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Science for a food-secure future

Our mission is to work with partners to achieve food security, well-being, and gender equity for poor people in root and tuber farming systems in the developing world. CIP achieves this mission through research and innovation in science, technology, and capacity strengthening.
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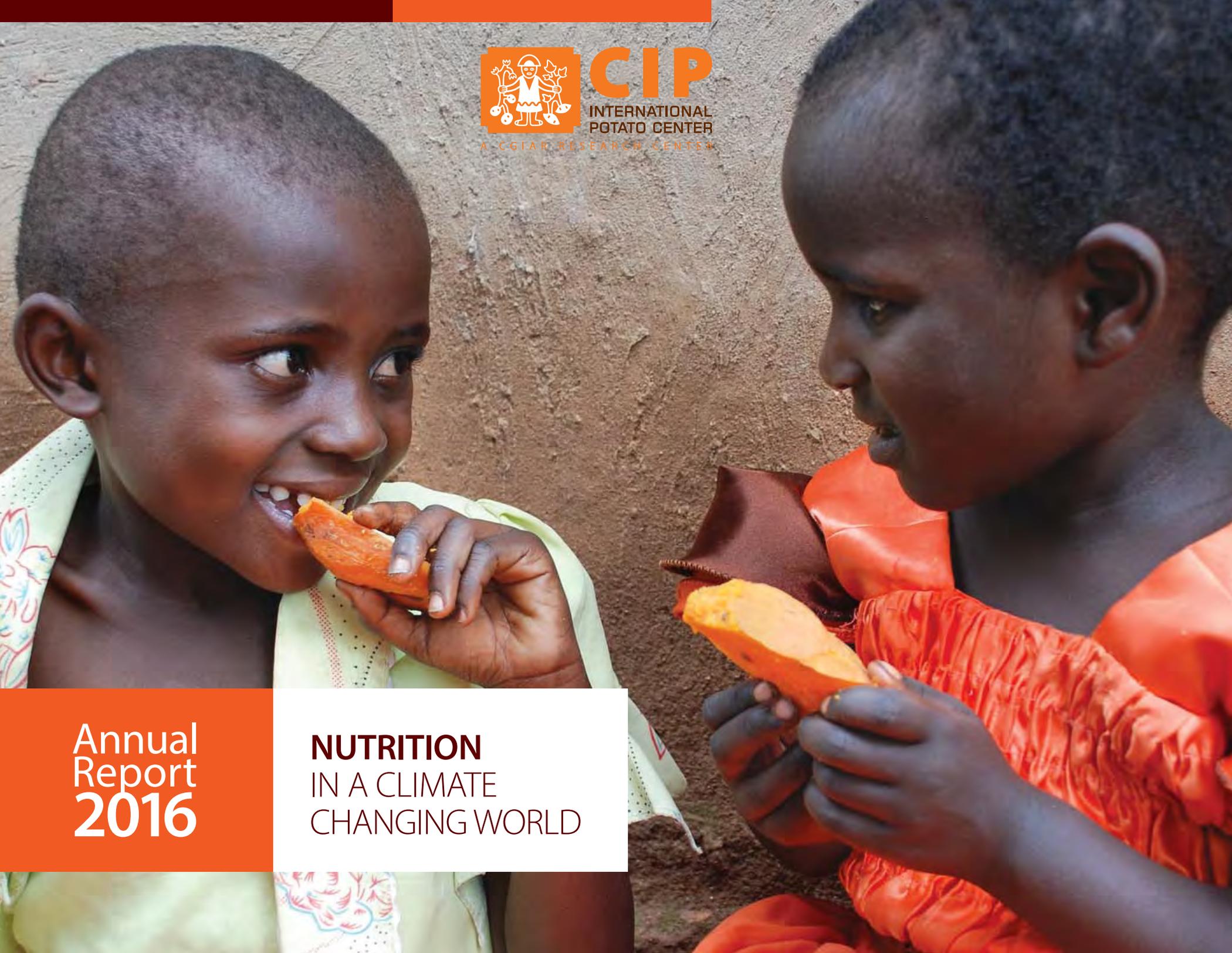
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Annual
Report
2016

NUTRITION
IN A CLIMATE
CHANGING WORLD

Nutrition in a Climate Changing World

International Potato Center | Annual Report 2016

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It is a privilege to serve an organization that is working with partners to achieve food security, well-being, and gender equity for poor people in root and tuber farming and food systems worldwide.

Board Chair Foreword

The International Potato Center's Board of Trustees remains firm in its commitment to provide programmatic governance and the financial oversight and leadership that ensures the Center's effective and efficient management. It is a privilege to serve an organization working with partners to achieve food security, well-being, and gender equity for poor people in root and tuber farming and food systems worldwide.

Center Highlights

In 2016, CIP continued to gain ground in accomplishing our 2014 strategic objectives to deliver impact at scale. CIP set a target of reaching 10 million households in Sub-Saharan Africa by 2020 with orange-fleshed sweetpotato. A full 30% of that ambitious target has been met.

The Agile Potato for Asia Program is working to mitigate the impact of climate change, high population density, and land degradation on the world's poor. Significant progress has been made in developing fast-maturing disease resistant varieties that provide flexible planting and harvesting times, without putting undue pressure on dwindling land and water resources.

The Seed Potato for Africa projects are on track to reach CIP's goal of providing 600,000 smallholder farmers in Africa's potato growing regions with high-quality seed. By the end of 2016 the program had reached 23% of its target.

The appropriately named Game Changing Solutions strategic objective, which uses advanced science to accelerate research, has shown significant results in Ugandan field trials in combatting the greatest threat to potato—late blight. This advance, though in its infancy, could indeed be a game changer for smallholder farmers. These are but a few of the notable achievements on the scientific front that CIP reports for this past year.

Financial Performance

Still recovering from a reduction in Window 1 and Window 2 funding over the past two years, CIP saw a leveling in revenues for 2016. Total revenue reported in 2016 was \$58.7M. The revenue from Windows 1 and 2 represents a decrease of \$6.5M, while Window 3 and Bilateral increased by \$8.1M when compared to 2015. CIP's operating expenses in 2016 are \$59.7M and include a reduction of \$0.8M from 2015.

The short-term solvency indicator (liquidity), which measures the number of days of working capital to fund expenditure excluding depreciation, was 105 days as of December 31, 2016. The long-term financial stability

indicator (adequacy of reserves), which measures the number of days of unrestricted net assets, was 90 days (both indicators are within the CGIAR recommended norms). The indirect cost ratio of the Center was 15.2% for 2016. The ratio has been calculated following CGIAR Financial Guidelines No. 5 and expresses the relation between direct and indirect costs.

CIP's financial indicators reflect the Center's continued financial health, though no institution is immune to financial or operational risk. To mitigate risk, the Board's Audit Committee ensures oversight of CIP's risk management policies and plans. In a much broader sense, the Board oversees Center operations in the interest of donors and stakeholders.

Outstanding Achievements in Biofortified Orange-Fleshed Sweetpotato, Eliminating Childhood Blindness and Contributing to Reduction in Stunting

The year 2016 was outstanding for CIP. Our groundbreaking Orange-fleshed Sweetpotato (OFSP) work received important accolades. Three of our scientists, Dr. Maria Andrade, Dr. Robert Mwangi, and Dr. Jan Low were honored with the 2016 World Food Prize for enriching sweetpotatoes, resulting so far in health benefits for 10 million people (about 3 million households) across 14 countries in Sub-Saharan Africa. This prize was in acknowledgement of the single most successful example of biofortification to date. It is positive recognition that agricultural interventions can have a positive effect on nutrition, in this case, vitamin A deficiency. In addition, the entire CIP Orange-fleshed Sweetpotato team was awarded the Al-Sumait Prize for Food Security for this work. The prize honors individuals or institutions who help to advance economic and social development, human resources development and infrastructure on the African continent.

Appreciation

I would like to express my gratitude and appreciation to VM Zhang Taolin who finished his term on the Board in 2016, and who served with dedication and high standards during his tenure as board member. I would also like to welcome Dr. Vo-Tong Xuan, Rector of Nam Can Tho University of Vietnam and Dr. Qu Dongyu, Vice Minister of Agriculture of the Peoples' Republic of China.

On behalf of the Board, I would like to thank CIP's funders, investors, and all CGIAR partners for their support. I also extend my appreciation to CIP's management and staff for their continued dedication to the organization and its important mission.

March 31, 2017

Dr. Rodney Cooke

Chair, Board of Trustees





CIP's 45th anniversary celebrated in 2016 marked a milestone in our existence and was a history making year itself. Together with our partners around the world, we had the opportunity to reflect on CIP's past achievements in food security and nutrition and project a vision for the coming decades.

Director General Foreword

CIP's 45th anniversary, celebrated in 2016, marked a milestone in our existence in what was a history making year. Together with our partners around the world, we had the opportunity to reflect on CIP's past achievements in food security and nutrition, and project a vision for the coming decades. Clearly, we have laid a firm foundation of upstream and downstream research and have made significant achievements at every step along the value chain. CIP's founding Director General, Richard Sawyer, and his colleagues would be pleased with the role CIP plays in agricultural research for development 45 years after its founding.

Agriculture's role in nutrition came to the fore in 2016 through the World Food Prize and the Al-Sumait Prize for African Development for Health and Food Security. The World Food Prize recognized the role of three CIP researchers, Dr. Jan Low, Dr. Maria Andrade and Dr. Robert Mwangi, and HarvestPlus' Dr. Howarth Bouis for their work on biofortified crops, including sweetpotato, to reduce hidden hunger and specifically vitamin A deficiency (VAD), one of the most pernicious forms of undernourishment in the developing world. The CIP team proved that Sub-Saharan Africa communities would accept biofortified orange-fleshed sweetpotato (OFSP) into their diets, that VAD could be prevented by eating it, and that countries would adopt it. The Al-Sumait Prize for African Development for Health and Food Security was awarded to the CIP Resilient Nutritious OFSP Team for its work linking agriculture and nutrition to introduce vitamin A biofortified OFSP into the diets of mothers and children in Africa. These two awards are positive recognition that crops farmers already grow, when improved, can have a real impact on the health and welfare of the communities where they live. They are proof that when we breed crops for micronutrient traits, resistance to biotic and abiotic stresses, and market preference we can make a difference in the lives of women, children and men who otherwise will face hardships due to hidden hunger and poverty.

This is certainly the case for OFSP, where 10 million people across 14 countries have benefitted from the vitamin A richness of this crop. CIP, along with our partners and with the support from our donors, has led the development of the most compelling evidence for going to scale with OFSP as a model for biofortified crops. We have built robust evidence to demonstrate that just 125 g/day of OFSP meets the daily vitamin A needs of a young child. We now have conclusive evidence that there is less childhood blindness because of this work and there is a growing body of work that indicates that stunting may be reduced as well. From the outset, we learned that nutrition education was critical to ensure that OFSP was incorporated into the diets of pregnant and lactating mothers and young children. Today OFSP is now firmly on the table in 14 Sub-Saharan African countries.

OFSP is not alone in this regard. It has certainly led the way but there are other crops. In the CIP pipeline, biofortified potatoes rich in iron, zinc or both will soon be a reality and will lead the charge in fighting anemia and wasting in places like Peru, the home of the potato, which paradoxically is also the country with the highest rate of anemia in South America.

In celebration of our 45 years I think it is appropriate to acknowledge the legacy of the famous Peruvian potato scientist Carlos Ochoa that lives on through the CIP Biodiversity Center, also known as our genebank, where we hold the largest collection of potato and sweetpotato germplasm in the world. It is at the core of CIP's research, continuing to grow and remaining on the cutting edge of agricultural conservation and preservation. This work is even more important today as the reality of climate change threatens these vital food security crops. It is not just a collection of germplasm, but a resource held in trust to be used by researchers around the world to improve resiliency to climate change, nutrition and productivity.

CIP has achieved much over the past 45 years. We have been a key player in research for development of potato and sweetpotato. Although the foundation of our work has been focused on breeding locally adapted and consumer preferred varieties that are tolerant to biotic and abiotic stresses, we work with our partners across the entire value chain — developing the best varieties, supporting the establishment of quality seed systems, ensuring that farmers have access to clean planting material, and working with and linking to private sector entrepreneurs to process their products after harvest. We focus on gender inclusion, and the empowerment of women throughout the process of value chain development and capacity strengthening is at the core of all that we do.

In many parts of the world 2016 was recognized as one of the hottest years on record and severe weather events like El Niño and weather shocks, like the drought in Ethiopia and Hurricane Matthew in Haiti and the Caribbean, have underscored the necessity to prepare for a climate changing world. This annual report speaks to CIP's efforts to improve nutrition in that climate changing world.

CIP has always been proud to be the lead center for the CGIAR Research Program on Roots, Tubers and Bananas (RTB); this year is notable in that this program has been approved as one of the 11 CGIAR Research Programs that are starting to work in 2017. This represents a strong endorsement of RTB's success and sets it up well for Phase II as a refocused Agri-Food System CRP with a broader vision. CIP congratulates RTB and all the participating centers for this success.

I am proud of CIP's work and the contributions that we, along with many partners, make toward ending poverty, eliminating hunger, ensuring gender equity, combating climate change, and improving our environment. It is through our partners and funders that we can have an impact and for this I am thankful.

Gratefully yours,

Barbara H. Wells
Director General

A handwritten signature in black ink that reads "Barbara H. Wells". The signature is written in a cursive, flowing style.







BIODIVERSITY
CONSERVATION |



OUR CROPS

POTATO



When boiled, a single medium-sized potato contains about half the daily adult requirement of vitamin C and significant amounts of vitamin B, iron, potassium, and zinc.



China is the world's largest producer, harvesting more than 73 million tons of potato a year.



More than a billion people worldwide eat potato.



Potato produces more food per unit of water than any other major crop.



Grown in about 130 countries, potato is the third most important food crop after rice and wheat (1 ha of potato can yield two to four times the food value of grain crops).



4700

Potato can grow in almost any climate, from sea level to 4,700 meters above sea level.



5000

There are about 5,000 different varieties of potato, most of which are found only in the Andes.





OUR CROPS

SWEETPOTATO



Just 125 g of fresh orange-fleshed sweetpotato root contains enough beta carotene to provide the daily vitamin A needs of a preschool-aged child. The crop is also a valuable source of vitamins B, C, and E.



Sweetpotato is also a healthy, cheap animal feed. Studies suggest that livestock fed on sweetpotato vines produce less methane, meaning its use could potentially mitigate global warming.



More than 105 million tons are produced globally each year, with 95% in developing countries.



Worldwide, sweetpotato is the sixth most important food crop after rice, wheat, potatoes, maize, and cassava, but it ranks fifth in developing countries.



Sweetpotato can grow at altitudes from sea level to 2,500 meters above sea level, and comes in varieties ranging in color from white to yellow to orange to purple.



Sweetpotato is a storage root, not a tuber like the potato.





IMPROVING LIVES
OF THE POOR





How a Song Helped Children Adapt to OFSP Meals

Donor: Agriculture for Nutrition and Health (A4NH), The Bill and Melinda Gates Foundation, CGIAR's Research Program on Roots, Tubers and Bananas (RTB)

Country/Region: Nigeria/Sub-Saharan Africa

Orange-fleshed sweetpotato (OFSP) can be a remarkably important lifeline for many under five children in communities affected by high incidence of vitamin A deficiency (VAD). Such is the situation in the Osun State, Nigeria where 53% of children are malnourished and a similar proportion suffers from severe stunting (Esimai *et al.* 2001). National statistics indicate that wasting and underweight increased from 2003 to 2013, with 37% of the population stunted (National Population Commission 2014). The situation is therefore more dire in the Osun State.

To combat malnutrition and hunger, and boost student academic performance, the federal government of Nigeria introduced school feeding in elementary schools in 2004. The Osun State redesigned the program in 2012 and renamed it the Osun Elementary School Health Program (O-MEALS). It serves one mid-morning lunch to over one-quarter million students in grades one through four. CIP's Jumpstarting Orange-fleshed Sweetpotato Project, the Partnership for Child Development and the Osun State piloted the incorporation of OFSP into the O-MEALS school lunch program. It was expected that school children would readily

accept OFSP due to its attractive deep orange color. Contrary to expectations, children showed apathy towards the OFSP-based school lunch meal, with some tossing it out of the window.

CIP scientists, Julius Okello and Souleimane Adekambi, in collaboration with researchers from the Swedish University of Agricultural Sciences and Cornell University, designed a two part experiment to test strategies for endearing OFSP to children, not just momentarily but for sustained periods (“for life”). The first experiment involved the use of behavioral “nudges”. The nudges were: an OFSP-song, a world-renown soccer player (inspirational character) and an age-appropriate communication, all of which associated OFSP consumption with good health and high academic performance. The study was conducted as a field experiment. About 1,000 students recruited from grades three and four in 20 schools were randomly assigned to treatments comprising the three nudges and a control, and their consumption of OFSP observed twice a week over four weeks. Reduction in plate waste (leftovers) estimated children’s acceptance of OFSP.

Results of the first experiment were as interesting as they were exciting. The nudges caused an immediate spike in OFSP consumption, and did so over the duration of the experiment. Comparative statistical tests found differences in the effectiveness of the OFSP-song, motivational character and age-appropriate communication in promoting OFSP consumption. The OFSP-song had the strongest effect, reducing plate waste from 31% (control) to 18% (treated). The results were even stronger (plate waste averaging only 12%) when school and socioeconomic effects were controlled for. Similarly, the motivational character reduced plate waste to 17%, but weaker (plate waste averaging 13%) after controlling for school and socioeconomic effects.

The second component of the experiment examined the effect of the type of promotional information on OFSP consumption among 556 third and fourth grade children randomly drawn from 10 schools. It also yielded very interesting results. Students exposed to promotional messages that focus on instrumental benefits (health, nutritional value) of OFSP ate more OFSP initially but less later. This shows that such messages are ineffective. The opposite effect was



observed among children exposed to promotional messages that focused on experiential benefits (taste, appearance) of OFSP consumption. Such children consumed more of OFSP for a prolonged period of time, that is, they adhered to healthy food choices.

To combat malnutrition and hunger, and boost student academic performance, the federal government of Nigeria introduced school feeding in elementary schools in 2004.



Leveraging Value Chain Expertise Globally

Donor: The International Fund for Agricultural Development (IFAD), The European Union (EU)

Country/Region: India, Philippines, Vietnam/Asia Pacific; Bolivia, Ecuador, Peru/South America

Throughout 2016, CIP leveraged the Participatory Market Chain Approach (PMCA) and other agricultural value-chain expertise developed in the Andes to Upland and Coastal Communities of the Asia Pacific region through FoodSTART+.

Implemented with the financial support from the International Fund for Agricultural Development (IFAD) and The European Union (EU), FoodSTART+ develops, validates and implements effective partnership strategies with IFAD investment projects to promote roots and tuber crops for food security. "It seeks to disseminate strategies that can assist smallholders and other constituencies with enhancing business skills and developing market opportunities," says Andre Devaux, CIP's regional director for Latin America.

The PMCA – first developed in Peru via sponsorship from the Swiss Agency for Development and Cooperation – has helped to increase the competitiveness of native potato value chains and to improve the livelihoods of Andean small-scale farmers, their families and their communities. It has subsequently been piloted in both Sub-Saharan Africa and in Asia with adaptations made for different root, tuber and vegetable market chains. It is still used in the project implemented by CIP – in collaboration with IFAD – in the Andes, taking advantage of the lessons learned from its validation in other parts of the world.

The PMCA approach has spurred the establishment of Farmers Business Schools (FBS) developed by CIP through an Australian Centre for International Agricultural Research (ACIAR)-funded project that aimed to link vegetable farmers with key markets in West and Central Java, Indonesia. FBS is a participatory action learning approach to support farmer groups' participation in – and benefit from – agricultural value chains. Guided by a value chain framework, the FBS comprises a series of group-based experiential learning activities over a production-marketing cycle while interacting with other chain actors and stakeholders. FoodSTART, in partnership with the IFAD investment project CHARMP2, brought and adapted the FBS in the Philippines. The FBS is now being rolled out in India and in Vietnam through FoodSTART+ with a broader model integrating climate change and gender perspectives.

“FBS builds farmer capacity to work with other market chain actors, to strengthen their business and marketing skills as a necessary compliment to PMCA for the development of new agribusiness,” Devaux says. “Participants are seeing new and additional profits through increased value addition and sales” of potato and other crops.

The cross-learning effort has powerful potential reach. Successfully applying information gleaned from work in the Andes to other parts of the world validates the approach in other regions, creates opportunities for it to be improved and demonstrates CIP's efficiency at using donor funds.



“FBS builds farmer capacity to work with other market chain actors, to strengthen their business and marketing skills as a necessary compliment to PMCA for the development of new agribusiness.”



Awards Recognize CIP's Scientific Leadership

When three CIP scientists received the World Food Prize in late 2016, it ushered in a new era of recognition for our scientific prowess both in conducting research and in working with multiple partners.

The World Food Prize underscores how “the proper combination of sound biological sciences and social sciences pays off,” says Hugo Campos, director of research at CIP. The Prize was awarded to three CIP scientists – Dr. Maria Andrade, Dr. Jan Low and Dr. Robert Mwangi – for their roles in getting biofortified orange-fleshed sweetpotato into the diets of millions of Africans. A fourth recipient was Dr. Howarth Bouis, founder of HarvestPlus.

CIP's work also garnered acclaim from the Al-Sumait Prize for African Development and Health and Food Security offered by the Kuwait Foundation for the Advancement of Sciences. The Prize recognized CIP and its sister CGIAR Center, International Institute of Tropical Agriculture, for the organizations' joint work in bringing orange-fleshed sweetpotato (OFSP) into millions of households in Sub-Saharan Africa.

These awards highlight "how well CIP scientists have developed the ability to work closely with our partners not just to achieve agronomic impacts and nutritional gains, but something even more important: improving the quality of life for people," says Campos.

The World Food Prize underscores how "the proper combination of sound biological sciences and social sciences pays off."



A close-up photograph of a young child with dark skin and short hair, wearing a bright red, ruffled shirt. The child is shown in profile, looking down at a slice of orange fruit they are holding with both hands. The background is a textured, light-colored wall. The image is overlaid with a pattern of thin, white diagonal lines on the left side. The text 'ENHANCING FOOD SECURITY' is written in white, uppercase letters, with a vertical orange bar to its left.

ENHANCING
FOOD SECURITY





A New Weapon in the Late-Blight Battle

Donor: USAID and 2Blades Foundation

Country/Region: Uganda/Sub-Saharan Africa

Three seasons' worth of field trials in Uganda have revealed that a transgenic potato of the Victoria variety continues to exhibit late blight resistance previously seen only in growth chambers.

"It held perfectly, without a single lesion," says Marc Ghislain, program leader at CIP.

The implications for farmers are powerful, he adds. Among them are greater crop yields, larger incomes, better health and increased food security. A benefit that's less readily apparent: farmers who had previously spent as much as a quarter of their annual income on fungicide may now conserve that money for other uses.

"2Blades felt our project was a great example of developing a product from upstream research that will reach all the way down to the smallholders in Africa," he adds. Farmers participating in the field trials "know Victoria well and were happy to see it" in its late blight-resistant form.

In the pipeline behind Victoria are other emerging late blight-resistant varieties farmers will need, including Shangi, and Tigoni, since "you don't want to put all your eggs in one basket," Ghislain says. Substantial additional



work is needed on them, Ghislain says, but he suspects the varieties under development “will be very attractive across East Africa.”

Trials continue, including substantial equivalence tests to ensure that late blight resistance was the only trait added in the transgenic Victoria, but CIP has its eye on the future. “Three years from now, if all goes well, planting materials of the new lateblight- resistant Victoria will be handed over to farmers,” says Ghislain.

Funding from two donors – USAID and, more recently, 2Blades Foundation – have advanced this vital work, Ghislain says. Staying out in front of the scourge of late blight is critically important for the global potato value chain.



“2Blades felt our project was a great example of developing a product from upstream research that will reach all the way down to the smallholders in Africa.”



A Model of Cooperation

Donor: Independent Science and Partnership Council's Standing Panel on Impact Assessment (ISPC-SPIA) under The Bill and Melinda Gates Foundation grant "Strengthening Impact Assessment in the CGIAR System" (SIAC); The Government of the People's Republic of China; CGIAR's Research Program on Roots, Tubers and Bananas (RTB)

Country/Region: China/Asia Pacific

Built over two decades, the runaway success of the Cooperation 88 (C88) potato variety in China's Yunnan Province is a testament to the power of persistence.

A project to measure the impact of this particular variety reveals the significant economic gains that have accrued to farmers since the variety was first planted in the province nearly 20 years ago: more than two billion dollars.

Initiated with the cooperation of Yunnan Normal University, the project was initially supported by the Independent Science and Partnership Council's Standing Panel on Impact Assessment (ISPC-SPIA). The Government of the People's Republic of China and the CGIAR's Research Program on Roots, Tubers and Bananas (RTB) are now funding the project.

Over the course of this project, CIP, Virginia Tech, and Yunnan Normal University staff interviewed hundreds of farmers in dozens of villages about planting, harvesting, consuming and selling C88. The variety was officially endorsed by the Chinese

To date, more than 160,000 hectares of Cooperation 88 (C88) are planted each year in China, says Guy Hareau, leader of CIP's Social and Nutritional Sciences Division.

"It is one of the most planted single CIP varieties in the world," he says.

government, a factor that has helped boost its acceptance, says Willy Pradel, an agricultural economist in the Social and Nutritional Sciences Division. Industry loves its processing quality; consumers, its flavor. Now, the search is on for a new variety that can replicate the success of C88.

Today, roughly one-fourth of all potato planted in China – representing 1.25 million ha – consists of more than 30 CIP-related varieties, including C88 and five others, each representing more than 100,000 hectares. As a point of reference, CIP varieties account for two million ha of the total global farmland.

Adoption-impact studies are invaluable in terms of quantifying the success of a given variety at every point along the value chain, notes Hareau.





Tracking Sweetpotato Virus

Donor: The National Science Foundation, The Bill and Melinda Gates Foundation

Country/Region: Sub-Saharan Africa

Jointly funded by The National Science Foundation (NSF) and The Bill and Melinda Gates Foundation, with NSF also managing the project, the database was built at Cornell University's Boyce Thompson Institute which wrote software to analyze the data CIP had processed.

"The whole idea of the project was to better understand the virus pressure in different parts of Africa," says Kreuze. Breeders take the results into account as they seek new varieties because "what you breed in one region might not work in another;" regulators, seed producers and other groups can also use it to improve their own practices. In addition, countries and regions whose climates mirror those of African nations can also make use of the database.

Both The Gates Foundation and the NSF are acutely aware of the critical need for this kind of baseline research and discovery, Kreuze adds. "The work they made possible enables future impact" at all points along the value chain.

Country by country, CIP researchers combed the whole of Sub-Saharan Africa for nearly two years in a bid to find and name every virus that afflicts sweetpotato in the region.

The team wrapped thousands of samples of leaves in coffee filters and plastic bags, tossing in silica gel to preserve them – to render them un-infective – before shipping them to CIP's Lima headquarters, where the fragmented bits of viruses were sequenced and identified using a specifically developed computer software.

Before this work occurred, "we knew very little about which viruses were causing which problems," says Jan Kreuze, sub program science leader, Crop Systems and



Intensification and Climate Change Division and the project leader. A plant would display clear signs of disease, "but you would not necessarily know which virus was causing them."

The fruits of all this labor – gathered in a first-of-its-kind sweet potato virome database – are now available on Cornell's website: <http://bioinfo.bti.cornell.edu/virome>

"The whole idea of the project was to better understand the virus pressure in different parts of Africa."



INNOVATION FOR DEVELOPMENT







Strengthening Partnerships with Government Support

Donor: Irish Aid

Country/Region: Mozambique, Sub-Saharan Africa

In Mozambique's Niassa Province, approximately 44% of children under five in the region were found to be stunted due to malnutrition in a 2013 study. With support from Irish Aid, CIP has taken action to help these children by undertaking a four-year project promoting orange-fleshed sweetpotato (OFSP) as both a source of income and of vital nutrients for more than 25,000 families.

"From the outset", says CIP's Benjamin Rakotoarisoa, project manager, "CIP worked closely with provincial government leaders to implement the work in eight districts of Niassa. Involving the authorities was the key strategy to get OFSP beyond the intervention districts," he says. With government support, now all 16 districts of Niassa are multiplying and producing OFSP.

That early commitment has yielded numerous positive results with hundreds of field technicians trained in vine multiplication and over 28,000 households with children or pregnant women consuming more of the vitamin A-rich storage roots. Niassa's provincial governor has not only chosen OFSP as the emblem of the province but recommended OFSP vine multiplication to the agricultural leaders of other districts in the province.

With Phase One now concluded, the project's Phase Two launches its next four-year term in 2018. In 2017, the work will expand into another province, Inhambane. The drier climate there will require greater reliance on irrigation and on the Triple S method for careful root-based planting material conservation.



Irish Aid has long embraced tenets underpinning this project, said Jan Low, principal scientist – in particular working closely with local government in order to continue to advance awareness of OFSP's economic and nutritional benefits. "Irish Aid is a donor who strongly supports programs to resolve food insecurity and undernutrition," she said. Due to the dogged commitment of Rakotoarisoa's team and others in the field in cultivating those ties, "the provincial government of Niassa is now investing in taking this integrated agriculture/nutrition approach using OFSP to scale in all the districts not yet served by the CIP-led project."



Reducing Malnutrition in Peru

Donor: CARE, The European Union, The International Fund for Agricultural Development, Ministry of Agriculture Peru

Country/Region: Peru/Latin America

Despite strong economic growth over the past two decades, approximately 22% of Peru's population lives in poverty; 4% in extreme poverty. Nearly all of the extreme poverty is found in predominantly indigenous rural Peru, where an estimated 28% of children suffer chronic malnutrition and 40% are anemic.

CIP has partnered with the international development organization CARE in the Puno region and with Peru's Ministry of Agriculture through their AGRORURAL program in the highland communities of Cajamarca and Lima regions. Both projects aim to reduce malnutrition and improve incomes by promoting the cultivation and consumption of native potato varieties with high levels of zinc and iron while encouraging more balanced diets through nutrition education.

The project in the highlands of the Cajamarca and Lima regions, which is supported by the International Fund for Agricultural Development (IFAD), has also provided training in nutrition and market chains, as well as seed potato production, integrated pest management and sustainable agriculture, to strengthen farm resiliency in the face of climate change. Miguel Ordinola, who coordinates CIP Projects in Peru, noted that farmers in the Lima highlands have the advantage of living relatively close to the capital, which facilitates their ability to access new markets.

The market for native potatoes has grown steadily over the past decade, largely thanks to CIP's regional Papa Andina project (2003-2012). Under Papa Andina, CIP created a coalition in Peru called 'Potato Innovation and Competitiveness' (INCOPA), which brought together representatives of government institutions and businesses – supermarkets, restaurants, packaged snack manufacturers and exporters – to build new markets and value chains for native potatoes.

In the Puno region, where the project is funded by The European Union, and administered by the Andean Community, agronomists supported by CIP have helped farmers evaluate various zinc-and-iron-rich native potato varieties

Photo: Courtesy of Jim Richardson



using participatory varietal selection, to determine which ones are best for local conditions. The project also produced materials on child nutrition and delivered nutrition training to rural women at 48 community health posts in 2016, while contributing to a regional nutritional and food security plan. At the same time, technicians provided training in appropriate farming practices while helping farmers find better markets for their native potatoes and produce a popular dried potato product called tunta for additional income.

Ordinola observed that before Papa Andina, neither native potatoes nor chips were sold in Lima, nor were they exported. Now those colorful potatoes and chips can be found in grocery stores on several continents and on the menus of Peru's best restaurants.

Papa Andina resulted in greater potato production and consumption in Peru, and a 30% increase in prices, and the market for native potatoes continues to grow. "Papa Andina is a good example of how innovation can create value and facilitate the development of value chains by the private sector," Ordinola said.

CIP's current efforts in the Peruvian highlands are strengthened by favorable market conditions and the knowledge that CIP researchers gained over the past 15 years about native potatoes, factors that contribute to malnutrition and the importance of combining farmer training with health education.

"Many of the lessons we've learned over the years are now helping us to achieve results in less time," Ordinola said.



Seizing the Moment to Help End Hidden Hunger

Donor: The Bill and Melinda Gates Foundation, CGIAR

Country/Region: Nigeria, Tanzania/Sub-Saharan Africa

Almost a quarter of Sub-Saharan Africans suffer micronutrient malnutrition, or “hidden hunger”, a condition that disproportionately affects women of reproductive age, infants and young children. Deficiencies of essential micronutrients such as vitamin A, iron and zinc can cause an array of health problems and, in some cases, early death.

Together with partners, CIP leads a CGIAR initiative funded by The Bill and Melinda Gates Foundation called Building Nutritious Food Baskets (BNFB) that uses a multi-crop (food basket) approach to promote four biofortified crops in Nigeria and Tanzania: orange-fleshed sweetpotato, vitamin A cassava, vitamin A maize and high iron beans. The three-year project has brought together CIP, the International Center for Tropical Agriculture, the International Maize and Wheat Improvement Center, the International Institute of Tropical Agriculture, HarvestPlus, the Forum for Agricultural Research in Africa, the Governments of Nigeria and Tanzania, and national partners to test a model for scaling up the production and utilization of biofortified crops based on the hypothesis that the success of scaling up is dependent on a supportive policy environment, strong institutional capacities and proven technologies.

“We want to start with biofortified crops that are available and begin to demonstrate how to scale up to reach the target population,” said Dr. Adiel Mbabu, CIP regional director for SSA and BNFB project advisor.

The research centers and their partners also strengthen the capacity of national institutions and communities by using a sustainable, step-down model that allows them to take ownership and drive their own agenda. By the end of 2016, 192 change agents, including 45 women, had been trained in the design and implementation of gender sensitive programs to get more farmers growing biofortified crops. At the same time, the project works with the public and private sectors to ensure that there is a sustainable supply of seed for the biofortified varieties promoted.

The BNFB consortium advocates for increased investment in biofortified staples as a sustainable way to combat hidden hunger by catalyzing policy change and efforts to mobilize resource commitments by governments, developmental partners and the private sector. In 2016 – the project’s first year of implementation – it mobilized US \$235,000 for biofortified crops programs in Nigeria. Its ultimate goal is to mobilize US \$10 million for biofortified crops in Nigeria and Tanzania by the end of 2018.

By catalyzing demand and investment in biofortified crops while strengthening institutional and community capacities, BNFB aims to enable 2.175 million households in Nigeria and Tanzania to begin growing and consuming biofortified crops. In the process, it expects to create a model for accelerating and scaling up the dissemination of biofortified crops that can be replicated in other countries or regions.

Dr. Hilda Munyua, BNFB Project Manager, noted that the awarding of the 2016 World Food Prize and Al-Sumait Prize for African Development and Health and Food Security to scientists at three of the organizations collaborating on BNFB is especially propitious, since those prizes raise the profile of their work with biofortified crops.



“Through BNFB, we are calling upon key actors in biofortification to ‘seize the moment’ and help combat hidden hunger.”



Potatoes on Mars with NASA

A collaboration between CIP, NASA and the SETI Institute is helping to determine whether potatoes can be grown under the harsh conditions of Mars.

In 2016, CIP teamed up with Julio Valdivia-Silva, a research associate with the SETI Institute who has worked at NASA's Ames Research Center and now works at the University for

Technology and Engineering (UTEC) in Lima. After research in several deserts, Valdivia determined that the soil in Pampas de la Joya – a hyper-arid section of Peru's coastal desert – is comparable to Martian soil in its lack of organic material and its high levels of salt and oxidants.

Valdivia collected and sent 500 kilograms of that soil from Pampas de la Joya to CIP's shade houses in Lima, where Amoros and colleagues tried to germinate true potato seeds, maize, beans and other crops in it, without success.

They then placed potato plantlets in germination cups with organic material and planted them in the soil from La Joya. They tested 41 of the most resilient clones in CIP's lowland tropical virus-resistant (LTVR) population and 24 drought-tolerant native potatoes from the Andigena group using this

technique. While most of the native potatoes died shortly after their roots entered the 'Martian' soil, a few of them and most of the LTVR clones managed to grow and produce potatoes.

"It was a pleasant surprise to see that potatoes we have bred to tolerate abiotic stress were able to produce tubers in this soil," Amoros said. He added that one of the best performing LTVR clones was salt-tolerant CIP396311.1, which was recently released as a variety in Bangladesh for cultivation in coastal areas with high soil salinity.

Together with students at UTEC, Valdivia built a simulator of Martian conditions for subsequent experiments in 2017 to see if the clones and varieties that produced potatoes in the first experiments can be grown under atmospheric conditions comparable to those of Mars.

The Martian atmosphere is 95% carbon dioxide, which could be conducive to potato farming, since plants use CO₂ for photosynthesis. However, other Martian conditions are extremely harsh: the average temperature is 10° to 20° C, with lows of -70° C; UV radiation is much more intense than on Earth, whereas gravity and atmospheric pressure are much lower. Valdivia said that growing

potatoes on Mars would probably require a dome, and maybe biotechnological modification of the potato or soil.

"We want to know what the minimum conditions are that a potato needs to survive."

Amoros noted that whatever their implications for Mars missions, the experiments have already provided good news about potato's potential for helping people to adapt to extreme weather conditions and environments on Earth that will become more common due to climate change.

"The results indicate that our efforts to breed varieties with high potential for strengthening food security in areas that are affected, or will be affected by climate change, are effective," he said.





A GENE BANK
FOR THE FUTURE





RTB: From learning to scaling

Led by Dr. Graham Thiele

The CGIAR Research Program on Roots, Tubers and Bananas (RTB) successfully concluded Phase I in 2016 and has now commenced the second phase of the program following the approval of a compelling and highly-rated Phase II proposal, with an enhanced focus on scaling. As both the lead center for and part of the broader RTB alliance with diverse and complementary partners, CIP has played a central role in the program's success while also benefitting from the shared learning and perspective across RTB's crops and partners. Root, tuber and banana crops, including potato and sweetpotato, are some of the most important staple crops in the world's poorest regions. They provide around 15% or more of the daily per capita calorie intake for the 763 million people living in the least developed countries. Often rich in key nutrients, such as with orange-fleshed sweetpotato, RTB crops can significantly improve nutrition and food security. However, these crops also share several common challenges, including that as they are propagated clonally rather than with true seeds this allows yield-reducing pathogens to build up over time, while the crops' bulk and perishability put pressure on postharvest innovation. Considerable progress was made in Phase I in tackling these and other challenges.

Reducing post-harvest losses in Uganda

2016 also saw the conclusion of the three-year 'Expanding utilization of roots, tubers and bananas and reducing their postharvest losses' (RTB-ENDURE) project, which addressed postharvest management of potato, sweetpotato, cassava and banana. The Participatory Market Chain Approach (PMCA) developed by CIP was adapted including a gender lens and guided the design of the interventions. Through carefully facilitated processes, the project's multi-agency research teams tested and validated postharvest innovations with the greatest potential to satisfy food consumption and

income generation needs, including increasing the shelf-life of the crops and improving storage and processing technologies. In order to manage the high perishability of these crops, the project used an innovative approach that encompassed the whole value chain, from the production to the consumption end. Instead of focusing on a single technology it worked through a combination of innovations in: crop varieties, harvesting, market chain organization, and postharvest and processing technologies.

Managing seed degeneration

A cross-center initiative to improve the understanding and management of seed degeneration – reductions in yield and quality due to the accumulation of pathogens in planting material over successive planting cycles – has shed new light on degeneration's dynamics and its management.

A common protocol was designed to estimate degeneration rates under different conditions, with the purpose of understanding quantitatively the effect of degeneration on yield and creating models that will help to predict the effectiveness of management practices. Data suggested strong and complex interactions among host, pathogen, weather conditions and seed management on degeneration rates. For example, research in Africa showed that farmers maintain sweetpotato viruses in local landraces at manageable levels using roguing (eliminating diseased plants) and positive selection (choosing healthy seed for the next planting cycle). However, some viruses are asymptomatic and may cause more yield loss in the long run than viruses with visible symptoms because farmers can't identify infected plants for removal. Potato scientists in Ecuador demonstrated that reversion (natural reduction of pathogen incidence within a seed lot) takes place at higher altitudes, confirming the validity of a traditional practice of moving seed to high altitudes to 'clean' it. Taken as a whole, the results strongly suggest that host resistance in combination with on-farm management techniques and strategic use of clean planting material can lead to a cost-efficient integrated seed health strategy, especially appropriate for low-income systems.

Looking forward

As Phase II gets under way, RTB scientists will pay particular attention to scaling the most promising technologies giving consideration to gender based barriers. Some technologies such as OFSP are already off to a flying start. New alliances including with Wageningen University & Research bring new insights into the scaling process. This will add value for CIP and for the RTB alliance as a whole so that we can have more OFSP-type success stories. Prospects are looking brighter for ensuring that great research will make even more of a difference to the livelihoods of those who depend upon RTB crops.





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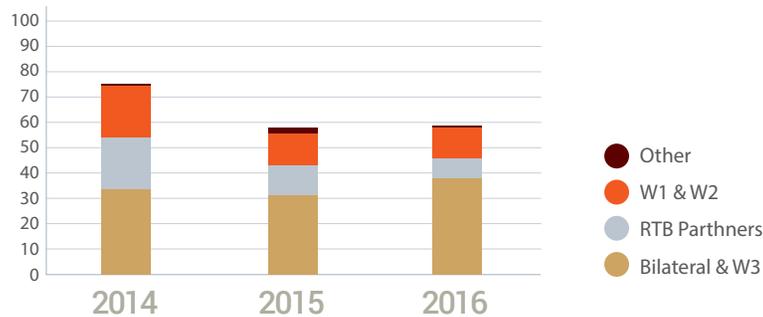
FINANCIALS

Financials

CIP successfully increased fundraising for Window 3 and Bilateral funds; however, due to a reduction in Window 1 and Window 2 of the CGIAR Fund, 2016 revenues were on the same level of 2015. Total revenue reported in 2016 is \$58.7M, including \$19.9M from Windows 1 and 2. While operational results were in line with total revenue, in 2016 CIP reported a deficit of \$0.9M as a result of a number of necessary accounting adjustments from previous years.

The financial results depicted here are derived from CIP's audited December 30, 2016 consolidated financial statements, which contain an unqualified audit opinion. CIP's complete audited financial statements can be obtained online.

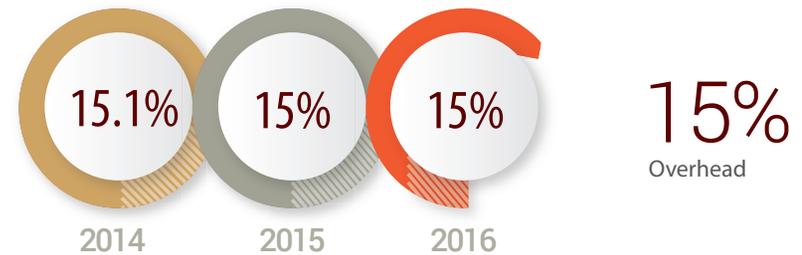
Luis Felipe Mendes / Chief Financial Officer



\$58.7 m
Revenue

Overhead Rate

The indirect cost ratio of the Center was 15% for 2016. The ratio has been calculated following the CGIAR Financial Guidelines N°. 5, and expresses the relation between direct and indirect costs.



Liquidity and Financial Stability

The long-term financial stability indicator (adequacy of reserves), which measures the number of days of unrestricted net assets that can be used to cover CIP's operations, is 90 days.



Global Presence

27 countries worldwide

Global Research (27 countries)

Country Offices (19 countries)

LATIN AMERICA & THE CARIBBEAN

Peru (**Lima**)
Ecuador (**Quito**)
Bolivia
Colombia

AFRICA

Ghana (**Kumasi**)
Burkina Faso
Nigeria (**Abuja**)
Ethiopia (**Addis Ababa**)
Uganda (**Kampala**)
Kenya (**Nairobi**)
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Malawi (**Lilongwe**)
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