIAR and its partners have achieved far-reaching outcomes that address climate change. Armed with more extensive and accurate climate data and analytical tools, innovative communication methods, and increased capacity, agricultural researchers, policymakers and extension personnel are better equipped to promote more effective policy and practices to accelerate climate change adaptation and mitigation.

One noteworthy breakthrough is the successful breeding of tropical grass hybrids that provide highly productive forage for cattle while curbing GHG emissions. The breeding program uses the grass *Brachiaria humidicola*, whose roots suppress nitrification, the chemical process that generates the extremely potent GHG nitrous oxide and leaches nitrates into the water table. After breeding *B. humidicola* for biological nitrification inhibition, scientists measured the hybrids' GHG benefits in a subsequent maize crop, finding higher grain yield achieved with less fertilizer. These results, published in the journal *Nature*, show the potential to limit GHG emissions and water pollution while improving livestock and crop productivity. A further advantage of *Brachiaria* and other superior forage grasses is their ability — second only to that of tropical forests — to sequester large amounts of carbon in their deep root systems.

In northwest China, researchers worked with herders and partners in government and the private sector to develop a cost-effective method of accounting and monitoring carbon sequestration in grasslands. Currently, carbon markets ignore grasslands and the carbon they sequester. The method, which meets rigorous double-verification requirements, promises to give herders access to carbon financing in exchange for culling their herds to allow overgrazed grassland to recover and to improve livestock productivity.

A complementary initiative in East Africa aims to quantify GHG emissions and identify farmers' mitigation options at both the farm and the landscape scale. Recognizing that efforts to curtail emissions are best guided by knowledge of their causes, a study found that beef and dairy cattle account for 77% of all GHG emissions from livestock globally. As most livestock in Sub-Saharan Africa, for example, graze on marginal land and crop residues, they typically exhibit low feed efficiency and high emission intensity. Cattle foraging in arid areas can release the equivalent of 1,000 kilograms of carbon for every kilogram of protein they produce, or 100 times the emission intensity recorded in parts of the developed world. Animals in the developing world require more food to produce a kilogram of protein than do animals in wealthy countries, and ruminants require up to 5 times more feed to produce a kilogram of protein as meat than as milk. This new data will help to assess the sustainability of livestock production systems.

In Uganda, research showed that intercropping two of the country's most important cash crops, coffee (which earns

20% of national export revenues) and banana, can earn farmers half again more income than growing either crop alone. A study found that the practice may also help farmers cope with climate change. Average temperatures in Uganda are expected to rise by 2°C in the coming decades. Shade from the taller banana trees can cool the coffee plants by at least this much, and banana's permanent canopy, roots and mulch prevent soil erosion and degradation in Uganda's hilly landscape. Moreover, banana captures atmospheric carbon dioxide, enriching soil carbon stocks while mitigating climate change.

Communications and capacity building

Strategies to mitigate and adapt to climate change must be communicated to stakeholders, especially in South Asia and Sub-Saharan Africa, the regions deemed to be most at risk. Several initiatives are extending the information age to farmers in these regions to compensate for overstretched agricultural extension services. In Kenya, a partnership with *Shamba Shape-Up*, a weekly reality TV show on farm makeovers that reaches over 3 million viewers, is bringing science into the makeovers and supporting the scale out of gender-sensitive climate-smart practices.

In South Asia, a collaboration with the Nepal Development Research Institute produced radio jingles and public service announcements to reach 1 million farmers with advice on how to adapt to climate change. As 90% of households have mobile phones, researchers disseminated 20 text messages on climate change and climate-smart practices for rice, wheat and maize to thousands of farmers in 11 districts. Farmers found the text messages and agro-advisories so useful that 84% of those interviewed said they would pay 10-20 US cents a month to subscribe to such a messaging service. This initiative demonstrates that innovative communication partnerships can indeed help reach deep into rural areas.

However, information technology cannot entirely replace face-to-face capacity building, and recognition is growing that special efforts are required to reach women stakeholders. Restricted access to land, other productive resources and information leaves many women in low-income countries disproportionately vulnerable to climate change. Moreover, policy makers have long overlooked the potential of engaging rural women usefully in adaption and mitigation initiatives. To address these issues, 15,000

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local women leaders were trained on climate-smart agriculture in Nepal and the neighboring Indian state of Bihar through a training-of-trainers program. Another project in Haryana State, also in northern India, first interacted in person with women farmers, elected heads of villages (some of them women) and educated women in male-headed households, eventually involving more than 1,200 female and male farmers in eight villages. Each farmer in the project now receives two voice messages daily (along with detailed text messages when required) that provide weather forecasts, information about pests and their control, and details of climate-smart technologies.

Weather forecast and analysis

To help smallholder farmers cope with increasingly variable and extreme weather, national meteorological services need to improve their forecasts and deliver them more effectively to end users. Research and capacity investment have helped national meteorological services in developing countries produce climate information at a resolution high enough to be useful to rural communities. At least four such services have changed their policies and practices in light of improved understanding of farmers' perceptions and information needs, adopting newly designed and disseminated methods of delivering climate information services that better meet those needs.

In Senegal, the results of participatory research revealed what kinds of seasonal weather forecasts farmers wanted and in what format. Researchers then worked with an association of community radio stations to get these new kinds of forecasts to farmers, reaching an estimated 2 million of them. It further collaborated with the national meteorological agency and agricultural extension department, and with local farmers' associations, to help farmers learn how to interpret the data so that they could decide what to grow and when to perform critical farming tasks.

The CGIAR-sponsored climate portal progressed its goal of becoming the go-to source for open access climate data that is properly scaled and coupled with crop models to make it useful for understanding the effects of climate change on agriculture. Last year, over 65,000 files were uploaded to the portal, to which users in nearly 700 institutions in 163 countries made over 14,500 unique visits. Some 5,000 users downloaded 135,000 files containing 125 terabytes of data.

Good weather data is essential to a new insurance product released in India in cooperation with the Agricultural Insurance Company. Affordable weather-indexed insurance now protects 50,000 farmers, the vanguard of what is expected to become millions of policyholders in the coming years. The advantages of weather-indexed insurance are its low transaction costs and timely claims processing. Providers of weather-indexed insurance pay claims automatically if rainfall fails to reach a set threshold, with no need to assess each farmer's actual loss. The program provides rainfall data for each cropping season, and local rainfall thresholds are set using historical data on land use, weather patterns, soil and crop management, and regional crop models. Participating Indian farmers can now shield themselves from devastating crop losses and be certain of prompt compensation if crops fail because of drought.

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Influencing policy and practice

Strong policy support is needed to successfully manage the impacts of climate change. CGIAR studied national climate change adaptation plans, policies and processes in 12 countries across West and East Africa and South Asia to see how they could be improved; supported Kenya's release of its national adaptation plan; assisted the first national implementation project of the United Nations Global Framework for Climate Services in Tanzania and Malawi; and played a part in formulating the climate change adaptation strategy adopted by the Ethiopian government. In Central America, it helped shape Nicaragua's adaptation strategy, which attracted from the International Fund for Agricultural Development an investment of $24 million to help coffee and cocoa farmers adapt to climate change.

CGIAR and its partners in East Africa are pushing for national and international climate change talks to fully integrate agriculture and provide scientific evidence to underpin policy. Recognizing the critical need to provide sound evidence to support a common African position, agricultural scientists and other experts reviewed progress on agricultural negotiations under the United Nations Framework Convention on Climate Change and eventually reached agreement on a conceptual framework for a technical paper on the situation.

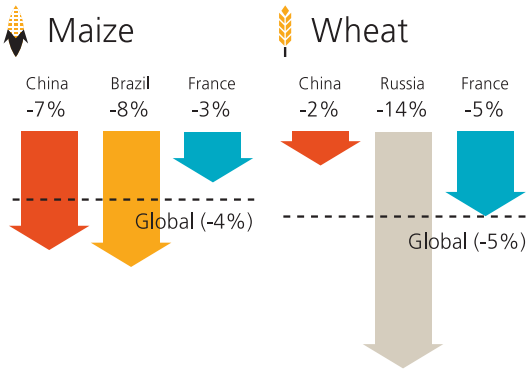
Scientists have also analyzed different aspects of United Nations-led work on reducing emissions from deforestation and forest degradation (REDD+) such as conserving forests, enhancing forest carbon stocks and sustainably managing forests. Research on these areas has helped to inform evidence-based decision making, influence policies and change institutional mechanisms to more effectively address climate change and better serve the poor.

Climate change, food and farming: 2010s

According to the Fifth Assessment Report of the IPCC, climate change is affecting food and farming now

It is affecting crop yields

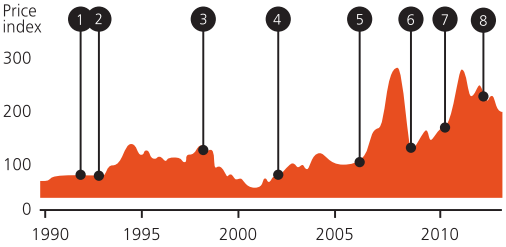
Maize and wheat yields show climate impacts



It is putting up prices

Recent price spikes for food have been linked to extreme weather events

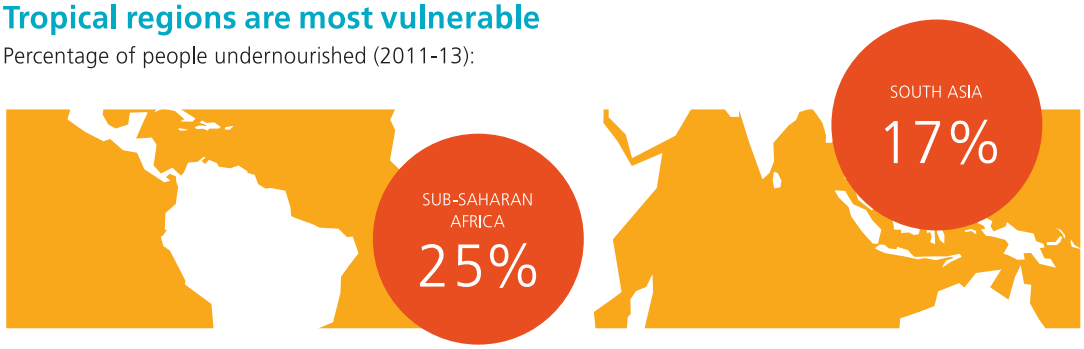
SEASONAL CLIMATE EXTREMES AND THE FOOD PRICE INDEX



1. Australia wheat. 2. US maize. 3. Russia wheat. 4. US wheat, India soy, Australia wheat. 5. Australia wheat. 6. Argentina maize, soy. 7. Russia wheat. 8. US maize.

Tropical regions are most vulnerable

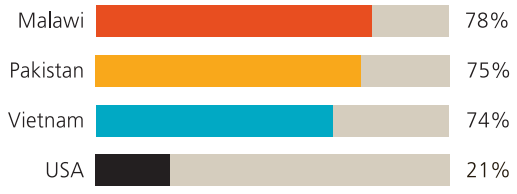
Percentage of people undernourished (2011-13):



Poor people are worst affected

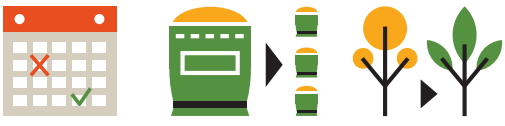
Poor people spend a higher proportion of their income on food – so price rises affect them more

HOW MUCH OF THEIR INCOME DO POOR PEOPLE SPEND ON FOOD?



Adaptation is happening, but is not enough

Farmers are:



Changing planting dates

Adjusting marketing arrangements

Using different crop cultivars and species

SOURCES: Porter, J. R., Xie, L., Challinor, A., Cochrane, K., Howden, M., Iqbal, M. M., Lobell, D., Travasso, M. I. 2014. Food Security and Food Production Systems. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. http://www.ipcc-wg2.gov/
With data from Lobell et al 2011, FAO 2014, US DOL 2014

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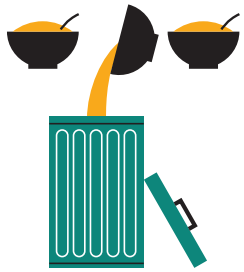
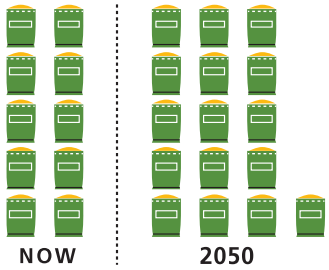
Productivity

ALMOST A BILLION PEOPLE are going hungry, while we waste 1/3 OF THE FOOD WE PRODUCE.



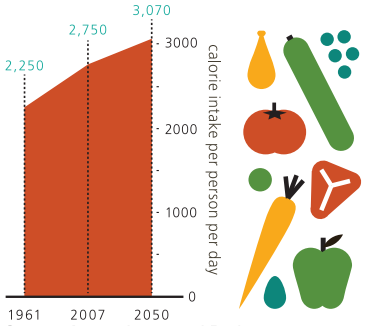
Source: FAO, 2013

With current global trends in diets and population, 60% MORE FOOD will be needed in 2050.



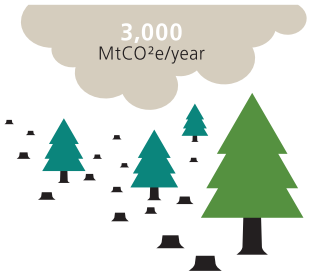
Source: Alexndratos and Bruinsma, 2012

Average calorie consumption is rising.

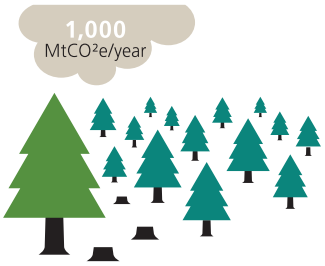


Source: Alexandratos and Bruinsma, 2012

If trends continue, ABOUT 10 MILLION km2 OF LAND will likely be cleared by 2050 to meet food demand.

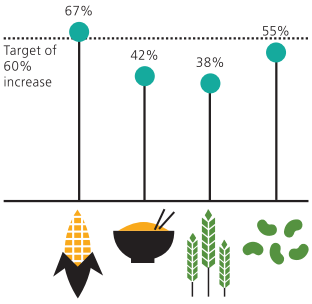


Alternative pathways would only require ABOUT 2 MILLION km2 OF LAND be cleared.



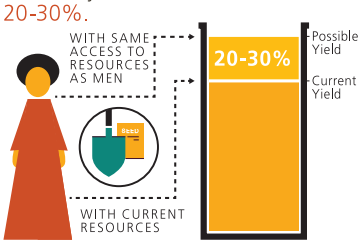
Source: Blaser and Robiedo, 2007 Tilsman et al., 2011

Yields of maize, rice, wheat, and soybean all need to INCREASE BY 60% by 2050 to meet demand but current growth in yield are falling short of the target.



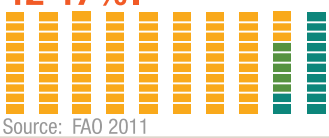
Source: Ray et al., 2013

If women had access to resources, on-farm yields could INCREASE BY 20-30%.



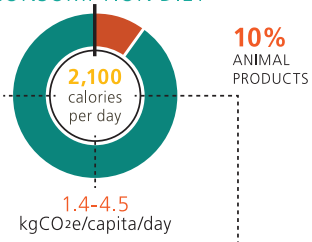
This extra output could reduce the number of hungry people in the world by

12-17%.



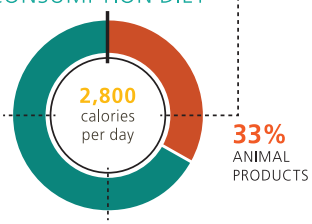
Source: FAO 2011

LOW CONSUMPTION DIET



A low-consumption diet with less meat consumption causes lower GHG emissions than a high-consumption, meat-rich diet.

HIGH CONSUMPTION DIET



Source: Pradban et al., 2013

We will need major innovations in how we eat and farm

To cope with climatic changes, we may need to consider:

Completely different diets

Shifting production areas for familiar crops, livestock and fisheries

New approaches to managing waste, water and energy in food supply chains

Restoring degraded farmlands, wetlands and forests

For these facts and more, visit www.ccafs.cgiar.org

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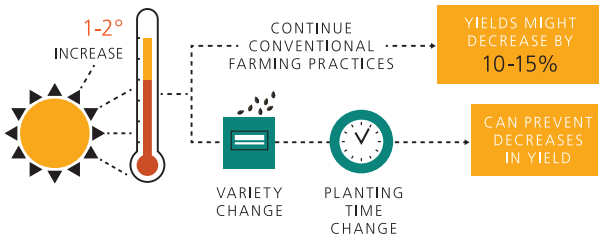
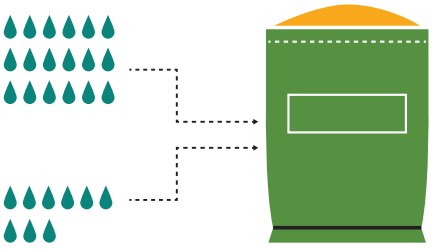
Adaptation

Simple adaptation strategies could offset crop yield changes caused by climate change.



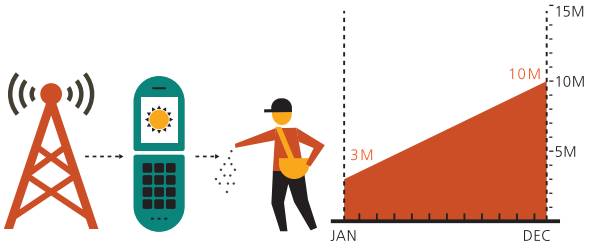
Source: Perry et al., 2007

Less water could equal the same amount of grain.



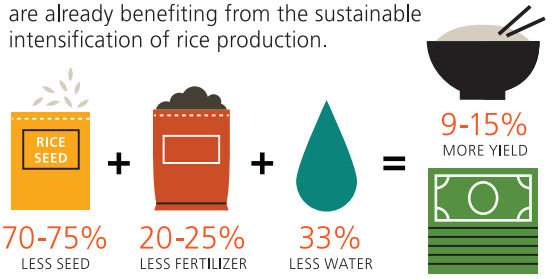
Source: Molden et al., 2007

In India, the Integrated Agrometeorological Advisory Services delivers crucial weather info to farmers to help them adapt. It aims to exceed its target of 10 MILLION FARMERS in 2014.



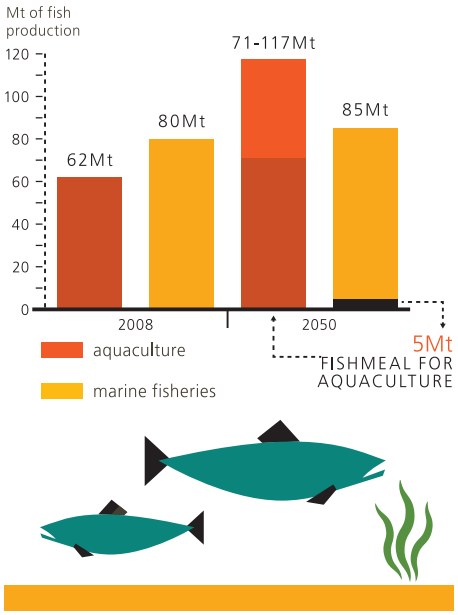
Source: Aggarwal, 2013

10% OF VIETNAMESE RICE FARMERS are already benefiting from the sustainable intensification of rice production.



Source: SIR Rice 2012

Aquaculture has huge potential to meet future protein needs under climate change, but relies on fishmeal from marine fisheries.



Source: Merino et al., 2012

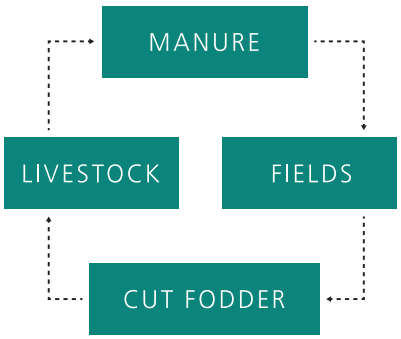
Future food security will depend on wild relatives to current crops.

Source: Padulosi et al., 2011

Mangroves provide protection from natural disasters.

Source: Pramova et al., 2012

Farms need to diversify and incorporate both livestock and crops.



Source: Herrero et al., 2010

SOURCES: Porter, J. R., Xie, L., Challinor, A., Cochrane, K., Howden, M., Iqbal, M. M., Lobell, D., Travasso, M. I. 2014. Food Security and Food Production Systems. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. http://www.ipcc-wg2.gov/
With data from Lobell et al 2011, FAO 2014, US DOL 2014

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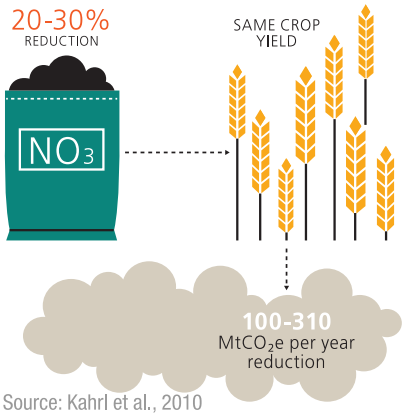
Mitigation

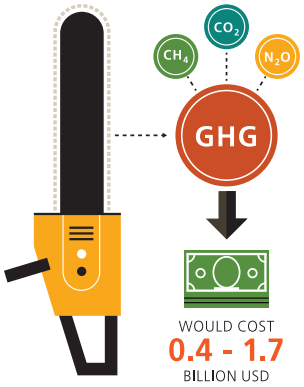
If farmers in China used less nitrogen fertilizer they could save GHGs emissions equivalent to Indonesia's entire power sector.



Source: Kahrl et al., 2010

10% REDUCTION IN DEFORESTATION

WOULD EQUAL A REDUCTION OF **300-600** MtCO²e PER YEAR



Source: Kindermann et al, 2008

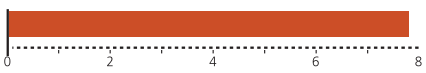
Sequestering carbon in the soils of croplands, grazing lands and rangelands offers agriculture's highest potential for climate change mitigation.

These soils can store between 1.5 AND 4.5 $GtCO_2e$ PER YEAR.

Source: Smith et al., 2007

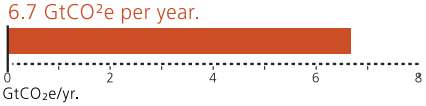
Changes in food consumption and waste may influence the emissions from all stages of the food chain.

Eliminating all animal products from our diet would save 7.8 $GtCO_2e$ per year.



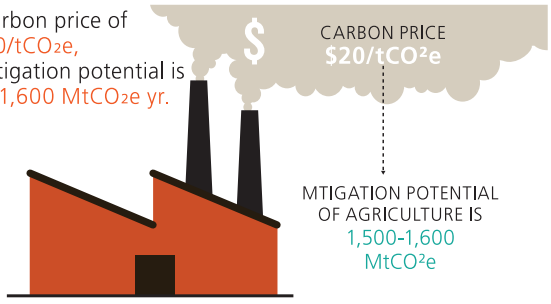
Eliminating meat would save 6.4 $GtCO^2e$ per year.

The entire emmissions of the United States 6.7 $GtCO^2e$ per year.



Source: Stehfest et al., 2009 || US-EPA2013

At a carbon price of USD 20/tCO_2e, the mitigation potential is 1,500-1,600 $MtCO_2e$ yr.

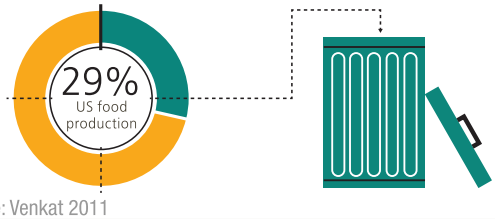


Source: Smith et al., 2008

ABOUT 70% OF AGRICULTURAL MITIGATION POTENTIAL is in low and middle income countries.

Source: Smith et al., 2008

Eliminating avoidable food waste in the USA would save 55 MILLION METRIC TONNES (Mt) OF FOOD PER YEAR, nearly 29% of annual production, and save greenhouse gas emissions of at least 113 Mt CO_2e/yr.



Source: Venkat 2011

SOURCES: Porter, J. R., Xie, L., Challinor, A., Cochrane, K., Howden, M., Iqbal, M. M., Lobell, D., Travasso, M. I. 2014. Food Security and Food Production Systems. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. http://www.ipcc-wg2.gov/
With data from Lobell et al 2011, FAO 2014, US DOL 2014

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CLIMATE-SMART AGRICULTURE

Climate change has raised the stakes for experts in agricultural research for development and called attention to the inadequacy of stock approaches. Reducing poverty, hunger and the environmental footprint of agriculture requires climate-smart options that deliver the triple win of improved productivity, strengthened resilience and mitigated greenhouse gas emissions. Positive results can come from simple adjustments to land, crop and livestock management that restore soils, as discussed in the section on climate-smart villages, or facilitate optimized sowing times for improved varieties, as under conservation tillage. The promotion of climate-hardy crops like sorghum and millet can keep drought-prone land productive and sustain the livelihoods of local farm communities. As highlighted by research on forestry and gender, the sustainability of triple win interventions depends on building the capacity of all stakeholders, men and women alike.

COORDINATED ACTION

Climate-smart villages bring together diverse stakeholders to test how farmers can adapt to climate change, manage risk, build resilience and boost incomes. Encouraged by smallholders' success, CGIAR is extending the approach from climate hotspots in Africa and South Asia to Southeast Asia and Latin America.

Farmers in the Lower Nyando Valley of Kenya plant maize, sorghum and other crops between rows of trees. The nitrogen-fixing trees fertilize the soil. Their roots prevent soil erosion, slow rainwater runoff, and improve soil structure and carbon content. The trees provide leaf fodder for sheep and goats and, later, wood for fuel and building materials. Meanwhile, the emerging market for saplings has encouraged local entrepreneurs, more than half of them women, to set up 22 tree nurseries.

This is one of 15 climate-smart villages selected since 2011 for their vulnerability to climate change, alternative land-use options, contacts with implementation partners and interest in participation. Where community groups do not yet exist, the program helps farmers, village officials, agro-advisory service providers and researchers form them and register for government subsidies.

Next, a steering committee of community representatives and researchers conducts a baseline survey to determine resource availability and which climate-smart technologies are realistic options for that village, as well as to inform later impact assessment. Local stakeholders convene to prioritize climate-smart approaches, then test on their own farms how well the preferred options work under local conditions.

Two factors affecting productivity, resilience and climate change mitigation are soil carbon and nitrogen. The agroforestry option adopted in the Lower Nyando Valley is one way to improve soil carbon content. It boosts fertility as it sequesters carbon to mitigate climate change. Other options are conservation tillage, managing crop residues and livestock manures more efficiently, and diversifying land-use systems. Similarly, farmers can improve their use of nitrogen fertilizer with leaf-color charts, handheld crop sensors and nutrient decision-maker tools, including those accessed by mobile phone. Nitrogen application needs to be just right because deficiency reduces crop yield, and excess wastes money and generates greenhouse gases.

> Soil carbon sequestration and the precise dosing of nitrogen fertilizer improve yields, reduce input costs and curtail the release of the greenhouse gases that cause climate change.

Water and energy resources are two other factors. Rainwater harvesting and drip irrigation are among the on-farm water management techniques that help farmers use water more efficiently. In

> Better community water management enables the operation of vertical drainage systems in India to protect standing crops from floods while recharging aquifers.

India, better community water management enables, for example, the operation of vertical drainage systems to protect standing crops from floods while recharging aquifers depleted by excessive groundwater withdrawal. Laser land leveling distributes irrigation evenly over a field to nourish a uniform crop and prevent soil waterlogging. Pumping less irrigation water, and doing so with fuel-efficient engines, reduces costs and greenhouse gas emissions, as does curtailed plowing under conservation tillage and improved residue management. Biogas obtained from manure can meet some fuel needs.

Climate analogue visits take farmers from one climate-smart village to another to see how their counterparts cope today with climate conditions predicted for their own village tomorrow.

Climate resilience depends on knowing what to expect and hedging risk. Climate-smart villages partner with government departments and others to link farmers with weather news, agro-advisories and market information through newspapers, radio, television and cellphone messaging. Program partners include private firms that offer cost-effective crop insurance indexed to local rainfall and temperatures, sometimes supported by government subsidies. Climate analogue visits take farmers from one climate-smart village to another to see how their counterparts cope today with climate conditions predicted for their own village tomorrow.

Community seed banks have inspired an innovative approach to crowdsourcing seed and variety evaluation that promotes farmer-to-farmer exchange and provides feedback to crop breeders. In India, women-empowering local partners Alternative Futures and Bihar Mahila Samakhya trained a core group of women trainers who reached 1,500 other farmwomen with songs they composed to convey easy-to-remember messages in the traditional way. Success story and testimonial videos shot in climate-smart villages are screened in nearby villages, and word is further spread through local, national and international media.

Climate-smart villages link farmers and local organizations with scientists and policymakers through a site coordinator and assistant in each village. Participating farmers keep daily diaries and, with the site coordinator, monitor and evaluate their chosen interventions. Researchers analyze the results at the end of each cropping season to validate and expand the body of knowledge that climate-smart villages tap to adapt to and mitigate climate change.

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CLIMATE-SMART CROPS

Sorghum and pearl millet are hardy, climate-smart grain crops ideal for environments prone to drought and extreme heat. CGIAR is breeding sorghum and millet varieties that thrive on soils low in phosphorus, which constrains their cultivation in West and Central Africa.

Settled communities in the Sahel struggle to eke a living out of this band of marginally arable land that stretches across Africa from Senegal to Eritrea. This is the zone of transition from savanna to the Sahara Desert, which sprawls across the northern third of the continent. The two most widely grown crops, sorghum and pearl millet, are nutritious and well adapted to heat and water stress. Yet the 120 million people who live in the western and central portions of the Sahel — a population forecast to double by 2050 — are among the poorest and most food insecure in the world. One leading cause is the prevalence on smallholder farms of soils deficient in phosphorus (P), an abiotic constraint that holds sorghum and millet yields below their potential.

Amending soil with P fertilizer is not practical for most farmers in the Sahel because they cannot afford these inputs, which are all the more expensive after being trucked long distances over bad roads. Further, mineral P is, like petroleum, a limited resource worldwide. Maritime guano deposits have long since been exhausted, and global production from phosphate rock is expected to peak in about 2030 as reserves of this nonrenewable resource dwindle.

Climate change is tightening the squeeze on food security caused by rapid population growth and worsening mineral P shortage and will likely make the Sahel depend even more on drought-tolerant crops such as sorghum and pearl millet, both of which originated here. One option for addressing food security in the region is to make them more productive under limited soil P.

A project on abiotic production constraints in pearl millet and sorghum-based agricultural systems of the West African Sahel conducted crop trials from 2010 to 2013 in multiple locations in Burkina Faso, Mali, Niger and Senegal. After establishing research protocols, scientists evaluated some 300 sorghum and millet genotypes for their performance under P-sufficient and P-deficient conditions.

> One option for tackling food insecurity in the Sahel is to make sorghum and pearl millet more productive on the phosphorus-deficient soils prevalent in the region.

Working with colleagues in the national agricultural research systems of the four West African countries, and simultaneously training them on international best practice, CGIAR researchers identified promising sorghum and millet landraces and crossed them to generate intermediate breeding materials for national crop-improvement programs. Using modern genomic techniques, they made significant strides toward identifying molecular markers for low-P tolerance in sorghum, as well as headway in the smaller parallel subproject for millet.

Heat and drought tolerance make sorghum and pearl millet resilient and well-suited for continued use in the Sahel and for adoption in other climate-vulnerable areas.

Alternative crop management techniques, such as fertilizer micro-dosing with a capful for each plant, were also explored. This innovation boosted millet yield by 55% in experimental fields in Niger while using only a sixth of the fertilizer expended in conventional application.

The project was the first effort to integrate conventional and marker-assisted breeding with improved natural resource management to enhance sorghum and millet productivity in Sub-Saharan Africa. The relative impact on millet productivity from drought, low-P soil and their interaction was assessed, with the aim of developing varieties that tolerate multiple abiotic stresses in the Sahel.

As these dryland crops require little or no irrigation or fertilizer, their cultivation generates only modest greenhouse gas emissions, mitigating climate change.

Any increase in sorghum and millet yield promises many benefits, as these crops provide not only food for people but also fodder for livestock and, with processing that adds value within the local economy, beverages and biofuel. A highly significant research achievement in dryland cereals was the introduction of hybrid sorghum, which boosted yields and simultaneously supported the development of seed cooperatives and small seed enterprises. In a single year, Mali tripled its production of hybrid sorghum seed to 30 tons, which helped supply the 10,000 farmers in the region who have adopted hybrid sorghum.

Heat and drought tolerance make sorghum and pearl millet resilient and well-suited for continued use in the Sahel and for adoption in other climate-vulnerable areas in future. They allow the production of highly nutritious grain to be sustainably increased, thereby bolstering food security. And they better enable farmers to cope with the more frequent and severe droughts expected under climate change, especially in Sub-Saharan Africa and South Asia. Improved tolerance of P-deficient soils, which addresses the key factor that constrains their productivity, promises to make sorghum and pearl millet even better options for future farm environments increasingly challenged by climate change.

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CONSERVATION AGRICULTURE

Zero tillage, crop residue retention, and other components of conservation agriculture cut costs, boost yields, strengthen resilience and mitigate climate change. CGIAR experts joined with multiple partners to make Kazakhstan, the world's sixth-largest wheat exporter, its second-fastest adaptor of this often climate-friendly practice.

Drought and high temperatures in 2012 helped underscore the advantages of these agricultural practices to many wheat farmers on the steppes of northern Kazakhstan. While production in this Central Asian breadbasket plunged from 24 million tons in 2011 to only 11 million, its 2 million hectares of zero-tillage wheat produced up to 3 times as much grain per hectare as those that had been plowed in the conventional way. The 700,000 tons of wheat protected from drought was worth $220 million freight on board.

This impressive result will likely speed the adoption of conservation agriculture in Kazakhstan, where the wheat area under zero tillage more than tripled from 2007 to 2012, to occupy 10% of all wheat land. Only in China is conservation agriculture spreading more quickly. Worldwide, the farmland under conservation agriculture ballooned from 3 million hectares in 1973 to 45 million in 1999 and 72 million in 2003, largely in the Americas and Australia but increasingly in Asia and Africa.

Conservation agriculture embraces both zero and low tillage, the idea behind both being to disturb the soil as little as possible while preparing a field and sowing seeds. Permanent soil cover provided by crops or their residues benefits soil health in many ways. Vegetation shields soil from direct exposure to rain and sun to prevent crusting and rapid runoff, improve water infiltration and retention, and reduce or eliminate soil erosion. It feeds beneficial soil organisms, permits natural biological tillage and the slow circulation of air and water, promotes humus formation, and stabilizes soil temperature.

> Conservation agriculture cuts expenditures by reducing the use of labor, machinery, fuel, fertilizer and irrigation water, while raising yields from unirrigated wheat fields.

Preserving crop stubble is especially important in the wheat belt of northern Kazakhstan, where 40% of annual precipitation falls as snow. The stubble keeps it from blowing away before the spring thaw, and the resulting deep saturation from snow melt contributes to observed yield improvement by 30% in years with good weather, 40% in dry years and 80% under drought. With normal weather, zero tillage and residue retention add 2 million tons of wheat to Kazakhstan's annual harvest, which is enough to feed 5 million people for a year or to cover the country's 2013 wheat exports to Afghanistan, which met a third of wheat consumption there.

Kazakhstan has recorded wheat yields improving under conservation agriculture by 30% in wet years, 40% in dry years and 80% under drought.

Testing and promotion of conservation agriculture in Kazakhstan began in 2000. The combined efforts of CGIAR, the World Bank, the Food and Agriculture Organization of the United Nations, and many national partners have raised the profile of conservation agriculture from nil to official state policy. Adopting farmers began to receive state subsidies in 2008.

Outlays are steep at $250-300 per hectare in the first year for machinery and herbicides. Costs not covered by subsidies are recouped from higher grain sales and annual savings, estimated at $15 per hectare, from lower use of labor, machinery, fuel, fertilizer, seed and — for the 7% of wheat land in Kazakhstan with irrigation — water. Time savings permit an optimized planting schedule. However, zero-tillage wheat must be rotated with pulses or oil seeds to facilitate nitrogen fixation, nutrient cycling and root penetration to different depths to rejuvenate the soil, as well as to starve wheat pathogens and pests. This has constrained adoption in northern Kazakhstan, where many farmers see no commercial alternative to wheat. Because the full benefits start to be realized only after 5-7 years, farmers must take the long view.

Toward mitigating climate change, conservation agriculture in Kazakhstan currently locks up 1.3 million tons of carbon dioxide, which equates to taking 270,000 cars off the road.

Wheat farmers in Kazakhstan and elsewhere are switching to conservation agriculture because it boosts yields and profits in good years, salvages bad years, and makes agriculture more sustainable over the long term by minimizing wind and water erosion while restoring and maintaining soil health.

Meanwhile, everyone in Kazakhstan can benefit as conservation agriculture mitigates the greenhouse gas emissions that cause climate change. It does so by using much less fuel to operate farm machinery, especially tractors for plowing but also pumps for irrigation. The practice uses less mineral fertilizer and so cuts carbon emissions associated with its shipment and application. In addition, higher crop production and residue retention sequesters the carbon that contributes to global warming if released into the atmosphere as carbon dioxide. It is estimated that conservation agriculture as currently practiced in Kazakhstan locks up 1.3 million tons of carbon dioxide. This equates to taking 270,000 cars off the road.

FORESTS AND GENDER

Women have little say in managing local forests relative to their extensive use and knowledge of these communal resources, or relative to men. CGIAR studies ways to facilitate women's participation in forest user groups in Nicaragua and Uganda, toward strengthening their tenure rights.

Responsibility for managing forests has shifted in recent decades away from remote state authorities into the hands of the local communities that depend directly on forests and therefore care the most about their sustainable use and conservation. However, this favorable global trend has not translated into forest management that fully engages women, as traditional community power structures often marginalize them.

Forest communities need better gender balance in their resource management to improve their prospects for sustainable development and poverty reduction. Climate change lends urgency to this need, as few communities can hope to cope with its unique challenges without the strong participation of women. The whole community must pitch in to regulate forest use so that it reduces poverty now and in a future increasingly affected by climate change, without undermining the role of woodlands as carbon sinks to mitigate climate change.

In this regard, an initiative in Uganda has changed attitudes toward women planting trees on land they do not own. Before the project, a woman could not plant trees on her husband's land without his consent or on community land, because tree-planting signified landownership. Training under the initiative, which reached 596 men and 562 women in Uganda, has changed people's minds such that both customary restrictions have loosened. Today, women in project areas have more freedom to plant trees that support livelihoods, restore forest environments and sequester greenhouse gases.

> Climate change demands gender balance in forest resource management, as few communities can hope to cope with its unique challenges without the strong participation of women.

Another project set out in 2010 to understand the dynamics of forest user groups in Nicaragua and Uganda. It aimed to apply this knowledge toward formulating strategies to make user groups more receptive to women's participation and leadership and, ultimately, to strengthen women's forest tenure rights.

Nicaragua and Uganda have signed international treaties on women's rights and empowerment. Both embrace gender equity in their legal frameworks, including forestry law and policy, but have not realized equity in forest communities. The project investigated whether negotiation and facilitation by trusted intermediaries could fill the void and strengthen women's forest rights. This approach is premised on the observation that land and resource rights are generally allocated in customary systems through negotiation between the authorities and resource users.

People's attitudes have begun to change in Uganda such that customary restrictions against women planting trees on land they do not own have been relaxed, facilitating carbon sequestration.

Working with academic and other partners in both countries and from the United States, researchers trained local stakeholders at 15 of 36 project sites in the problem-solving and learning process called adaptive collaborative management (ACM). Baseline surveys conducted in 2011 will allow comparison with follow-up surveys in 2015 to compare results achieved with and without ACM.

Improvements in gender equity stemmed from actively encouraging women's participation, but not to the exclusion of men, while ensuring that all stakeholders contribute and share benefits equitably.

Preliminary findings show better results at ACM sites in both Nicaragua and Uganda. In some communities, women participate more actively, confidently and assertively in group discussions. They fill more leadership roles in forest user groups; in Uganda, the forest user groups at four of six ACM sites are now chaired by women, up from zero before ACM, and women now fill about half of all leadership roles, up from 16%. Coordination has improved with forestry agencies, research organizations and nongovernmental organizations. Communities in each country have received up to 10,000 seedlings for reforestation, and those in Uganda have further been trained on establishing tree nurseries and beekeeping. Having successfully solicited this assistance, the communities now plant more of the tree species preferred by men and women alike.

These positive results appear to stem from actively encouraging women's participation, but not to the exclusion of men, while developing rules to ensure that all stakeholders contribute and share benefits equitably, as well as mechanisms to manage conflicts.

Building on the success achieved with local stakeholders in the first phase of the project, the partners launched in October 2013 the second phase to extend gender sensitivity training to policy makers in national government.

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OPERATIONAL PROGRESS

Strategic partnerships, committed investors, streamlined business processes, enhanced accountability, expanded access to knowledge and stronger orientation for impact — these are some of the assets and ideals that enable CGIAR to generate and deliver research that yields real results on the ground.

CGIAR has long been one of the best investments for sustainably reducing poverty, hunger and malnutrition. As the Scientific Progress section of this report highlights, it continues to provide solutions to some of the world's most pressing development challenges. Recognizing how important good governance, strong financial systems and effective business practices are to producing world-class research, CGIAR took a number of steps toward more efficient operations to put it in an even better position to deliver science and technology that benefits the poor.

The second 3-year term of the Fund Council, the decision-making body of CGIAR's multilateral trust fund, began in 2013. The new Fund Council includes four "recognition seats," which were created to guarantee that donors who contributed most to pooled funding — the Netherlands, Sweden, the United Kingdom and the United States — have a direct voice in the governance of the CGIAR Fund.

Following a thorough assessment of the numerous recommendations emerging from a review of CGIAR governance, the Fund Council decided to focus on developing a system-wide resource mobilization strategy, enhancing policies on risk management and conflict of interest, improving strategic leadership, and refining CGIAR's brand and image. As a first step, the Fund Council established a Resource Group, which will collaborate with Consortium counterparts to coordinate fundraising across the system, develop best practices and make donor investments more efficient. To expand on the earlier governance review, the Fund Council commissioned a comprehensive midterm review of the CGIAR reform to assess progress and recommend course corrections and improvements.

Another key decision was to extend the current CGIAR Research Programs (CRPs) to the end of 2016 so that lessons learned from the first round of CRPs can be fed into the development of the second generation of research programs, along with recommendations emerging from the midterm review and the evaluation of each CRP. The new portfolio of CRPs is expected to be more robust, relevant and results-oriented, as well as better aligned with the CGIAR Strategy and Results Framework, which is also under revision along with its Action Plan — a roadmap to improve the quality, coherence and integration of the research agenda. To provide input and background information for the Action Plan, the Independent Science and Partnership Council (ISPC) commissioned the foresight study *Trends in urbanization and farm size in developing countries: Implications for agricultural research*.

"It has been a great privilege to serve as the inaugural ISPC Chair. Over the past 3 years, I believe all players in the CGIAR system have learned a great deal, providing a strong foundation for moving ahead. I look forward to watching the continued evolution of CGIAR and believe all the pieces are in place for continued success if underpinned by good faith, good leadership, good science and good partners."

Ken Cassman, Chair of the Independent Science and Partnership Council (ISPC), 2011-13

Improving accountability for results

Significant efforts were made toward developing an improved accountability framework. Leaders of the CRPs met for the first time en masse with donors, implementing partners and colleagues from other parts of the CGIAR system to review the CRPs' theories of change, activities and priorities. In conjunction with the fall Fund Council meeting, the CGIAR Knowledge Day was convened to provide another opportunity for donors and scientists to engage in dialogue. CRP leaders presented their achievements to date, with particular attention to gender equity and value for money. Participants assessed CRPs' progress and plans in terms of expected impacts on four broad outcomes critical to development: reduced poverty, strengthened food security, improved nutrition and health, and sustainably managed natural resources.

Science leaders in the CRPs and Centers collaborated with experts in the ISPC to identify measurable contributions to large-scale development impact. They agreed on 11 common intermediate development outcomes — including improved productivity, stronger emphasis on gender and empowerment, mitigated climate change and improved nutrition for vulnerable populations, especially women and children — to fill in the "missing middle" between research on the ground and the four broad outcomes mentioned above.

Monitoring and evaluation are vital at all levels of operation, from the front lines to system management, and to reinforcing a results-based culture, keeping CGIAR accountable to its donors and stakeholders, and demonstrating value for money. The Independent Evaluation Arrangement made good progress in its first full year of operation. Among other activities, it conducted its first evaluation of a CRP, reviewed the Generation Challenge Programme, and initiated a governance and management review that included recommendations to streamline structures, strengthen the independence and legitimacy of decision-making, improve transparency, provide CRP leaders with the authority to manage for results, and sustain the institutional capacity of CGIAR Research Centers. The Independent Evaluation Arrangement Office launched the Evaluation Community of Practice and established the Quality Assurance Advisory Panel to provide strategic advice on evaluation approaches, standards and procedures.

In response to concerns from the Centers and CRPs regarding the stability and transparency of CGIAR financing plans, the Consortium put in place a new multiyear financing plan for 2014-15. This new approach is a step toward a clear quantitative accountability framework planned for the next round of CRPs. The new plan was well received by donors and researchers alike.

Greater impact through open access and efficiency

Open access is gathering pace in agriculture, and the reformed CGIAR has the means and the will to lead the way. Building on the 2012 Principles on the Management of Intellectual Assets, the first Open Access Policy was developed in a groundbreaking effort to address open access system-wide. The policy commits CGIAR to provide open access within the next 5 years to its wealth of data, information and knowledge — including spatial, crop, socioeconomic and genomic datasets. All 15 Research Centers adopted the policy, which is now mandatory.

This clear commitment to open access will improve the efficiency, efficacy and impact of CGIAR research; aid interdisciplinary studies; and allow the public to further benefit from research outcomes. For example, in response to a call from the Group of Eight, collaboration is underway with the Forum for Agricultural Research in Africa and its partner organizations on the African Agricultural Technology Platform to develop a platform

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toward scaling up African smallholders' use of agricultural technologies. The platform includes a virtual space from which data and information will be freely accessible to decision-makers and other stakeholders to use in addressing development challenges.

CGIAR explored the feasibility and desirability of scaling up shared services to improve efficiency and reduce costs across the Consortium. In addition to putting existing shared services on a fee-for-service basis, the Consortium pursued establishing field office "hubs," undertaking a Consortium-wide approach to staff security and instituting joint procurement in a number of areas. Efforts will continue to identify additional ways to work more efficiently and cost-effectively.

Building effective partnerships

Building on active engagement with the Global Forum on Agricultural Research and hundreds of partners, CGIAR is committed to developing an effective partnership strategy. In 2013, it celebrated 30 years of scientific collaboration and partnership with China. To mark the anniversary, the Chinese Academy of Agricultural Sciences hosted a major event in Beijing, at which participants highlighted the role that joint initiatives can play in transforming people's lives through the tangible impacts of agricultural research. CGIAR strives to learn lessons from what has worked particularly well, so that it can direct more attention and resources to the most effective programs, policies and partnerships, ultimately delivering more and better benefits to the poor.

To further enhance the value and relevance of its work, CGIAR is aligning its research priorities with the priorities of its key stakeholders and ultimate beneficiaries, including by aligning the work of the CRPs and the Comprehensive Africa Agriculture Development Programme of the New Partnership for Africa's Development, a flagship program of the African Union. The CGIAR Consortium and African Union signed a memorandum of understanding that is already showing results through a collaboratively developed science agenda.

To track compliance with CGIAR's Intellectual Assets principles, the Fund Council Intellectual Property Group assessed the Centers' implementation of and compliance with the new policy, which aims to harness the assets of all partners, including the private sector, to speed the dissemination and adoption of new technologies and knowledge, especially to poor smallholders.

Capacity development received a much-needed boost when experts began collaborating on a capacity development strategy, driven in large part by the need to apply science in practice for tangible impact. Working with global initiatives such as the Tropical Agriculture Platform — an initiative hosted by the Food and Agriculture Organization of the United Nations to promote and facilitate capacity development for agricultural innovation — CGIAR has been exploring how best to contribute to improved capacity development and is committed to delivering more in this area.

> "For more than 3 decades, China has benefited greatly from its scientific collaboration with CGIAR and the global public goods that CGIAR uniquely provides, making tremendous progress in reducing poverty, hunger and malnutrition through the tangible impacts of agricultural research, such as improved crop varieties. Going forward, China is committed to strengthening and expanding its strategic partnership with CGIAR so that together we can achieve global food security while contributing to the good of the planet."
>
> **Mr. Qu Sixi,** Counsel, Department of International Cooperation, Ministry of Agriculture, China

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TRIBUTE TO CGIAR DONORS

CGIAR achieved an historic milestone in 2013, with total system revenue surpassing the $1 billion mark. This is an exceptional achievement and one in which all partners can find a lot of satisfaction. The real credit goes of course to dedicated investors who, despite challenging economic realities, stepped up and provided unparalleled support to CGIAR, making it possible to pursue the common mission. By sharing success stories, examples of concrete impact, and development challenges, this annual report demonstrates why this money matters and how investment in CGIAR pays big dividends for the benefit of the world's poorest people and for the planet itself. Sincere appreciation is extended to donors for their valuable contributions, sustained commitment to pursuing a food-secure future for all, and belief in the power of agricultural science and innovation to transform and improve lives across the developing world.

Donors contributing to the CGIAR Fund in 2013

Australia
Bangladesh
Belgium
Bill & Melinda Gates Foundation
Canada
China
Denmark
European Commission
Finland
France
India
International Development Research Centre
International Fund for Agricultural Development
Ireland
Italy
Japan
Korea
Luxembourg
Mexico
Netherlands
New Zealand
Nigeria
Norway
Portugal
Russia
South Africa
Spain
Sweden
Switzerland
Thailand
Turkey
United Kingdom
United States of America
World Bank

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FINANCIAL HIGHLIGHTS

Overview

In 2013, CGIAR system revenue surpassed the $1 billion mark to reach $1.007 billion, or a 14% increase over 2012 revenue. Expenditure in 2013 was $984 million, an increase of $108 million, or 12%, from 2012. The net result was a surplus of $23 million. Table 1 sets out revenue and expenditure in 2013, comparing it with 2012.

Table 1: CGIAR Revenue and Expenditure ($ million)

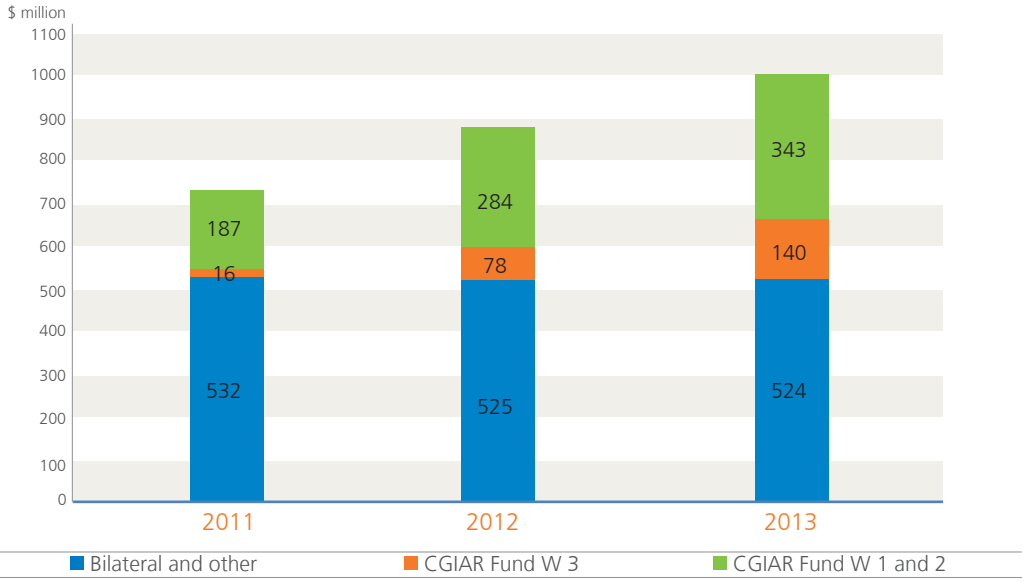
	2013			2012		
Revenue	**Total**	**CRPs**	**Non-CRPs**	**Total**	**CRPs**	**Non-CRPs**
CGIAR Fund Windows 1&2	343	324	19	284	260	24
CGIAR Fund Windows 3	140	115	25	78	56	22
	483	439	44	362	316	46
Bilateral	503	362	141	498	384	114
Sub-total funding	986	801	185	860	700	160
Center own income	21	5	16	27		
Total revenue	1,007	806	201	887		
Expenditure						
CRPs	806			700		
Center own programs	161			162		
Systems entities	17			14		
Total expenditure	984			876		
Net result	23			11		

Sources of revenue

As illustrated by Figure 1, revenue growth has been strong over the past 3 years, driven by increased contributions through CGIAR's multi-donor trust fund, which was established in December 2010 to provide reliable and predictable multiyear funding to enable research planning over the long term, resource allocation based on agreed priorities, and the timely and predictable disbursement of funds.

The CGIAR Fund's share of total CGIAR revenue grew from 27% in 2011 to 41% in 2012 and 48% in 2013, indicating greater donor interest in a multilateral approach to funding. Donors to the Fund may designate their contributions to one or more of three funding windows. Contributions to Windows 1 and 2 — which are the least restricted — together accounted for 34% of CGIAR revenue in 2013.

Figure 1: Sources of Revenue



CGIAR Fund

The CGIAR Fund finances research carried out by the 15 CGIAR Centers working with hundreds of partners through CGIAR Research Programs (CRPs). The CGIAR Fund Council determines how contributions to Window 1 are allocated to CRPs, used to pay system costs or otherwise applied to achieving the CGIAR mission. Contributions to Window 2 are designated by Fund donors to specific research programs, while contributions to Window 3 are allocated by Fund donors to specific CGIAR Centers.

Contributions channeled through the CGIAR Fund increased by 27%, from $514 million in 2012 to $652 million in 2013, with 78% of commitments received by the end of the year (Annexes 1 and 2). When those funds were combined with $181 million carried over from 2012, a total of $704 million was available for distribution, as indicated in Table 2. Of the total available, only $503 million was disbursed in 2013, as the late receipt of some contributions hampered the timely disbursement of funds to CRPs, leaving a balance of $201 million at the end of the year.

Of the $503 million disbursed in 2013, $286 million came from Windows 1 and 2 ($169 million from Window 1 and $117 million from Window 2) and $217 million came from Window 3. Of the funds disbursed from Windows 1 and 2, $47 million was used to finance 2012 activities that had been pre-funded by CGIAR Centers, and $239 million was used to fund 2013 activities, particularly those undertaken by CRPs, as well as system costs. Annex 3 shows cash flow to the CRPs in 2013, as reported by their Lead Centers.

Table 2: CGIAR FUND Statement of Receipts, Disbursements and Fund Balance as of December 31, 2013 ($ million)

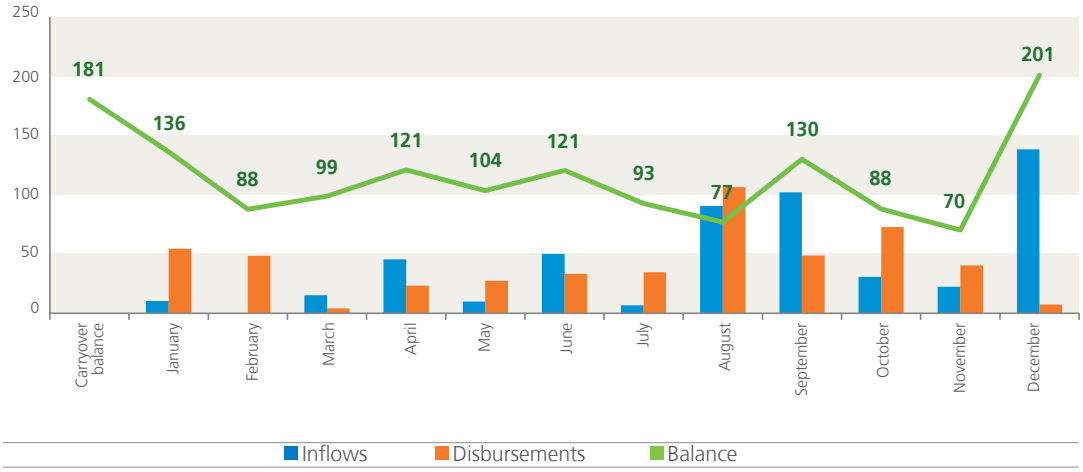
	Window 1	Window 2	Window 3	Provisional	Total 2013
Balance b/f from 2012	67.8	35.8	51.5	25.5	180.6
Receipts					
2012 Contributions received in 2013		7.1	1.4		8.5
2013 Contributions received in 2013*	215.8	98.1	195.7	2.8	512.4
Other (CSP from Bilaterals)	2.3				2.3
Total available in 2013	285.9	141.0	248.6	28.3	703.8
Transfers					
Collection of Cost Sharing Percentage	6.5	(2.5)	(4.0)		0.0
Transfer from provisional		11.1	9.0	(20.1)	0.0
Less: disbursements	(168.6)	(117.2)	(216.9)	0.0	(502.7)
Fund balance	**123.8**	**32.4**	**36.7**	**8.2**	**201.1**
Contributions in process*	1.5	38.2	91.8	8.5	140.0

* see Annex 1

Fund inflows and outflows

Figure 2 shows monthly cash flow and Fund balance during 2013. Despite many donors continuing to disburse their contributions toward the end of the year, disbursement timeliness improved thanks in large part to donors who provided multiyear contributions: Australia, Belgium, the Bill & Melinda Gates Foundation, Denmark, the International Development Research Centre, Luxembourg, the Netherlands, Russia, Spain, Sweden, Switzerland and the United Kingdom. The multiyear commitments shortened the processing time required to get contributions into the Fund, thereby faciliating their more timely disbursement.

Figure 2: Balance in the CGIAR Fund in 2013 in $ million



Expenditure

Expenditure in 2013 was $984 million, an increase of 12% over the $876 million spent in 2012. As shown in Figure 3, Sub-Saharan Africa absorbed 50% of expenditures in 2013, compared with an average of 43% during the period from 1972 to 2008. Investment in Latin America rose from an average of 15% in the earlier timeframe to 19% in 2013. Meanwhile, expenditure in Asia decreased from 31% to 25%, and in the Central and West Asia and North Africa region from 11% to 6%.

Expenditure by cost category is shown in Figure 4. Collaboration and partnership expenditures continued to increase, from 17% in 2012 to 20% in 2013. This is sharply up from the historical average of 4%, clearly demonstrating CGIAR's strengthening emphasis on collaboration. Personnel as a percentage of total costs edged up from 36% in 2012 to 38% in 2013, while supplies and services eased from 35% to 29%. System costs decreased from more than 3% in 2009 to less than 2% in 2013.

Figure 3: 2013 Expenditure by Region

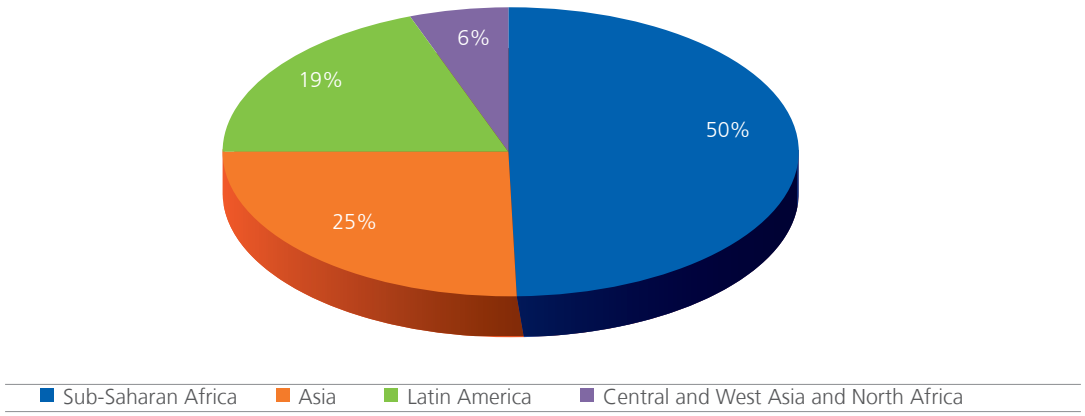
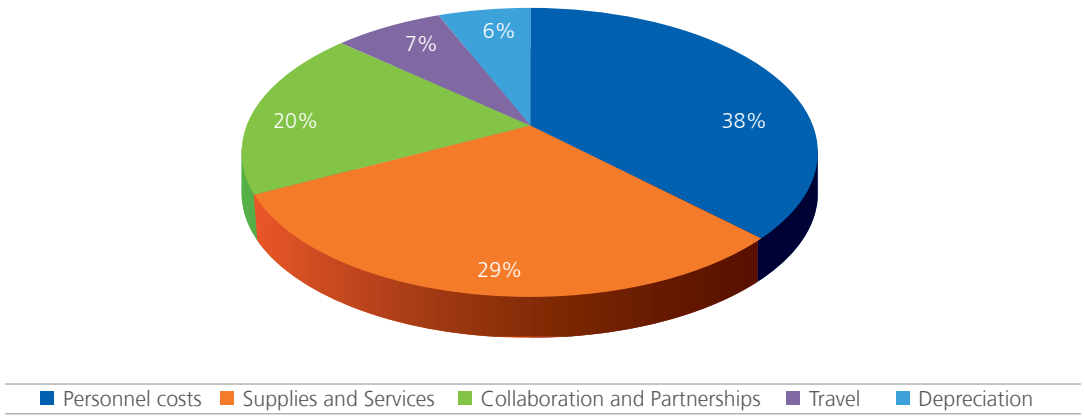


Figure 4: Expenditure by Cost Category



CGIAR Research Program financial summary

In 2013, CRP expenditures were $806 million, or 82% of the $984 million expended by Centers, up from $700 million, or 80%, in 2012. As shown in the breakdown of CRP funding by source in Table 3, the CGIAR Fund was the major source of funding to the system in 2013, financing $439 million, or 54%, of CRP activities during the year. Windows 1 and 2 provided $324 million in funding, and $115 million came from Window 3. Bilateral funding accounted for $362 million, or 45% of CRP funding.

Table 3: Summary of CRP Funding, 2013 ($ million)

		From Individual Centers' Financial Statements					% of Individual CRP funding			Total
		Windows 1 and 2	Window 3	Bilateral	Own Funds	**Total**	Windows 1 and 2	Window 3	Bilateral	**(% of Total)**
CRP 1.1	Dryland Systems	12	7	16	0.4	35	33%	20%	46%	4%
CRP 1.2	Humidtropics	12	7	7	0.3	26	46%	26%	28%	3%
CRP 1.3	Aquatic Agricultural Systems	13	4	9	0.3	26	48%	16%	34%	3%
CRP 2	Policies, Institutions and Markets	27	15	50	0.3	93	29%	16%	54%	12%
CRP 3.1	WHEAT	12	5	16	-	33	36%	16%	48%	4%
CRP 3.2	MAIZE	13	14	28	-	55	24%	26%	51%	7%
CRP 3.3	GRiSP	34	11	45	-	91	38%	13%	50%	11%
CRP 3.4	Roots, Tubers and Bananas	29	12	24	-	65	45%	18%	37%	8%
CRP 3.5	Grain Legumes	20	10	18	-	48	41%	22%	37%	6%
CRP 3.6	Dryland Cereals	8	1	7	-	16	48%	8%	44%	2%
CRP 3.7	Livestock and Fish	11	4	9	-	24	47%	18%	36%	3%
CRP 4	Agriculture for Nutrition and Health	26	5	39	0.2	70	37%	6%	56%	9%
CRP 5	Water, Land and Ecosystems	23	7	27	1.3	58	40%	11%	46%	7%
CRP 6	Forests, Trees and Agroforestry	27	8	42	2.4	79	34%	10%	53%	10%
CRP 7	CCAFS	42	4	20	-	66	64%	6%	30%	8%
	Genebanks	15	-	6	0.4	21	72%	0%	28%	3%
		324	**115**	**362**	**5**	**806**	**41%**	**14%**	**45%**	**100%**

CGIAR Center financial summary

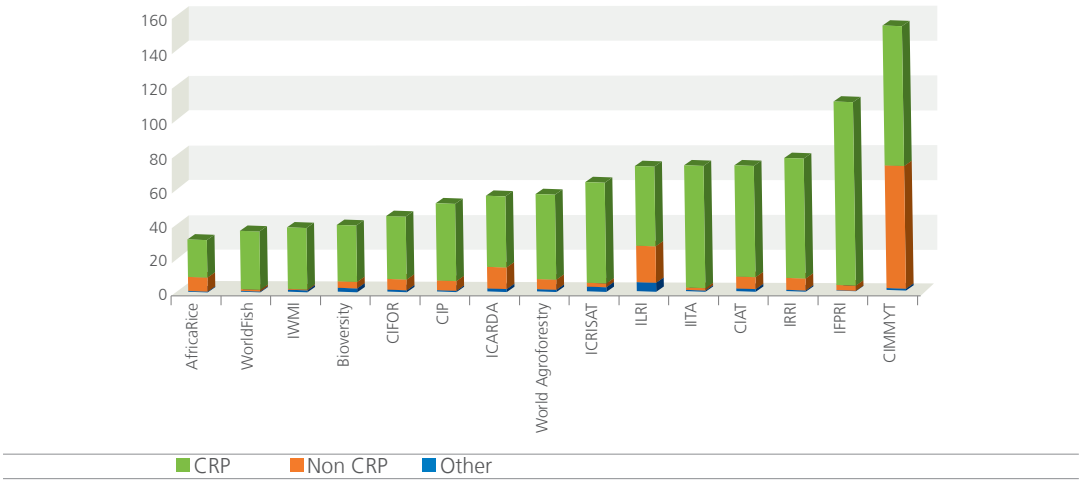
As shown in Table 4, CGIAR Centers exhibited wide variability in financial results in 2013, showing a net accumulated surplus of $23 million. It is worth noting that the two Centers that experienced financial strain in 2012 finished 2013 with financial surpluses: $2 million for the International Institute of Tropical Agriculture and $1 million for the International Center for Agricultural Research in the Dry Areas. The surpluses recorded by both the International Potato Center and the Center for International Forestry Research reflected the late receipt of unrestricted income, which has been designated for expenditure in 2014.

Table 4: Financial Results by Center, 2013 ($ million)

	Revenue				Expenditure			Surplus/ (Deficit)
Center	CRP	Non-CRP	Other	**Total**	CRP	Non-CRP	**Total**	
AfricaRice	21.9	8.2	0.4	30.5	21.9	8.0	29.9	0.6
Bioversity	33.1	3.7	2.2	38.9	34.1	3.8	37.9	1.0
CIAT	66.5	7.0	1.7	75.2	66.5	6.3	72.8	2.4
CIFOR	36.8	7.1	0.4	44.2	36.8	6.2	43.0	1.3
CIMMYT	83.0	72.0	1.2	156.3	83.0	68.2	151.3	5.0
CIP	46.7	4.5	0.4	51.6	46.7	2.0	48.7	2.8
ICARDA	41.5	12.7	1.9	56.1	41.5	13.3	54.9	1.3
ICRISAT	59.0	2.1	3.0	64.0	59.0	2.8	61.8	2.3
IFPRI	105.5	3.1	0.3	109.0	106.4	1.9	108.3	0.6
IITA	71.5	1.5	0.8	73.7	71.5	0.2	71.7	2.0
ILRI	46.4	21.5	5.4	73.3	46.4	24.3	70.7	2.5
IRRI	69.7	7.2	0.7	77.6	69.7	8.1	77.8	(0.2)
IWMI	36.0	0.5	1.1	37.5	36.0	1.5	37.5	0.0
World Agroforestry	49.5	6.0	1.4	57.0	52.3	4.6	56.9	0.1
WorldFish	33.8	1.0	0.4	35.1	34.1	0.1	34.2	0.9
Subtotal	800.9	157.9	21.3	980.1	805.9	151.5	957.4	22.8
Challenge Program partners		10.3		10.3		10.3	10.3	-
Total	800.9	168.2	21.3	990.4	805.9	161.8	967.6	22.8
System-level activities	-	16.6		16.6	-	16.6	16.6	-
Total	**801**	**185**	**21**	**1,007**	**806**	**178**	**984**	**23**

Figure 5 sets out Center revenue by source of funding. The International Maize and Wheat Improvement Center has by far the most non-CRP revenue because it realigned bilateral projects to non-CRP activities, while the International Livestock Research Institute has significant non-CRP revenue largely from hosting of the BecA-ILRI Hub at its research campus in Nairobi, in collaboration with Biosciences eastern and central Africa.

Figure 5: Center Revenue by CRP and non-CRP ($ million)



Annex 1: CGIAR Fund 2013 Donor Contributions ($ million)

Receipts	Window 1	Window 2	Window 3	Provisional	Total CGIAR Fund
Australia	2.7	6.3	15.8		24.8
Bangladesh			0.1		0.1
Bill & Melinda Gates Foundation	1.7		51.5		53.2
Canada	14.2	19.7	0.4		34.4
China		0.1	2.9		3.0
Denmark	3.1	3.1			6.2
European Commission			3.7		3.7
Finland	1.3	1.3	1.3		4.0
France	1.6				1.6
International Development Research Centre		0.5			0.5
International Fund for Agricultural Development			0.5		0.5
India	0.7		4.6		5.4
Ireland		2.7	2.9		5.7
Italy	0.5		0.6		1.1
Japan	0.2	1.4	18.6		20.2
Korea	0.3				0.3
Luxembourg	0.3		0.4		0.7
Mexico		0.5	0.5		1.0
Netherlands	11.4	30.0	15.9		57.3
New Zealand	1.9				1.9
Nigeria	0.2				0.2
Norway	21.2				21.2
Russia		1.2	1.0		2.2
South Africa		0.1	0.4		0.5
Spain			0.2		0.2
Sweden	17.6	21.9			39.5
Switzerland	6.2	9.3	2.0		17.5
Thailand			0.1		0.1
Turkey			0.5		0.5
United Kingdom	80.6		22.5		103.1
Unites States of America			49.3	2.8	52.1
World Bank	50.0				50.0
Subtotal 2013 receipts	**215.8**	**98.1**	**195.7**	**2.8**	**512.4**
Contributions in process					
Belgium*		7.7	2.5		10.1
European Commission *			33.8		33.8
Portugal **			0.1		0.1
United States of America*	1.5	30.5	55.5	8.5	95.9
Subtotal contributions in process	**1.5**	**38.2**	**91.8**	**8.5**	**139.9**
Total 2013 contributions	**217.3**	**136.3**	**287.5**	**11.2**	**652.3**

* Contributions that are supported by signed contribution agreement but the money was not yet received by Dec 31, 2013
** includes contributions which have been received but the contribution agreement is still in process

Annex 2: CGIAR Fund 2013 Window 2 Donor Contributions by CRP in US $ million

Donors	Total	CRP 1.1 Dryland Systems	CRP 1.2 Humid Tropics	CRP 1.3 Aquatic Agricultural Systems	CRP 2 Policies, Institutions and Markets	CRP 3.1 WHEAT	CRP 3.2 MAIZE	CRP 3.3 GRiSP	CRP 3.4 Roots, Tubers & Bananas	CRP 3.5 Grain Legumes	CRP 3.6 Dryland Cereals	CRP 3.7 Livestock and Fish	CRP 4 Agriculture for Nutrition and Health	CRP 5 Water, Land and Ecosystems	CRP 6 Forests, Trees and Agroforestry	CRP 7 CCAFS	Genebanks
2012 contributions received in 2013																	
Belgium	**7.11**	2.40							2.31						2.40		
Received																	
Australia	6.26	0.42	0.21	0.21	0.63	0.63	0.42	0.42	0.21	0.63	0.21	0.42	0.63	0.63	0.42	0.21	
Canada	19.69												19.69				
China	0.14					0.02	0.02	0.10									
Denmark	3.12				3.12												
Finland	1.32											0.66			0.66		
IDRC	0.49			0.49													
Ireland	2.71												1.35			1.35	
Japan	1.40							1.00									0.40
Mexico	0.50						0.25			0.25							
Netherlands	30.00	2.80			6.40				4.30			4.30	4.30	2.90	2.90	2.10	
Russia (2013)	1.20												1.20				
South Africa	0.10						0.10										
Sweden	21.90	2.14	3.22	3.06	2.14				1.22			3.22	1.53	2.14	3.22		
Switzerland	9.31	1.13	1.69	1.13	0.80				1.69					0.56		0.62	1.69
Subtotal	**98.13**	**6.49**	**5.11**	**4.89**	**13.09**	**0.65**	**0.79**	**1.52**	**7.42**	**0.88**	**0.21**	**8.59**	**28.70**	**6.23**	**7.19**	**4.28**	**2.09**
Transfers from PA																	
Russia	3.99	0.50			1.48	0.51							0.50			1.00	
United States	7.00									5.00	2.00						
India	0.10									0.10							
Subtotal	**11.09**	**0.50**	**-**	**-**	**1.48**	**0.51**	**-**	**-**	**-**	**5.10**	**2.00**	**-**	**0.50**	**-**	**-**	**1.00**	**-**
Confirmed in process																	
Belgium (2013)	7.65	1.91	1.91						1.91						1.91		
United States	30.50			1.00	1.50	4.50	1.50	4.50	5.00	5.00	2.00	4.00	1.50				-
Subtotal	**38.15**	**1.91**	**1.91**	**1.00**	**1.50**	**4.50**	**1.50**	**4.50**	**6.91**	**5.00**	**2.00**	**4.00**	**1.50**	**-**	**1.91**	**-**	**-**

Annex 3: Summary of CRP Cash Flows, 2013 ($ million)

	CRP	Lead Center	Opening Balance	Receipts	Disbursements	Balance
CRP 1.1	Dryland Systems	ICARDA	1.4	12.5	(9.5)	4.4
CRP 1.2	HumidTropics	IITA	(7.2)	17.6	(11.8)	(1.4)
CRP 1.3	Aquatic Agricultural Systems	WorldFish	0.4	7.3	(12.8)	(5.1)
CRP 2	Policies, Institutions and Markets	IFPRI	12.4	15.0	(27.5)	(0.1)
CRP 3.1	WHEAT	CIMMYT	1.0	7.1	(10.3)	(2.2)
CRP 3.2	MAIZE	CIMMYT	5.4	7.9	(13.1)	0.2
CRP 3.3	GRiSP	IRRI	5.6	23.9	(40.1)	(10.6)
CRP 3.4	Roots, Tubers and Bananas	CIP	9.8	17.4	(23.6)	3.6
CRP 3.5	Grain Legumes	ICRISAT	0.0	24.8	(24.0)	0.8
CRP 3.6	Dryland Cereals	ICRISAT	0.0	11.1	(10.1)	1.0
CRP 3.7	Livestock and Fish	ILRI	6.5	10.3	(11.4)	5.4
CRP 4	Agriculture for Nutrition and Health	IFPRI	4.1	32.8	(27.1)	9.8
CRP 5	Water, Land and Ecosystems	IWMI	5.0	14.9	(25.7)	(5.8)
CRP 6	Forests, Trees and Agroforestry	CIFOR	1.5	23.8	(25.3)	0.0
CRP 7	CCAFS	CIAT	16.0	29.5	(45.5)	0.0
			61.9	255.9	(317.8)	0.00

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CGIAR IN 2013

CGIAR FUND

The CGIAR Fund is the largest public vehicle for financing the agricultural research needed to meet the food security challenges of the 21st century. Established in 2010, the multi-donor trust fund finances research carried out by the 15 CGIAR Centers in collaboration with hundreds of partners worldwide through CGIAR Research Programs (CRPs). The Fund aims to provide reliable and predictable multiyear funding to enable research planning over the long term, resource allocation based on agreed priorities and the timely disbursement of funds. The CGIAR Fund is governed by the Fund Council.

CGIAR Fund Trustee

The World Bank serves as Trustee of the CGIAR Fund and in this role has the following functions: It holds in trust the funds transferred by Fund donors under Trust Fund administration agreements. It serves as an agent of the Fund Council for disbursing Fund resources based on instructions from the Fund Council and through fund transfer agreements between the World Bank and the CGIAR Consortium. And it provides regular reports on its Trustee activities to the Fund Council, Fund donors and the Consortium.

Trustee
Pamela Crivelli

CGIAR Fund Office

The Fund Office supports the Fund Council and its Chair in the conduct of its business and meetings, including by liaising with all CGIAR system entities and drafting background notes and papers. In acting as a liaison to the Trustee, the Consortium, the ISPC and the IEA, the Fund Office assists the Fund Council in maintaining its business relations and dialogue with the CGIAR system entities on day-to-day operational matters and collaborates with the World Bank Trustee as needed. The Fund Office manages Fund contributions and relations with Fund donors, analyzes the Fund's status and the Consortium's compliance with performance agreements, and supports the Fund Council's resource mobilization efforts, including by raising prospective investors' awareness of the value of investing in CGIAR. The Fund Office, which is hosted by the World Bank, also organizes the Funders Forum and supports its Chair.

Head, Fund Office
Jonathan Wadsworth

CGIAR Fund Council

The CGIAR Fund Council, a representative body of Fund donors and other stakeholders, is the decision-making body of the CGIAR Fund. It sets priorities for the use of resources from the Fund and, in consultation with the Consortium, sets criteria, standards and processes for funding CRPs. The Fund Council also has responsibilities for governance, monitoring and evaluation, such as appointing the Independent Science and Partnership Council and authorizing independent evaluations of CRPs, which are commissioned through the Independent Evaluation Arrangement. The chair leads the conduct of the Fund Council's business and meetings.

Chair of the CGIAR Fund Council
Rachel Kyte

Executive Secretary of the CGIAR Fund Council
Jonathan Wadsworth

CGIAR Fund Council Members
Asia-Pacific Association of Agricultural Research Institutions
Australia
Bill & Melinda Gates Foundation
Canada
China
European Commission
Food and Agriculture Organization of the United Nations
France
Global Forum on Agricultural Research
India
International Fund for Agricultural Development
Japan
Mexico
Nigeria
Netherlands
Norway
Papua New Guinea
Russia
South Africa
Sweden
Switzerland
Turkey
United Kingdom
United States of America
World Bank

Observers
Carlos Pérez del Castillo, Chair, CGIAR Consortium Board Frank Rijsberman, CEO, CGIAR Consortium Kenneth Cassman, Chair, ISPC Rachel Bedouin, Head, IEA

Independent Science and Partnership Council

The Independent Science and Partnership Council (ISPC) advises Fund donors on major science issues. It is a panel of world-class scientific experts chosen by the Fund Council to provide independent advice. Where there is no conflict of interest, the ISPC also responds to requests for advice from the Consortium. As the ISPC reports to the Fund Council, it is also an important link between donors and the Consortium on scientific issues.

Chair of the ISPC
Kenneth G. Cassman

Executive Director of the ISPC Secretariat
Peter Gardiner

Independent Evaluation Arrangement

The Independent Evaluation Arrangement is the totality of the provisions of the CGIAR Policy for Independent External Evaluation, which was adopted by the Fund Council and became effective in February 2012. The policy addresses the independent external evaluation of CGIAR as a whole and of its ongoing and completed policies, programs and institutional entities, in particular the CRPs.

Head, IEA
Rachel Bedouin

CGIAR Consortium

The CGIAR Consortium is an international organization that, together with the CGIAR Fund, advances international agricultural research for a food-secure future by integrating and coordinating the efforts of those who fund research and those who do the research. The CGIAR Consortium is made up of the Consortium Board, the Consortium Office and the 15 Research Centers that are members of the CGIAR Consortium. The CGIAR Consortium develops and carries out research programs to address complex development issues related to agriculture.

Chief Executive Officer
Frank Rijsberman

CGIAR Consortium Board

The Consortium Board leads the CGIAR Consortium, sets policies and is responsible for the attainment of the CGIAR Consortium's purpose. The Consortium Board has 10 members, including an ex officio member who is the chief executive officer of the CGIAR Consortium.

Chair
Carlos Pérez del Castillo

Vice Chair
Carl Hausmann

Members
Mohamed Ait-Kadi
Ganesan Balachander
Gebisa Ejeta
Marion Guillou
Lynn Haight
Martin Kropff
Agnes Mwang'ombe

Ex officio member
Frank Rijsberman, Chief Executive Officer

Observers
Shenggen Fan Director General, International Food Policy Research Institute, Consortium Research Centers' representative to the CGIAR Consortium Board
Alan Tollervey Department for International Development of the United Kingdom, CGIAR Fund Council's representative to the CGIAR Consortium Board

CGIAR Consortium Office

The CGIAR Consortium set up its headquarters, in Montpellier, France, in March 2011. The Consortium Office supports the Consortium Board and helps it carry out its responsibilities; helps Research Centers that are members of the CGIAR Consortium communicate and collaborate among themselves and with the Consortium Board; positions the Consortium globally, advocates for international agricultural research and mobilizes resources; explores opportunities to improve efficiency, adopt best practices and share knowledge; develops, in cooperation with the Research Centers that are members of the CGIAR Consortium, donors, and partners, the CGIAR Strategy and Results Framework for approval by the Funders Forum; approves and manages the performance of CRPs; reviews the efficiency and structure of the Research Centers that are members of the CGIAR Consortium and decides on appropriate action in accordance with the Constitution; and develops, manages and operates shared services to boost efficiency.

CGIAR Consortium Research Centers

	Center	Board Chair	Director General
	AfricaRice (AfricaRice) www.AfricaRice.org	Peter Matlon	Papa Abdoulaye Seck (until September 2013) Adama Traoré (Interim Director General, since September 2013)
	Bioversity International (Bioversity) www.bioversityinternational.org	Paul Zuckerman	Emile Frison (until July 2013) M. Ann Tutwiler (since August 2013)
	International Center for Tropical Agriculture (CIAT, for Centro Internacional de Agricultura Tropical) www.ciat.cgiar.org	Wanda Collins	Ruben Echeverría
	Center for International Forestry Research (CIFOR) www.cifor.org	Hosny El-Lakany	Peter Holmgren
	International Maize and Wheat Improvement Center (CIMMYT, for Centro Internacional de Mejoramiento de Maíz y Trigo) www.cimmyt.org	Sara Boettiger (until March 2013) Andrew Barr (since April 2013)	Thomas A. Lumpkin
	International Potato Center (CIP, for Centro Internacional de la Papa) www.cipotato.org	Rodney D. Cooke	Pamela Anderson
	International Center for Agricultural Research in the Dry Areas (ICARDA) www.icarda.org	Camilla Toulmin	Mahmoud Sohl
	International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) www.icrisat.org	Nigel Poole	William Dar

	Center	Board Chair	Director General
	International Food Policy Research Institute (IFPRI) www.ifpri.org	Fawzi Al-Sultan	Shenggen Fan
	International Institute of Tropical Agriculture (IITA) www.iita.org	Bruce Coulman	Nteranya Sanginga
	International Livestock Research Institute (ILRI) www.ilri.org	Lindiwe Majale Sibanda	Jimmy Smith
	International Rice Research Institute (IRRI) www.irri.org	Emerlinda Roman	Robert Zeigler
	International Water Management Institute (IWMI) www.iwmi.cgiar.org	Donald Blackmore	Jeremy Bird
	World Agroforestry Centre (legally the International Centre for Research in Agroforestry, or ICRAF) www.worldagroforestry.org/	Eric Tollens (until May 2013) John.Lynam (since May 2013)	Tony Simons
	WorldFish (WorldFish) www.worldfishcenter.org	Remo Gautschi	Stephen Hall

CGIAR Research Programs

	CGIAR Research Program	Program Leader	Lead Center / Organization
RESEARCH PROGRAM ON Agriculture for Nutrition and Health	**Agriculture for Nutrition and Health** (A4NH) a4nh.cgiar.org/	John McDermott	IFPRI
RESEARCH PROGRAM ON Aquatic Agricultural Systems	**Aquatic Agricultural Systems** (AAS) aas.cgiar.org/	Patrick Dugan	WorldFish
Climate Change, Agriculture and Food Security	**Climate Change, Agriculture and Food Security** (CCAFS) ccafs.cgiar.org/	Bruce Campbell	CIAT
RESEARCH PROGRAM ON Dryland Cereals	**Dryland Cereals** drylandcereals.cgiar.org/	Dave Hoisington (acting until June 2013) Shoba Sivasankar (since July 2013)	ICRISAT
RESEARCH PROGRAM ON Dryland Systems	**Dryland Systems** drylandsystems.cgiar.org/	Bill Payne	ICARDA
RESEARCH PROGRAM ON Forests, Trees and Agroforestry	**Forests, Trees and Agroforestry** (FTA) foreststreesagroforestry.org/	Robert Nasi	CIFOR
RESEARCH PROGRAM ON Grain Legumes	**Grain Legumes** grainlegumes.cgiar.org/	David Hoisington (acting until June 2013) Noel Ellis (since July 2013)	ICRISAT
RESEARCH PROGRAM ON Integrated Systems for the Humid Tropics	**Integrated Systems for the Humid Tropics** (Humidtropics) humidtropics.cgiar.org	Kwesi Atta-Krah	IITA

	CGIAR Research Program	Program Leader	Lead Center / Organization
	Livestock and Fish (L&F) livestockfish.cgiar.org/	Thomas Fitz Randolph	ILRI
	Maize (MAIZE) maize.org/	David Watson	CIMMYT
	Managing and Sustaining Crop Collections (Genebanks) croptrust.org/content/managing-genebanks	Paula Bramel	Global Crop Diversity Trust
	Policies, Institutions and Markets (PIM) pim.cgiar.org/	Karen Brooks	IFPRI
	Global Rice Science Partnership (GRiSP) grisp.net/	Bas Bouman	IRRI
	Roots, Tubers and Bananas (RTB) rtb.cgiar.org/	Graham Thiele	CIP
	Water, Land and Ecosystems (WLE) wle.cgiar.org/	Andrew Noble	IWMI
	Wheat (WHEAT) wheat.org/	Victor Kommerell	CIMMYT

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