RTB

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CGIAR RESEARCH PROGRAM ON Roots, Tubers and Bananas

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RTB Annual Report 2017

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The CGIAR Research Program on Roots, Tubers and Bananas (RTB) is a partnership collaboration led by the International Potato Center implemented jointly with Bioversity International, the International Center for Tropical Agriculture (CIAT), the International Institute of Tropical Agriculture (IITA), and the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), that includes a growing number of research and development partners. RTB brings together research on its mandate crops: bananas and plantains, cassava, potato, sweetpotato, yams, and minor roots and tubers, to improve nutrition and food security and foster greater gender equity especially among some of the world's poorest and most vulnerable populations.
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ACRONYMS

A4NH	CGIAR Research Program on Agriculture for Nutrition and Health
ACAI	African Cassava Agronomy Initiative
ACB-Net	Asian Cassava Breeders Network
AFS	Agri-Food System
ARI	Advanced research institute
BASICS	Building an Economically Sustainable, Integrated Seed System for Cassava in Nigeria
BBTD/V	Banana bunchy top disease/virus
BCoP	Breeding Community of Practice
Bioversity	Bioversity International
BMGF	Bill and Melinda Gates Foundation
BMZ	Federal Ministry of Economic Cooperation and Development
BXW	Banana Xanthomonas wilt
CBB	Cassava Bacterial Blight
CBSD	Cassava brown streak disease
CC	Cross-cutting
CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security
CGIAR	Global research partnership for a food secure future dedicated to reducing poverty, enhancing food and nutrition security, and improving natural resources
CGM	Cassava green mite
CIAT	International Center for Tropical Agriculture
CIP	International Potato Center
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement
Cluster	Cluster of Activities
CMD	Cassava mosaic disease
CRP	CGIAR Research Program
DArTseq	Diversity Arrays Technology sequencing
DDPSC	Donald Danforth Plant Science Center
DFID	Department for International Development
DNA	Deoxyribonucleic acid
DRC	Democratic Republic of the Congo
DSM	Decentralized Seed Multiplier
DST	Decision Support Tool
DVM	Decentralized Vine Multiplier
EGS	Early Generation Seeds
EIAR	Ethiopian Institute of Agricultural Research
EiB	CGIAR Excellence in Breeding Platform
ELISA	Enzyme-linked immunosorbent assay
ENDURE	Expanding utilization of roots, tubers and bananas and reducing their post-harvest losses
FANEL	Food and Nutrition Evaluation Lab
FARA	Forum for Agricultural research in Africa
FAO	Food and Agriculture Organization of the United Nations
Fe	Iron
FIPS	Farm Input Promotions Africa Ltd.
FMARD	Federal Ministry of Agriculture and Rural Development of Nigeria
Foc TR4	*Fusarium oxysporum* f. sp. *Cubense* Tropical race 4

FTA	CGIAR Research Program on Forest, Trees and Agroforestry
GBI	Gender and Breeding Initiative
GBS	Genotyping-by-sequencing
GDAAS	Guangzhou Agricultural Academy of Sciences
GIS	Geographic Information System
GLDC	CGIAR Research Program on Grain Legumes and Dryland Cereals
GM	Genetically modified
GREAT	Gender-responsive researchers equipped for agricultural transformation
GWAS	Genome Wide Association Studies
HIDAP	Highly Interactive Data Analysis Platform
HQCF	High quality cassava flour
HQCP	High quality cassava peel
Humidtropics	CGIAR Research Program on Integrated Systems for the Humid Tropics
ICT	Information and Communications Technology
IDO	Intermediate Development Outcome
IEA	Independent Evaluation Arrangement
IFAD	International Fund for Agricultural Development
IITA	International Institute of Tropical Agriculture
ILCYM	Insect Life Cycle Modeling
INIA	Instituto Nacional de Innovación Agraria
INRA	French National Institute for Agricultural Research
IPM	Integrated Pest Management
ISC	Independent Steering Committee
ISPC	Independent Science and Partnership Council
KALRO	Kenya Agriculture and Livestock Research Organization
KASP markers	Kompetitive Allele Specific PCR markers
KEPHIS	Kenya Plant Health Inspectorate Service
LAMP	Loop mediated isothermal amplification
LB	Late blight
Livestock	CGIAR Research Program on Livestock
MAS	Marker-assisted selection
M&E	Monitoring and evaluation
MEL	Monitoring Evaluation and Learning Platform
MEL CoP	Monitoring Evaluation and Learning Community of Practice
MELIA	Monitoring, Evaluation, Learning and Impact Assessment
MSP	Multi-stakeholder platform
NaCRRI	National Crops Resources Research Institute, Uganda
NARI	National agricultural research institution
NARO	National Agricultural Research Organization, Uganda
NARS	National agricultural research system
NEPAD	New Partnership for Africa's Development
NGO	Nongovernmental organization
NIRS	Near-infrared spectroscopy
NPPO	National Plant Protection Organization
NRCRI	National Root Crops Research Institute - Nigeria
NRI	Natural Resource Institute, UK
NWO	Netherlands Organisation for Scientific Research

OFSP	Orange-fleshed sweetpotato
P&D	Pests and Diseases
PCR	Polymerase Chain Reaction
PIM	CGIAR Research Program on Policy, Institutions and Markets
PMCA	Participatory Market Chain Approach
PMU	Program Management Unit
POWB	Plan of Work and Budget
PPD	Post-harvest physiological deterioration
ppm	Parts per million
pVACs	Provitamin A carotenoids
PVP	Plant Variety Protection
PVS	Participatory varietal selection
PVY	Potato Virus Y
QTL	Quantitative trait loci
R4D	Research for Development
RAD	Restriction-site Associated DNA marker
RBM	Results-Based Management
RHUL	Royal Holloway University of London
RICE	CGIAR Research Program on Rice
RPA	Recombinase Polymerase Amplification
RTB	CGIAR Research Program on Roots, Tubers and Bananas
SAH	Semi-Autotrophic Hydroponic
SASHA	Sweetpotato Action for Security and Health in Africa
SDG	Sustainable Development Goals
SDSR	Single-Diseased Stem Removal
SLO	System Level Outcome
SMART	Specific, Measurable, Attainable, Relevant and Time bound
SMEs	Small and Medium Enterprises
SMO	CGIAR System Management Office
SNP	Single nucleotide polymorphism
SPHI	Sweetpotato for Profit and Health Initiative
SPIA	Standing Panel on Impact Assessment
SPVD	Sweetpotato virus disease
SRF	CGIAR Strategy and Results Framework
SSA	Sub-Saharan Africa
Sub-IDO	Sub-Intermediate Development Outcome
ToC	Theory of Change
UDP	Uridine diphosphate glucose
UoW-M	University of Wisconsin – Madison
UQ	University of Queensland
USAID	United States Agency for International Development
VAD	Vitamin A deficiency
VIRCA	Virus resistant cassava for Africa project
W1/2/3	Window 1/2/3 – CGIAR Funding system
WUR	Wageningen University and Research
YIIFSWA	Yam improvement for Income and Food Security in West Africa
Zn	Zinc

1. Key Results

1.1 CRP PROGRESS TOWARDS INTERMEDIATE OUTCOMES AND SLOS

Evaluative and impact assessment studies document how the results obtained by RTB, its implementing centers and partners, contribute to the achievement of the SRF targets. The Independent Evaluation Arrangement (IEA) collated existing reports against the CGIAR results framework (IDO level). Based on this, RTB identified 20 studies completed in the last six years that provide evidence on the contribution to the targets linked with SLO 1 and SLO 2. Research areas covered are: 1) enhancement and conservation of genetic material, including the development of improved and biofortified varieties and the conservation of local biodiversity; 2) production and processing technologies; 3) management of pests and diseases; 4) promotion of inclusive value chains. Summaries are available in Table A-1.

Case studies documented in 2017 and their linkages with the SRF framework are listed in Table A-2. They include:

Adoption of improved cassava varieties in Nigeria gives 64% productivity gain. DNA-fingerprinted adoption data revealed that about 66% of cassava growers adopted improved cassava varieties. Adoption of improved varieties is associated with an 82% increase in yield (http://hdl.handle.net/10568/80706). Based on FAOSTAT 2014 (the year of the study), this corresponds to 3.1 million households that adopted improved cassava varieties. Using a poverty line of USD 1.9 per person per day at purchasing power parity, adoption has led to a 4.6% poverty reduction implying that 7.5% of the rural poor cassava producers escaped poverty due to adoption of improved varieties, representing about 2 million individuals (RTB report under publication).

28% of potato households in Peru adopt CIP related potato varieties. For more than 40 years CIP worked with the potato breeding program of the National Institute of Agriculture Innovation of Peru (INIA) to develop new genetic material. Through this collaboration, 34 improved potato varieties have been released. A nationally representative household survey was conducted of 86% of the total potato area in Peru. The survey results showed that overall 62% of the potato cropped area is under improved varieties. 202,676 households benefitted from planting varieties related to CIP-related material (28% of total number of potato growers), from a total of 403,590 households that plants improved varieties (the universe of potato producer farmers is 711,313 households in Peru according to 2012 census). The area cultivated with CIP-related material is 91,300 ha, from a total of 275,000 ha in the selected Departments of Peru (http://hdl.handle.net/10568/83497). Farmers growing improved varieties have benefited from higher yield and marketed a larger share of their output, earning higher incomes than comparable neighbors.

270 economically viable decentralized seed multipliers in Kenya, Ethiopia and Malawi improved farmer access to quality seed potato. Rapid seed multiplication technologies were adapted and used by national agricultural research institutes and private enterprises to produce early generation seed (EGS) of robust, user-preferred varieties. Increased availability of EGS allowed for the development of commercial decentralized seed multipliers (DSM) located near to production areas. In 2017, 29 seed producer cooperatives in Ethiopia, 204 DSM in Kenya and 38 DSM in Malawi actively engaged in potato seed markets and, in all countries, obtained average gross margins above 1,000 USD/ha with variations depending on cropping season and country. In the three countries, more than 15,000 farmer households directly purchased or accessed quality seeds. Overall, 4,700 individuals in Ethiopia, 7,300 in Kenya, and 4,100 in Malawi had access to technical assistance and training on use of quality seed and agricultural practices (project reports).

Over 1,100 registered vine multipliers in 14 countries in SSA reach more than 0.5 million households with improved sweetpotato varieties for nutrition enhancement. During the past decade, many new OFSP and non-OFSP varieties were released. To enable planting material (vines) to reach the wider population, decentralized sweetpotato vine multipliers (DVMs) were established in the farming communities close to the targeted households. As of 2017, a total of 1,118 DVMs have been registered, contributing to increased access to improved planting materials by vulnerable targeted households in 14 countries in Sub-Saharan Africa (SSA). This has resulted in over 500,000 direct and 800,000 indirect beneficiaries (approximately 1.34 million households) with access to improved sweetpotato varieties. Since the launch of the SPHI platform (in 2009), over 4.3 million households have been reached through this model (http://www.sweetpotatoknowledge.org/sphi-dashboard/).

Advocacy for biofortification strategies in Nigeria, Tanzania and regionally. The Building Nutritious Food Basket Project (https://cipotato.org/bnfb/) focuses on scaling orange-fleshed sweetpotato (OFSP); vitamin A (yellow) cassava, vitamin A (orange) maize and high iron/zinc beans. A network of champions and advocates belonging to a wide range of organizations (e.g. civil society organizations, FARA, FAO, NEPAD, parliamentary groups, universities) has been created and supports policy dialogue and mobilization for new investments. The project contributed to (1) a national advocacy brief prepared by the Federal Ministry of Budgets and Planning in Nigeria, (2) the food security and nutrition strategy (2016–2025) of the Federal Ministry of Agriculture and Rural Development of Nigeria (FMARD) and (3) the Ministry of Agriculture, Livestock and Fisheries' Food Security plan and the Food and Nutrition Centre (TFNC) 5-year strategic plan in Tanzania.

1.2 PROGRESS BY CRP FLAGSHIPS

1.2.1 FLAGSHIP PROJECT 1: DISCOVERY RESEARCH FOR ENHANCED UTILIZATION OF RTB GENETIC RESOURCES

The RTB breeding community of practice (BCoP), is aiming to resolve the major challenges to RTB breeding research and breeding program management. In 2017 it enhanced communication among breeders of different RTB crops, and became the point of contact for the RTB program to interact with the CGIAR Excellence in Breeding Platform (EiB). During the year, there were significant advances in the use of genomic approaches and tools in breeding populations across the RTB crops for identifying putative molecular markers associated with important traits to enhance and accelerate breeding programs.

Gearing up for stewardship and regulatory approval of late-blight multi-genic resistant potato and BXW resistant banana in East Africa. A cross-crop RTB initiative to address stewardship and regulation of genetically modified (GM) crops started in 2017. CIP and IITA have developed respectively GM late blight resistant potato, and a BXW resistant cooking banana for East Africa. These have been shown to be effective in confined field trials in Uganda. Before they can enter a regulatory phase, prior to their deployment to small-holder farmers, a stewardship strategy (for the responsible management of a product from its inception through its ultimate use; http://www.excellencethroughstewardship.org) and a strategy for risk assessments need to be in place. A workshop was convened by CIP and IITA in Nairobi, bringing together RTB scientists and Ugandan and Kenyan national partners with regulatory and stewardship experts to provide training in preparing these products for their countries' regulatory environment. Participants were introduced to the data and methodology used to conduct risk assessments for food and feed safety and environmental safety. The workshop contributed to a new stewardship plan for the two GM products. In addition, a plan for both GM products has been laid out identifying the gaps in information needed for a regulatory dossier, and field trials planned accordingly. Likewise, the plan identified those topics that do not need further clarification and can be incorporated into the regulatory dossier.

Molecular markers for development of biofortified cassava varieties. Dry matter content and provitamin A carotenoids appear to be negatively correlated in the African cassava germplasm. A genome-wide association mapping using 672 clones genotyped at 72,279 single nucleotide polymorphism (SNP) loci was performed (http://dx.doi.org/10.3835/plantgenome2016.09.0094). Two major loci for root yellowness were identified on chromosome 1. A single locus for dry matter content that co-located with one of the loci for carotenoids was identified. Further analysis suggested that physical linkage rather that pleiotropy is more likely to be the cause of the negative correlation between the target traits. Moreover, candidate genes for carotenoid (phytoene synthase) and starch biosynthesis (UDP-glucose pyrophosphorylase and sucrose synthase) occurred in the vicinity of the identified locus. Therefore, it should be possible to breed high β-carotene varieties with good dry matter content using African germplasm. In a related study, gene-based markers linked to pro-vitamin A content variation were developed, to be used as molecular markers to increase the rate of genetic gain for this critical trait (http://dx.doi.org/10.1007/s11032-017-0718-5). Total carotenoid content, total β-carotene, and color parameters were significantly associated with markers in the phytoene synthase (PSY2) gene, which plays an important role at the start of the carotene synthesis pathway. To facilitate marker-assisted selection (MAS) for

β-carotene in cassava, these were converted to KASP markers. These validated and breeder-friendly markers have potential to enhance the efficiency of selection for high β-carotene cassava, thus accelerating genetic gain.

Sequencing of white guinea yam leads to the mapping of a sex-determination locus which can improve efficiency of yam breeding programs. IITA led the sequencing of the white Guinea yam (*Dioscorea rotundata* Poir.), the most popular yam species in West and Central Africa (https://doi.org/10.1186/s12915-017-0419-x). A diploid genotype, TDr96_F1, was selected for sequencing and this resulted in an assembled genome of 594Mb, 76.4% of which was distributed among 21 linkage groups. Sequence analysis predicted 26,198 genes in the genome. Using the genome sequence the authors mapped a sex-determination locus on linkage group 11, linked to female flowering in a female heterogametic flowering system (ZZ=male; ZW=female). This has been converted into a molecular marker to determine the sex flowering habit of parental lines. The marker was tested on 54 lines that showed association with the flower sex phenotype with 93% accuracy. It is being tested further on several more lines to better ascertain its accuracy. Having a molecular marker to select male and female parents before planting, will strongly enhance the efficacy of planning of crossing blocks in yam breeding.

Elucidation of the banana genome rearrangements shed light on its evolution and emergence of triploid cultivars. Most banana cultivars are triploid seedless parthenocarpic clones derived from hybridization between *Musa acuminata* subspecies and sometimes *M. balbisiana*. Research by CIRAD and Bioversity suggests that *M. acuminata* subspecies differ by a few large chromosomal rearrangements based on chromosome pairing configurations in inter-subspecies hybrids. Large chromosome structural variations generally cause chromosomal segregation distortions which reduce fertility and gene flow. *M. acuminata* is divided into six to nine subspecies which diverged following geographical isolation in distinct Southeast Asian continental regions and islands. The currently accepted domestication scenario suggests that human migrations led to contacts between these subspecies through the transport of plant material, resulting in the emergence of intersubspecific hybrids with reduced fertility. Early farmers would then have selected parthenocarpic diploid and triploid hybrids producing fruit with high flesh and low seed content. Using next-generation sequencing approaches, large chromosomal rearrangements in a seedy *M. acuminata* ssp. *malaccensis* banana accession were identified (http://dx.doi.org/10.1093/molbev/msx164). A heterozygous reciprocal translocation involving two segments from chromosomes 01 and 04 was identified, which could have played a role in the emergence of the sterile and seedless triploid cultivars.

1.2.2 FLAGSHIP PROJECT 2: ADAPTED PRODUCTIVE VARIETIES AND QUALITY SEED OF RTB CROPS

In 2017, crosscutting work on seed systems resulted in the publication of a toolbox that addresses different critical bottlenecks and guides seed system interventions. Efforts in FP2 were also directed at testing and/or releasing varieties that address important constraints common to RTB crops that go beyond yield increase, such as enhanced nutritional content, or resilience to climate change (abiotic stresses).

Toolbox for RTB Seed Systems available for designing, implementing and evaluating seed system interventions. A first version of the toolbox was published (https://sites.google.com/view/clustercc21/o-toolbox). The set of tools are being validated in over 10 projects in Asia, Africa, and South America across five major RTB crops. Tools cover both socio-economic and biophysical dimensions and include the "multi-stakeholder framework for intervening in RTB seed systems" which provided an overview of the major stakeholders, their roles, and critical bottlenecks in Nigeria for cassava, India for potato, Ethiopia for sweetpotato, and Uganda for banana; "impact network analysis" which is now being applied in four PhD theses (potato in Ecuador and Kenya, sweetpotato in Tanzania, and cassava in Vietnam) to understand how seed network dynamics influence the spread of new technologies, new pathogens, or new information; the "gender constraints analysis tool" which was used to understand the sweetpotato seed value chain in Ethiopia; and the "seed tracker" which has been piloted in cassava seed systems in Nigeria (http://seedtracker.org/). In addition, in order to identify lessons and gaps for mainstreaming gender into the toolbox, a literature review of the gender dimension of seed system publications (produced by RTB between 2013 and 2016) was carried out. Evidence from the literature review showed that seed systems are socially embedded and, therefore, to develop equitable seed systems, researchers and practitioners need to understand the social contexts in which they aim to intervene. For example, improved understanding of the division of labor in seed production and management with sex disaggregated socioeconomic data could help shape the nature of interventions by assisting managers to identify the methods, measures and strategies to ensure that men and women are able to benefit equally.

Provitamin A rich banana cultivars show good overall acceptability in Burundi and eastern DRC, showing potential for adoption. Vitamin A deficiency (VAD) is a widespread health problem in Eastern Africa where banana is a staple food crop. Certain banana cultivars grown outside Eastern Africa are rich in provitamin A carotenoids (pVACs) and could thus be utilized in addressing VAD in the region. Therefore, consumer preferences in Burundi and eastern DRC were studied, comparing pVAC-rich banana cultivars with local cultivars of the same genome and following similar postharvest handling treatments (https://doi.org/10.17660/th2017/72.5.1). During sensory evaluations 450 panelists (50% male and 50% female) tested the products and rated them on a 5-point hedonic scale. Dessert types were served raw; cooking types were boiled, roasted and pan-fried. Overall acceptability median scores in Burundi were good (4), in North Kivu, DRC, fair to very good (3-5) and in South Kivu, DRC, good (4) for most cultivars. In all three sites taste and texture in mouth were the major consumption attributes that determine acceptability of a banana cultivar. Moreover, a number of the pVAC-rich cultivars showed good potential for adoption within existing farming systems and diets in these regions. In addition, a systematic screening of 64 plantain varieties for total carotenoids was carried out and 5 varieties with higher provitamin A content than the pVAC-rich variety Apantu were identified. These 5 plantain varieties have a total carotenoid content between 13.9% and 7.2% higher than Apantu and higher yields (t/ha) than Apantu - one (Obino L'Ewai) is currently being used for plantain breeding.

Climate resilient, virus resistant potato clones selected in India for arid and semi-arid regions. The CIP potato clone *397065.28* was evaluated in on-farm trials and was proposed for variety release in arid and semi-arid regions for early planting, at higher temperatures. The clone is resistant to the major viruses PVX and PVY and has moderate resistance to late blight (LB). It is a suitable alternative to the popular heat tolerant variety, Kufri Surya in early plantings in the Indo-Gangetic plains of India. It yielded 26% higher total tuber yield and 30% marketable size tuber yield than Kufri Surya. It has good storability, is mealy in texture and has excellent taste and appearance. In addition, another drought-tolerant clone, CIP *397006.18* was selected and introduced in All India Coordinated Research Project (AICRP) for multilocation testing in different agro-ecologies. The drought tolerant CIP clone produced higher yields than Kufri Bahar and Kufri Surya and Kufri Pukhraj varieties when evaluated at different arid regions. It has a higher drought tolerance index under mild water deficit than the local controls, moderate late blight resistance, long tuber dormancy, good flavor and good keeping quality under ambient temperature.

Net tunnels and negative selection compared as sources of clean planting material for sweetpotato in Ghana. Commercialization of sweetpotato vines is sustainable if multipliers show evidence of vine superiority, especially being free of viruses and pests such as weevils. To keep the vines clean and healthy, net tunnels and/or negative selection can be used. The effects of net tunnel source and of pathogen-tested planting material compared to "apparently" healthy vines (after strong negative selection against vines showing virus symptoms) on yield and health status at three defined environments in Northern Ghana during the rainy season of 2015 were determined for four varieties (https://doi.org/10.1515/opag-2017-0026). Highly significant statistical differences were found among varieties and trial sites for plant establishment, foliage yield, root yield, weevil, and sweetpotato virus disease (SPVD). However, the two sources of planting material were not significantly different for yield, showing negative selection to be as effective as the net tunnels. Nevertheless, the net tunnel derived material had significantly lower SPVD symptoms, and in some localities, less weevil infestation. Therefore, net tunnels may have a distinct advantage for multiplication and maintenance of vine planting material.

1.2.3 FLAGSHIP PROJECT 3: RESILIENT RTB CROPS

Access and capacity of FP3 to utilize big data related to pests and diseases distribution and incidence as well as climate data is increasing rapidly. ICT tools that help to translate the results of complex analysis into evidence that can be used in decision making process are becoming affordable for different stakeholders (i.e. plant protection organizations, farmers). These tools are helping design new diagnostic, surveillance and management strategies of critical pests and diseases of RTB crops.

ICT tools and artificial intelligence help accurate diagnosis and monitoring of major cassava diseases in Africa and can be used for other RTB crops. Two major biological threats to cassava in Africa are cassava mosaic disease (CMD) and cassava brown streak disease (CBSD), transmitted by the whitefly (*Bemisia tabaci*) and also spread through the movement of infected planting material (https://doi.org/10.1111/jph.12609). Significant achievements have been made in the development of tools and an enabling environment for more effective

virus surveillance. Using artificial intelligence and mobile devices to develop image-based cassava disease detection tools has shown to be effective for CMD, CBSD and other important diseases (https://doi.org/10.3389/fpls.2017.01852). In 2017, this progress convinced the Big Data Platform, through the INSPIRE grant, to support efforts to expand the work to diseases of other RTB crops. Building networks for rapid preliminary diagnosis of cassava diseases and monitoring of the spread of viruses is also part of the proposed strategy to minimize the impact of cassava diseases in Nigeria, DRC and Tanzania. The Cassava Disease Surveillance (CDS) is a virtual network that allows different stakeholders to submit data on visual inspection of symptomatic plants as 'digital images' by an internet enabled device such as smartphone, touch-pad, computer and other. With a team of national and international experts, the aim of CDS is to support, also through follow-up inspections and laboratory testing of suspect samples, accurate diagnosis and to offer solutions for prevention and management.

CGIAR and national partners strengthened their capacities to perform pest risk assessments in the face of climate change and global movement of pests. The Insect Life Cycle Modeling software (ILCYM) facilitates the development of pest insect phenology models and provides analytical tools for studying pest population ecology. It was successfully used to perform pest risk assessment at the regional and country level (see Pest Distribution and Risk Atlas for Africa). In 2017 ILCYM was further enhanced with modules that enable prediction of risk of insect-transmitted viruses and generation of georeferenced risk maps. Maps allow easy location of the estimated risk index values in georeferenced points and are linked with climatic data. A practical training course on ILCYM was organized in Benin in 2017 in collaboration with the newly established Biorisk Management Facility (BIMAF). Twenty-three participants from seven countries across sub-Saharan Africa including Benin, Cameroon, Kenya, Nigeria, South Africa, Sudan, and Togo attended the course. The uptake of this software will facilitate the development of pest insect phenology models and will provide analytical tools for studying pest population ecology and risk assessment in GIS environment.

In Nigeria and Tanzania scientists and extension agents developed demand-driven support tools for cassava agronomy. To contribute in reducing cassava yield gap and increase crop production and quality, the African Cassava Agronomy Initiative (ACAI) project adopted a demand-oriented approach. For six use cases, specific sets of information needed for improving cassava agronomic practices, were identified and R4D activities are being developed that will be translated in decision support tools accessible to NARS agronomists, extension agents, farmers and other beneficiaries. A geospatial cassava agronomy information base has been developed. It serves as basis for the modeling and data analysis that allows the provision of site-specific recommendations. In 2017, working prototypes in various formats (smartphone apps, software or paper-based tools) have been released on 1) best planting practices (link to presentation); 2) best intercropping practices (link to presentation); 3) site-specific fertilizer recommendations (link to presentation); 4) scheduled planting and high starch content (link to presentation). Data generation and development of these tools is a joint effort with national organizations and advanced research institutions. More than 200 extension agents have been trained and involved in trials, validations and baseline surveys.

Removal of single diseased banana stems proved its effectiveness in restoring productivity of Xanthomonas wilt infected bananas fields. *Xanthomonas campestris* pv. *musacearum*, the causal agent of Xanthomonas wilt of banana (XW), does not infect or cause symptom development in all physically attached shoots in an infected mat. The single diseased stem removal (SDSR, the removal of only symptomatic plants) technique has been evaluated in eastern Democratic Republic of Congo as a novel XW control option. Compared with complete mat uprooting, SDSR is low-cost, simple and easily applicable. By applying SDSR in the experimental fields, XW plant incidence was reduced to less than 1% after 10 months and restoration of banana plots was observed even in plots that initially had over 80% plant disease incidence. SDSR appears as an adequate option in subsistence-oriented production systems, such as in eastern DR Congo, Burundi or central Uganda, where farmer objectives are oriented towards XW management/control more than complete eradication and can be suggested where access to clean planting material is difficult (https://doi.org/10.1007/s10658-017-1189-6).

1.2.4 FLAGSHIP PROJECT 4: NUTRITIOUS RTB FOOD AND ADDED VALUE THROUGH POSTHARVEST INTERVENTION

The bulkiness and high perishability of RTB crops, poor postharvest handling, lack of processing and storage facilities result in short marketing channels, high postharvest losses and limited value addition, all areas where progress was made in 2017. In addition, basic and applied research was conducted on improving nutrition.

Multi-crop postharvest innovation. The RTB-ENDURE project adapted the Participatory Market Chain Approach (PMCA) to stimulate post-harvest innovation with existing and emerging private sector players including i) a sequence of competitive and collaborative phases to identify and develop the core innovations and ii) monitoring of partnership health. Resources were specifically allocated for gender integration and multi-stakeholder platforms. The project stimulated marketing, technological and institutional innovations including: charcoal storage cooler and marketing of peeled cooking bananas; silage business centers for pig feed; ambient store technology for extending marketing period of potatoes; and waxing technology and agronomic practices for extending shelf life of cassava. Achievements were reviewed and follow up actions for scaling and learning from the application of PMCA were agreed in a workshop of the cross cutting cluster for FP4 (http://hdl.handle.net/10568/92554).

Improved energy performance of small-scale dryers used for processing cassava. Experiments were conducted at two cassava processing centers, in Tanzania and Nigeria. Sensors were installed on the dryers, product samples were collected and the mass and energy balance of the equipment analyzed, allowing the dryers' minimum air mass flow rates to be calculated. The air mass flow rates of both dryers were then reduced to the minimum: in Tanzania, by 24%, and Nigeria by 14%. In both locations, the modifications decreased the dryers' heat input without jeopardizing evaporation rates, and so not affecting the final moisture content of the dry products. Air temperatures at the dryer outlets decreased and relative humidity increased, while enthalpy remained unchanged. The modification improved energy efficiency by 25% in Tanzania and 14% in Nigeria (http://dx.doi.org/10.1016/j.biosystemseng.2016.10.001).

Evaluation of proximate composition and pasting properties of high quality cassava flour (HQCF) from β-carotene-enriched roots. Forty-five cassava genotypes in two sets were processed into HQCF, comprising 40 clones of β-carotene enriched roots and 5 check clones of white roots. The effects of variety on the proximate composition and pasting profile of the flour was investigated. The starch content ranged between 67.1 g/100 g (for 01/1663) o 77.8 g/100 g (for Z97/0474). Peak viscosity values ranged between 271.9 RVU (rapid viscosity value - for 01/1404) to 471.3 RVU (for 01/1417). Significant differences ($P < 0.05$) existed in the proximate composition and pasting properties of the flour from different cassava genotypes. The high peak viscosity exhibited by most β-carotene genotypes is indicative that the flour may be suitable for products requiring high gel strength and elasticity. The proximate composition compares competitively with values obtainable from clones of white roots (http://hdl.handle.net/10568/83228).

Effects of Simulated Human Gastrointestinal Digestion of Purple-Fleshed Potato Cultivars on Anthocyanin Composition and Cytotoxicity in Colonic Cancer. A dynamic human gastrointestinal model was used to digest cooked tubers from purple-fleshed Amachi and Leona potato cultivars to study anthocyanin biotransformation in the stomach, small intestine and colonic vessels. Colonic Caco-2 cancer cells and non-tumorigenic colonic CCD-112CoN cells were tested for cytotoxicity and cell viability after 24 h exposure to colonic fecal water (FW). The total anthocyanin concentration was over thirty-fold higher in Amachi compared to Leona digests but seven-fold higher anthocyanin concentrations were noted for Leona versus Amachi in descending colon digests. Leona FW showed greater potency to induce cytotoxicity and decrease viability of Caco-2 cells than observed with FW from Amachi. The present findings indicate major variations in the pattern of anthocyanin breakdown and release during digestion of purple-fleshed cultivars. The differing microbial anthocyanin metabolite profiles in colonic vessels between cultivars could play a significant role in the impact of FW toxicity on tumor and non-tumorigenic cells (https://doi.org/10.3390/nu9090953).

Making storable orange-fleshed sweetpotato purée a commercial reality. Research in Rwanda demonstrated that orange-fleshed sweetpotato (OFSP) purée (steamed, mashed roots) was an economically viable, vitamin A enhancing ingredient in baked products when the purée was produced and used in the same bakery. Having a storable, packaged OFSP purée produced by a firm to supply bakers is an alternative model. Vacuum-packed OFSP purée with preservatives with a four-month shelf-life at 23°C was developed by CIP under laboratory conditions in 2015. Turning it into a commercial reality required a public-private partnership to establish an OFSP purée-bread value chain. The first OFSP bread began to be marketed in six Tuskys' stores in June 2015 at a premium price (5 Ksh above its regular bread), reaching 20 stores by August 2016. OFSP bread was well-received by consumers. Purée production became profitable (18% profit margin) when unpeeled roots were used, the new product being a "high fiber" purée. Commercial OFSP purée production has been improved and is poised for profitable, larger-scale output (http://hdl.handle.net/10568/91985).

1.2.5 FLAGSHIP PROJECT 5: IMPROVED LIVELIHOODS AT SCALE

Scaling. FP5, in close collaboration with PMU, developed and pilot-tested two innovations: the "Scaling Readiness Approach", and the "RTB Scaling Fund". The scaling readiness approach scans the different innovation components to find the most limiting ones and then seeks to substitute or find a way around them. Validation of the scaling readiness approach began with innovations around community phytosanitation for combating cassava brown streak disease (CCP4CBSD), farmer decision support tools for potato late blight management (PLBM), single diseased stem removal for managing banana xanthomonas wilt (SDSR), decision support tools for cassava agronomy (ACAI-DST), integrated systems for cassava agronomy at scale (ACAI-CAS), and cassava national policy framework (CNP) (http://hdl.handle.net/10568/90666). A set of RTB innovations was stress tested for readiness through peer review in an interactive poster based session (http://www.rtb.cgiar.org/scaling-rtb-technologies-world-cafe/). Teams with eligible innovations applied to the RTB Scaling Fund. This is an internal competitive mechanism that uses independent reviewers for the assessment of the submitted proposals. In 2017, twelve concept notes were submitted from which three projects were selected (blog). These and the other cases are being used to rigorously assess the scaling readiness framework. Within the framework of the Third International Conference on Global Food Security organized by Elsevier (December 2, 2017, Cape Town, South Africa), RTB convened a symposium entitled "Science of scaling: connecting the pathways of agricultural research and development to improve rural livelihoods" that is leading to a special edition on scaling by the Agricultural Systems journal. Representatives from the research, development and business sectors participated in the symposium and shared their insights on enabling and hindering factors that agricultural innovations may encounter in their pathways to scale.

Soil organic carbon (SOC) stocks and fractionation under different land uses in the Peruvian high-Andes. Research assessed the impact of changes in land use, such as cultivation of the Andean root maca (*Lepidium meyenii Walpers*), on C sequestration, fractionation and δ13C natural abundance. In the first study SOC stocks were greater than average temperate grassland soils (between 123 ± 4 and 136 ± 4 Mg C ha^{-1} in the 0–30 cm soil profile); however, they did not differ between land uses. SOC loss was found in long fallow plots, correlated to steep and low plant cover plots; evidencing that soil degradation is due to land abandonment. In a second study, a long-established perennial ryegrass (*Lolium perenne L.*) - white clover (*Trifolium repens L.*) association (> 40 years) was studied. No increase in SOC stock under the cultivated pasture was found. However, there was a better soil aggregation and an increase of 17.3 and 12.2 g C kg^{-1}_{WSA} in particulate organic C, and SOC within small macroaggregates in cultivated pasture soils. Soil δ13C natural abundance was about 1‰ depleted in all measured C fractions of cultivated pastures when compared to native grasslands, suggesting that pasture-fixed C forms labile and recalcitrant SOC fractions (https://cgspace.cgiar.org/handle/10568/90584). Better understanding the dynamics of SOC under different land uses is a key aspect to design new strategies for sustainable soil management in high Andean regions that are center of origin of native root and tuber crops.

Gender in agricultural change: towards more inclusive innovation in farming communities. The GENNOVATE global research collaboration used a comparative qualitative methodology based on single sex and age differentiated focus group discussions and semi structured individual interviews with men and women representing diverse trajectories of wellbeing. The sub-set of 24 case studies undertaken by RTB and Humidtropics between 2014 and 2016 as part of GENNOVATE were carried out in Bangladesh, Burundi, Colombia, DRC, Kenya, Malawi, Nigeria, Rwanda, Uganda and Vietnam. These sought to detect commonalities and differences regarding the way gender norms and agency affect and are affected by agricultural innovation (http://hdl.handle.net/10568/83498). The study offers key insights on: a) what unleashes agricultural innovation among women and men; b) how persistent and changing norms interact with and condition innovation choices; and c) what and how social conditions enable women, men and communities to leverage opportunities for innovation. Study findings challenge stereotypes that depict women's innovation preferences as driven only by concerns for food and nutrition security, highlighting the importance of income generation and autonomous decision making as contributing drivers for innovation. Study results provide useful information to design research strategies and interventions for more gender equitable technology adoption and adaptation.

Social network analysis of multi-stakeholder platforms (MSPs) in agricultural research for development. By increasing collaboration, exchange of knowledge and influence mediation among farmers, researchers and other stakeholders, MSPs supposedly enhance their 'capacity to innovate' and contribute to the 'scaling of innovations'. Research examined the capacity to innovate and scaling potential of MSPs in Burundi, Rwanda and the Democratic Republic of Congo (DRC). Results demonstrate mismatches between collaboration, knowledge exchange and influence networks for effective innovation and scaling processes: NGOs and private sector are respectively over-

and under-represented in the MSP networks. Linkages between local and higher levels are weak, and influential organizations (e.g., high-level government actors) are often not part of the MSP or are not actively linked to by other organizations. Organizations with a central position in the knowledge network are more sought out for collaboration. The scaling of innovations is primarily between the same type of organizations across different administrative levels, but not between different types of organizations. The results illustrate the potential of social network analysis to diagnose and improve MSPs for development impacts (https://doi.org/10.1371/journal.pone.0169634).

Guidelines for innovation platforms in agricultural research for development. The guidelines build on an analysis of the optimal compositional dynamics of multilevel innovation platforms (http://hdl.handle.net/10568/80715). They were developed through a learning collaboration among CGIAR research centers and other academic and more applied research centers. Eleven CGIAR centers participated and contributed expertise and experiences across multiple agricultural systems, geographies, and types of complex constraint. The guidelines provide information grounded in a wide practical experience of key design and implementation principles, and the financial and human resources needed, with suggestions for more effective monitoring, evaluation, and learning. They list reference materials, answer frequently asked questions, and provide a decision support tool for research, development, and funding agencies (http://hdl.handle.net/10568/82550). The guidelines will be an important reference tool for the establishment and consolidation of innovation platforms that support agricultural research on RTB crops in different regions and contexts.

1.3 CROSS CUTTING DIMENSIONS (AT CRP LEVEL)

1.3.1 GENDER

Established as a collective space for collaboration and shared learning among breeders and social scientists, the Gender and Breeding Initiative (GBI) has been coordinated by RTB. A workshop held in Nairobi allowed experts from across CGIAR Research Centers and Research Programs to develop a strategy for gender-responsive breeding (http://hdl.handle.net/10568/89834). A series of working papers and briefs were made available to provide researchers with supporting methods, tools and practices for gender responsive breeding (http://www.rtb.cgiar.org/gender-breeding-initiative/resources/).

GBI methods and tools require the establishment of common crop ontologies for gender related traits and the compilation of information related to trait preferences from gendered target groups. In FP1, protocol and trait dictionary of quality and chemical evaluation for RTB crops is being documented and incorporated in the Crop-Ontology Platform, considering gendered trait preferences. Also, several breeding programs working with participatory varietal selection and varietal preferences are developing gender-sensitive tools (https://research.cip.cgiar.org/potatoknowledge/pvs.php; https://cgspace.cgiar.org/handle/10568/89296) and capacity development materials (GBI webinar).

The RTB gender team worked closely with the seed system scientists in FP2. As result, tools from the seed systems toolbox were given a gender lens and piloted in the Ugandan banana seed system and will continue to be piloted elsewhere. In the area of end-user preferences, the knowledge base of seed system dynamics was expanded through the inclusion of gender differentiated end-user needs and preferences for the high yielding, disease resistant EAHB hybrids (NARITAs) and for cassava varieties in Nigeria. Review of research work published between 2013 and 2016 was the basis to draw lessons learnt and identify gaps in mainstreaming gender in RTB crop and seed system interventions (http://hdl.handle.net/10568/89806).

In FP3, gender responsive research protocols and guidelines to strengthen IPM research and dissemination strategies, with specific emphasis on BXW and BBTD have been developed. Gender norms and roles in disease management were analyzed to understand disease spread considering gender differences in use of different practices and technologies. In banana production systems, due to the predominance of men's access to land rights, most decisions about crop management, sales and income control are in the hands of men; and women are not financially compensated for their labor on banana fields. Women engaged in banana production have limited access to knowledge and fewer incentives to engage in banana pest and disease management practices particularly if they are labor intensive. However, while men's control over banana sales and revenues is generally accepted by women and men alike, women challenge this norm and find ways to subvert men's authority particularly when it comes to production of cooking bananas. Thus, supporting collective action and intra-group

exchange of information about IPM practices can have gender transformative effects while contributing to the sustainable management of banana production systems.

Gender influence on participation in cassava value chains (https://doi.org/10.1017/S0014479717000552) and women's empowerment in traditional food value chains were studied in Tanzania (https://doi.org/10.1080/21683565.2017.1325433). Results indicated that gender was significantly related to socio-economic characteristics. About 34% of the women participating in the cassava value chain were young, some below 17 years of age. There were significant relationships between gender and access to resources (land, extension services and markets), control over resources (land, house and household assets) and benefits (revenue) generated from cassava value chains. Overall, there was gender disparity in participation along the cassava value chain. These results suggest that any intervention in the cassava value chain should consider gender relations to benefit men and women and alleviate household poverty. In parallel, limited participation in productive decisions, very restricted access to credit and associated decision-making power, limited autonomy in production, and a heavy workload were identified as main areas of disempowerment for women.

In FP4, a large part of the work conducted on gender is related to nutritional strategies to promote the consumption of orange fleshed sweetpotato by children and women in reproductive age. Gender sensitive protocols for farmers' participatory evaluations were developed to measure end user and consumer preferences of biofortified cassava and gendered preferences of varieties for yam processing. Preference ratings for genotype desirability were ranked for each location and disaggregated by gender to indicate similarities and differences in gender preferences

Gender strategic research is embedded in FP5. This includes the development of analytical approaches and tools for gender-responsive innovation, and gender analysis in the context of specific innovations. Some of the tools and studies conducted in 2017 include: best practice guidelines for integrating gender into seed systems (https://cgspace.cgiar.org/handle/10568/81051), an analysis of the role of gender norms in access to agricultural training in Chikwawa an Phalombe, Malawi (https://cgspace.cgiar.org/handle/10568/89051), and the report on gender transformative agricultural innovations (https://cgspace.cgiar.org/handle/10568/83498). The data shows that the perception of men as household heads and women as care givers or helpers who are also illiterate and ignorant often has implications on women's ability to access training and information. Negative stereotypical perceptions about women by their husbands and extension workers militate against women's access to training and information. Institutional biases within extension systems reproduce gender inequality by reinforcing stereotypical gender norms. In this context, to address the scaling of innovations, extension officers should be targeted with training on gender responsive adult learning methodologies and gender awareness to help them be more inclusive and sensitive to women's needs.

1.3.2 YOUTH

Towards inclusive scaling strategies in agriculture: Understanding youth issues and opportunities. New agricultural technologies and innovations are leading to changes in smallholder farming system. The role of agricultural innovations and understanding how they may address youth employment in the agricultural sector is a research priority in the CGIAR and specifically on the RTB agenda. It is therefore essential to better understand youth specific constraints and opportunities in order to maximize agricultural interventions and to improve sector performance. To address this concern a review of current literature was conducted to identify commonalities and gaps in the understanding of youth issues. The paper elaborates on the different forms of engagement of young people in agriculture, the factors that explain their transition into and out of the agricultural sector, and research approaches to foster the understanding of youth dynamics in agriculture.

Young women and men led local development in 10 DRC communities. IITA-Kalambo Youth Agripreneurs (IKYA) is a cooperative of young women and men in Bukavu, DR Congo, who have improved on-farm production and processing of cassava. IKYA works with rural Community Cassava Processing Centers (CCPCs) to source their raw cassava roots, which they then process to produce high quality cassava flour (HCQF) that is sold in supermarkets and in retail shops in Bukavu. This value-added activity is a way to diversify the cooperative's sources of income and to increase the revenue of rural CCPC's as a regular and reliable buyer. In total, the CCPCs have a total of 234 individuals, 89 young men and 145 young women. Each CCPC has 3-4 paid salary members. In 2017, each CCPC, on average, produced 1 tonne of flour monthly. A total of 200 CCPC members have received technical trainings on processing and preparing cassava flour products for sale and home consumption. Young people from the IKYA program are engaged in activities that increase income and reduce poverty in rural households,

providing technical training on Integrated Soil Fertility Management to stakeholders who include NGOs and youth groups that are embarking on developing their own agribusinesses.

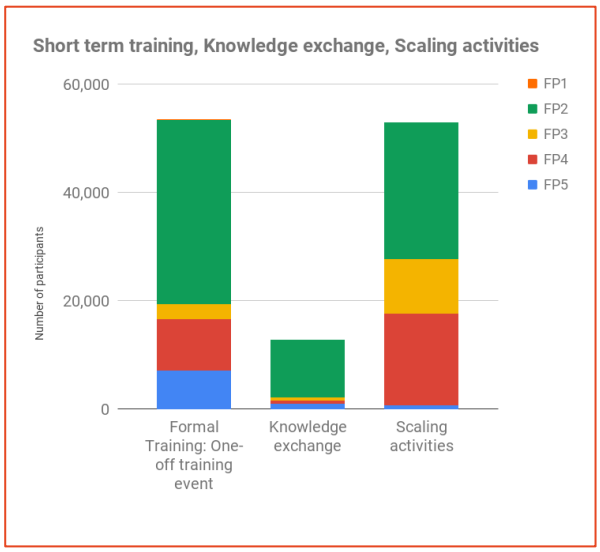
1.3.3 Other Aspects of Equity / "Leaving No-one Behind"

Integrated agriculture for nutrition approaches in the Andes. In high Andean indigenous communities of Bolivia and Peru, ancient knowledge on native potato varieties from both the Aymara and Quechua cultures was documented, and local varieties with high levels of Iron and Zinc were identified in previous years. Native landraces and new varieties with higher content of Fe and Zn may also benefit from agronomic practices aimed at enhancing the concentration of nutrients in edible parts of crops (e.g. with fertilizers containing specific micronutrients) (https://doi.org/10.1007/s11104-016-3065-0). This information was used to implement capacity building programs with indigenous communities through the International Fund for Agricultural Development (IFAD) Andes Program. Men, women and children were targeted to enhance dietary diversity and increase the consumption of biofortified potatoes to combat anemia amongst vulnerable groups. In Peru, the IFAD Andes program is also deriving support from the national strategy to eliminate chronic malnutrition. Agreements were signed with the Ministry of Development and Social Inclusion and a workshop was conducted to design a pilot intervention in the district of Curgos (one of the regions with the highest poverty indices in Peru). The pilot intervention will include biofortified potatoes in capacity building programs to enhance agricultural production and nutrition for women of childbearing age and children under 5 years old.

Indigenous knowledge systems and climate change management in Africa. Climate change challenges food security and sustainable development in Africa. In recent years, the knowledge of local and indigenous people, often referred to as indigenous knowledge has been increasingly recognized as an important source of climate knowledge and adaptation strategies. In order to document and share proven practices, tools or policies that promote resilience and help farmers to address the challenges posed by climate change, a book on indigenous knowledge systems and climate change management for different regions of Africa was produced (https://publications.cta.int/media/publications/downloads/2009_PDF.pdf). The document provides insights into specific climate solutions that work for smallholder farmers and others that could have potential to scale.

1.3.4 Capacity Development

In 2017, a total of 261 students and young researchers have been associated with RTB research programs for long term training. 94 of them were PhD and 95 MSc students, see figure below left. The number of participants in one-off short-term training was 53,500, with 12,826 in knowledge exchange activities and 52,977 in scaling activities, see figure below right. The distribution by flagship projects shows that most scaling activities have been mapped in RTB delivery flagships (FP2, FP3, FP4) even when FP5 supported the definition of the scaling strategies.



Here we present the approach taken in one of the clusters to enhance the effectiveness of long-term training.

Building research capacities on RTB seed systems. Cluster 2.1 is implementing a coordinated effort to strengthen the capacities of a group of 11 talented young scientists. RTB scientists involved in this cluster are actively mentoring four PhD students from Wageningen University and Research (WUR), three students from University of Florida (UFL), one student from Makerere University (MU), two young scientists associated with WUR and one post-doc associated with UFL. This group is receiving training in several ways: formal training at WUR, UFL and MU; hands-on training with CGIAR host institutions on the projects in which they are doing their field work; participation in cluster meetings, in which they interact actively with senior scientists, and by attending dedicated training events (2 events organized by WUR in 2017). These young scientists contribute in developing, testing and refining the Toolbox for RTB Seed Systems described above (See Section 1.2.2). It is expected that they will become the next generation of scientists that will help practitioners to better design, implement and evaluate projects in seed systems. At a conservative rate of two research papers per scientist, it is estimated that this group (with support of others) will deliver over 20 high-quality research papers by the end of RTB's Phase II.

A rigorous approach to document the results obtained through training is shown in the following example.

Improving Food Safety Practices of OFSP Puree Handlers in Kenya. OFSP puree is a nutritious food ingredient for promoting Vitamin A intake in processed food products in Sub-Saharan Africa (SSA). OFSP puree handlers play an important role in ensuring production of consistently safe and quality OFSP puree and related processed products. Insufficient knowledge on food safety and poor practices by food handlers are major causes of foodborne illnesses and deterioration in food quality along the food chain. A study of 35 handlers showed a low level of knowledge on personal hygiene, food contamination, foodborne illnesses, cleaning and sanitation with mean scores of 80, 64, 76 and 63%, respectively. Training had a significant impact on knowledge ($p=0.020$), attitude ($p=0.050$), practices ($p=0.006$) and overall KAP ($p=0.001$). A significant moderate positive correlation existed between knowledge and practices ($r=0.358$, $p=0.035$) and attitude and practices ($r=0.42$, $p=0.013$). As per adjusted linear regression analysis, food safety practices significantly ($p=0.045$) increased by 0.32% with one percent increase in knowledge and by 0.38% ($p=0.018$) with one percent increase in attitude. Frequent food safety training is needed to improve hygienic practices of handlers (http://hdl.handle.net/10568/91984).

1.3.5 Open Data

Open Access and ISI Journals and RTB Collection in CGSpace. All centers aim to increase the number of publications in Open Access and ISI Journals to achieve the CGIAR targets. The cost of making publications open access has been assumed in compliance with the institutional guidelines of each center. To foster global accessibility and impact of knowledge products developed under RTB, a specific collection has been created in CGSpace for RTB (click here). This facilitates the identification and findability of, and access to, publications. CGSpace also publications to be easily monitored in terms of mentions, downloads, views, etc., and it facilitates the tracking of the usage of these materials. Other relevant crop-specific websites that facilitate access to knowledge products are: Banana bibliographic database (www.musalit.org); Banana image bank (www.musarama.org); Sweetpotato Knowledge Portal (http://www.sweetpotatoknowledge.org/).

RTB databases. The program contributes to the systematic and long-term effort for making available genomic and phenotypic data as well as data from experimental trials related with all the RTB crops. The table below lists some of the databases maintained and/or contributed by RTB and its centers.

RTB databases
BioMart (http://germplasmdb.cip.cgiar.org/)
Cassava genome hub (http://www.cassavagenome.org/)
CASSAVABASE (https://www.cassavabase.org/)
MGIS (http://www.crop-diversity.org/mgis)
MUSABASE (https://musabase.org/)
ProMusa knowledge base (www.promusa.org)
Southgreen (http://www.southgreen.fr/content/rtb-multi-genomes-hub)
Potato Gene Identity Kit (https://research.cip.cgiar.org/confluence/display/IPD/SSR+Marker)
PotatoGENE (https://research.cip.cgiar.org/confluence/display/potatogene/Home)
The Catalogue of CIP Potato Varieties (https://research.cip.cgiar.org/red_varie/pages/home.php)

RTB databases
SWEETPOTATOBASE (https://sweetpotatobase.org/)
YAMBASE (http://www.yambase.org/)

CIP Open Access Data Sprint. For the first time, CIP launched a Data Sprint competition. Important datasets were uploaded and shared in the Dataverse repository, this competition was considered a good practice among the CG Open Access and Data Management groups, as a way of promoting Open Access policies and implementing knowledge sharing strategies to increase visibility and access to data.

Interoperability. To seek interoperability between frequently used platform and repositories, RTB has worked with MEL Platform to match and exchange data and metadata with CGSpace and CIP-Dataverse.

1.3.6 INTELLECTUAL ASSETS

Intellectual assets management. CGIAR centers in RTB are responsible for strategically managing their intellectual assets. Most of the centers have recently approved or reviewed their internal related policies and aligned them with the CGIAR Open Access and Data Management Policy and the CGIAR Principles on the Management of Intellectual Assets. They report every year to the System organization the main progress and any challenge they faced. Most of the intellectual assets are maintained in the form of scientific publications (which are inclusive of journal articles, books, conference presentations, reports) and varieties released through the national agriculture research systems in the partner countries. Project development and/or Legal units are in place in each center. They support managers in the establishment of management of IA and maintain IP registers.

Patents and/or plant variety right applications. CGIAR centers in RTB did not apply for PVP or Patents during 2017, and therefore, nothing has been tracked or strategically managed in terms of intellectual property rights as specified in table E.

Critical issues and challenges in the management of intellectual assets in the context of the CRP. Centers reported that there were no critical challenges encountered in 2017 with regards to management of intellectual assets in the context of RTB.

2. CRP Effectiveness and Efficiency

2.1 VARIANCE FROM PLANNED PROGRAM

A major achievement which built on earlier RTB supported workshop on breeding for quality traits with strong cross center collaboration from the postharvest team was to contribute to the design and start-up of the BMGF funded project - **Breeding RTB products for end user preferences (RTBFoods) -** led by CIRAD. The proposed investment will expand the program capacities in this research area and will improve knowledge of the essential quality traits for successful RTB variety adoption all along the value chain. Multidisciplinary teams bringing together specialists of social sciences and food technologies will capture these essential quality traits through surveys conducted with users of RTB crops, i.e. processors and consumers, as well as farmers and traders or middlemen (https://www.cirad.fr/en/news/all-news-items/press-releases/2018/rtbfoods).

In the last quarter of the year, potato and sweetpotato breeding (CIP), cassava breeding (IITA and CIAT) and plantain breeding (IITA) programs were facing a challenging situation due to the curtailment of a significant portion of Window 3 funds. Breeding is a core element of an Agri-Food System CRP and as the Excellence in Breeding Platform (EiB) gets underway, the Independent Steering Committee considered it vital that centers have strong breeding programs to engage. So, concerned by this loss of W3 funding, after appropriate consultation, RTB took measures that will protect areas of the breeding programs that are at risk in 2018 due to W3 cut.

2.2 USE OF W1-2 FUNDING

W2 funds allocated by DFID to RTB were allocated following the distribution by flagship indicated by the funder. RTB assigned W1&2 through two main mechanisms:

1. Earmarked Funding: Semi-competitive funds annually allocated to clusters for synergistic research which creates added value for RTB as a program. This includes: discovery and cross-cutting clusters where cross-crop and cross-center collaboration are fostered, for example the RTB Breeding Community of Practice and interventions linked to the cross-cutting areas of gender and youth, and capacity development.
2. Non-Earmarked Funding: Funds annually allocated to Program Participants for the implementation of cluster specific R4D agenda as defined in the full proposal.

Earmarked and Non-Earmarked funds represent respectively 35% and 65% of total W1&2 allocation to program participants. During 2017 RTB established the Scaling fund to foster the scaling of the most promising RTB innovations, generate an evidence base around the scalability of these innovations and improve scaling strategies, approaches and tools. The first call was launched the 15th of August 2017 and the assessment of the full proposal was published the 15th of November. Three projects were selected and implementation started at the end of 2017.

2.3 KEY EXTERNAL PARTNERSHIPS

FP1-FP5. Strategic use of W1-2 includes support to partnerships with **French institutions** (CIRAD and IRD), which whilst fully part of RTB are external to CGIAR. Since phase I, they have been significantly contributing in key areas in all the flagships.
FP1. Collaboration with **RHUL** improved program capacities to perform molecular and biochemical characterization of important traits in several RTB populations and cultivated varieties.
FP2 & FP5. In the second phase, collaboration with **WUR** was initiated for the science of scaling and significantly enhanced in the domains of seed systems, where a collaboration with the **University of Florida** is also highly productive.
FP4. Joint work with **NRI** allowed the assessment of the energy efficiency of a small-scale cassava flash dryer and the analysis of the correlations between physicochemical and textural characteristics, sensory attributes and consumption patterns of traditional cassava products in Tanzania.
FP1 & FP5. Partnerships with **Cornell University** were strengthened and diversified. Flagship 1 team collaborated closely with the Genomic Open-source Breeding Informatics Initiative (GOBII) to ensure that the 'omics' tools developed will be widely available for use in breeding programs. The collaboration 2016/2017 with Gender-Responsive Researchers Equipped for Agricultural Transformation (GREAT) project helped in building capacity of researchers within RTB to integrate gender into research and analysis. Additionally, the RTB gender team contributed in the development of gender-sensitive training modules widely applicable for researchers and students.

2.4 CROSS-CGIAR PARTNERSHIPS (OTHER CRPS AND PLATFORMS)

CRP on Policies, Institutions and Markets: joint work on the analysis of seed systems and markets for vegetatively propagated crops in Kenya (potato), Nigeria (cassava) and Vietnam (potato and cassava) is helping in better understanding and in creating an evidence base on options for public policies, regulations or regulatory reforms that can foster access, availability, and quality of RTB planting material.

Joint work on foresight, policy and institutional analysis, focused on modeling approaches for assessing priorities in international agricultural research. New funds were leveraged for 2018 through the proposal "Changing world, changing climate: Meeting complex demands with nutritious roots, tubers and bananas value chains" that will be jointly funded by RTB and PIM.

Big Data Platform: Enhancement of data management and analytics tools using roots, tubers and bananas databases, which hold genomic and phenotypic information for next generation breeding applications (RTBbase) and development of complementary tools such as the Highly Interactive Data Analysis Platform (HIDAP) and the Breeding API (BrAPI) are at the center of the collaboration. The smartphone image-based application for cassava disease and pest damage identification under developed in collaboration with Penn State University, received a

grant from the INSPIRE initiative of the Big Data Platform to be piloted and expanded into diseases of other RTB crops (RTB blog).

Excellence in Breeding Platform: Strong links between RTB and the EiB were established in 2017, with the BCoP cluster leader forming part of the Expert Advisory Group (EAG) of the Platform, as well as a number of other RTB scientists, who participated in an EAG startup planning meeting. In addition, the RTB Science Officer, was selected to form part of the EiB steering committee, and participated in the first virtual meeting. Discussions are underway on applying EiB initiatives for breeding program management, such as applying Stagegate decision tools, and defining product profiles for each breeding program. Moreover, through the EiB, the IITA yam, cassava, banana and plantain breeding programs underwent a Breeding Program Assessment by a group of experts from industry and public-sector breeding programs.

Maize and Wheat: The scaling readiness approach developed by FP5 has been adopted by the CIMMYT maize and wheat programs and used to apply for the Netherlands Organisation for Scientific Research (NOW) funding for "Understanding and improving scaling readiness of climate smart, nutrient management decision support tools (DST) in different institutional environments: Ethiopia & Tanzania" (efficiency benefits).

CCAFS: RTB participated in the scientific conference and writeshop held in Galway, Ireland (https://www.qatano.org/home). A joint paper that explores options for climate smart breeding is under discussion. RTB scientists participated in the 4th Global Science Conference on Climate Smart Agriculture and following interactions among CRPs and centers.

Gender platform: Two projects awarded in 2017 for assessing Gender Dynamics in Seed Systems are the result of the collaboration with RTB and its implementing centers (http://gender.cgiar.org/gender-dynamics-seed-systems/seed-systems-proposals/). The seed system team in cluster 2.1 used RTB multi-stakeholder seed system framework (http://hdl.handle.net/10568/72975; http://hdl.handle.net/10568/81049) to guide the entire set of seed system projects.

2.5 MONITORING, EVALUATION, IMPACT ASSESSMENT AND LEARNING (MELIA)

The "**scaling readiness approach**" (http://hdl.handle.net/10568/90665; see also section 1.2.5) is being tested as tool for assessing and monitoring the innovations included in the RTB portfolio. The approach has strong complementarity with the common indicator **#C1 Innovations**. RTB promoted the use of the approach by integrating a lighter version of one of the scaling readiness assessment tools as part of the evaluation process of the 12 concept notes submitted to the first call for proposals of the RTB Scaling Fund.

RTB scientists and managers were trained on new functions of the **MEL platform** for planning, monitoring and reporting. Interoperability with CIP-Dataverse was completed and metadata retrieving from CGSpace is now possible and will limit reporting burden for scientists. IITA adopted MEL as center solution and is gradually setting up and adapting the platform to its requirements. Interoperability with MARLO and System Level Dashboard is under study to allow relevant data to flow from a platform to another.

The **IEA evaluation of RTB (2015)** noted significant progress in establishing governance and management structures and processes that promote the inter-dependence of the members of the RTB partnership collaboration. However, it observed the lack of an overarching business framework that can help guide these relationships beyond common goals and mutual trust. Hence Recommendation 16 proposed an "alliance compact that would bring clarity and greater understanding to critical partnership questions". In response a joint statement was signed by the DGs of the centers in 2017 to specify, with respect to the RTB Program, the terms of a partnership collaboration concerning certain general organizational and collaborative efforts among the parties. This covered:

1. RTB Partnership Collaboration
2. Inclusive Partnership
3. Strengthening Business Partnerships for RTB
4. Stewardship of donors especially window 2
5. Linking center talent management to positions such as flagship project and cluster leaders

6. Shared communications

Progress in these different areas by centers will be reviewed by the ISC.

Table I-2 provides an update on the implementation of the action plan defined as part of the management response to the IEA evaluation or RTB (2015).

2.6 IMPROVING EFFICIENCY

The online platform, MEL, is a management information system (MIS) used as CRP (RTB, GLDC) and Center solution (CIP, ICARDA, IITA) for planning, monitoring and reporting. Sharing the efforts among CRPs and Centers for the development and maintenance of the platform as well as for the training and support provided to the users has allowed to save costs and improve the product.

Careful coordination of meetings and use of joint events as opportunities for face-to-face coordination among flagship and cluster members has contributed to an efficient use of the staff time / travel days.

3. CRP Management

3.1 CRP MANAGEMENT AND GOVERNANCE

A joint statement on Partner collaboration was signed (see 2.5). The ISC self-evaluation of performance was complemented by including feedback from members of the PMU.

The new flagship and cluster arrangement of RTB became fully operational. Eleven of the cross cutting clusters (FP1: DI1.1: Breeding Community of Practice, DI1.2: Next Generation Breeding, DI1.3: Game-changing traits, DI1.4: Genetic diversity; FP2: CC2.1: Quality seeds & access to improved varieties; FP3: CC3.2: Crop Production Systems; FP4: CC4.1: Post-harvest innovation and FP5: CC5.1: Foresight and impact assessment, CC5.2: Sustainable intensification / diversification, CC5.3: Gender and youth, CC5.4: Scaling RTB agri-food system innovations) held workshops in 2017 to review progress, build functional teams, develop specific roles and responsibilities for product and output leaders and develop detailed workplans and deliverables. The process of review of FP leader performance with feedback to their centers was extended to cluster leaders (in line with the joint statement).

3.2 MANAGEMENT OF RISKS TO YOUR CRP

Management. As a result of center staff departure or reassignment, key CRP management positions (i.e. flagship and cluster leader) may be subject to changes in the course of the agreed three-year term. If not well managed, changes in leadership may create discontinuity in flagship and cluster guidance and coordination. In 2017, RTB successfully managed the transition of five cluster leaderships. Cross-center consultations were used to ensure best candidate selection and bilateral work with centers hosting the leaders ensured the definition and implementation of transition plans. Based on this experience, replacement procedures are being reviewed and formalized by the Management Committee.

Institutional. USAID originally sought to support breeding programs of RTB crops with W2 funds. In 2015, they shifted funding to W3 for potato and sweetpotato breeding (CIP), cassava breeding (IITA and CIAT) and plantain breeding (IITA). In 2017, USAID curtailed most of these funds. RTB created a fund to support breeding programs directly impacted by the reduction of USAID W3 funding in 2018.

Financial. Uncertainty over the final amounts of W1&2 funding persisted until November. A prudential scenario of USD 18.7m was used to guide center spending. The most damaging aspects of the uncertainty were a) some level of reputational damage amongst our partners and b) it inhibited better and broader engagement of non-CGIAR partners or with other CRPs where it would be harder to offset the risk if the expected budget did not

materialize. Finally, the budget came in somewhat above the prudential scenario with concomitant carry-over in some programmatic areas.

Programmatic. In 2017, a portion of W2 was earmarked by donors for allocation in specific flagships. Earmarking was in line with overall budget allocation and did not result in deficit or surplus for any of the flagships. Nevertheless, if the portion of earmarked W2 were to increase without consultations between donors and CRP management, there is a significant risk of jeopardizing the strategic allocation of funds agreed in the proposal for Phase 2.

3.3 FINANCIAL SUMMARY

The total 2017 budget for RTB was USD 107.4M, USD 20.6M (19%) from W1&2, and USD 86.8M (81%) from W3, bilateral and RTB participant centers' own funds. The final 2017 allocation of W1&2 to RTB was USD 20.6M (including carry-over of USD 0.1M).

RTB total expenditure for the period was USD 93.5M, or 87% of the budget, of which USD 18.3M (20%) was from W1&2, and USD 75.2M (80%) from W3, bilateral and centers' own funds. W1&2 expenses reached 89% execution of the final budget and W3, bilateral and centers' other own expenditure, reached 87% execution. Most flagships underspent with an average execution of 86% of flagship budget. The exception was FP1 where an overspending of 6% was recorded in relation with the execution of W3 / bilateral projects.

A total amount of USD 2.3M for W1&2 was carried forward to 2018. This corresponds to 1) funds allocated through an internal competitive mechanism in 2017 but for which implementation started in December 2017 (USD 0.9M); 2) the rest reflects prudency of RTB participant centers that only received confirmation of the remaining 30% of the planned budget in December.

Expenditure for gender research was USD 10.4M, representing 11% of RTB total expenditure in 2017.

TABLES

TABLE A: EVIDENCE ON PROGRESS TOWARDS SLOS

TABLE A-1: EVIDENCE ON PROGRESS TOWARDS THE SLOS (SPHERE OF INTEREST)

SLO Target (2022)	Brief summary of new evidence of CGIAR contribution to relevant targets for this CRP (with citation)	Year of publication	Expected additional contribution before end of 2022 (if not already fully covered).
1.1. 100 million more farm households have adopted improved varieties, breeds, trees, and/or management practices	Floro IV, Victorino O.; Labarta, Ricardo A.; Becerra López-Lavalle, Luis Augusto; Martinez, Jose M.; Ovalle, Tatiana. 2017. Household Determinants of the Adoption of Improved Cassava Varieties using DNA Fingerprinting to Identify Varieties in Farmer Fields: A Case Study in Colombia. Journal of Agricultural Economics 1-19 p. http://hdl.handle.net/10568/89044 *In 2015, 30,000 ha were used for cassava in the Cauca Department in southwest Colombia. This represented 6.8% of total of cassava acreage in the country. The study found that 13% of the total area was cultivated with improved varieties.*	2017	
	Wossen, T., Abdoulaye, T. Alene, A., Haile, MG, Feleke, S. Olanrewaju, A. & Manyong, V. (2017). Impacts of extension access and cooperative membership on technology adoption and household welfare. Journal of Rural Studies 54 (August 2017): 223-233. https://doi.org/10.1016/j.jrurstud.2017.06.022 *Analyzing household-level data from rural Nigeria through different matching techniques and endogenous switching regression approach, this study shows the positive impacts of access to extension services and cooperative membership on technology adoption, asset ownership and poverty.*	2017	

	Oparinde, A., Abdoulaye, T., Mignouna, D. B. & Bamire, A. S. (2017). Will farmers intend to cultivate Provitamin A genetically modified (GM) cassava in Nigeria? Evidence from a k-means segmentation analysis of beliefs and attitudes. PloS one, 12(7), 1- 22. http://hdl.handle.net/10568/83063 *Analysis of market segments within a population remains critical to agricultural systems and policy processes for targeting new innovations. Patterns in attitudes and intentions toward cultivating Provitamin A genetically modified (GM) cassava were examined using a state-level sample of smallholder cassava farmers in Nigeria. Three distinct classes of attitude and intention denoted as low opposition, medium opposition and high opposition farmers. It was estimated that only 25% of the surveyed population of farmers was highly opposed to cultivating Provitamin A GM cassava.*	2017	
	Oparinde, A., Abdoulaye, T., Manyong, V., Birol, E., Asare-Marfo, D., Kulakow, P. & Ilona, P. (2016). A technical review of modern cassava technology adoption in Nigeria (1985-2013): Trends, challenges, and opportunities (HarvestPlus working paper No. 23). Washington, D.C.: International Food Policy Research Institute. http://hdl.handle.net/10568/76990 *Using an extensive review of cassava-adoption literature focused on Nigeria, this paper discusses the uptake of improved cassava varieties and it shows the challenges in comparing the results of collected studies due to differences in sampling approaches and coverage.*	2016	
	Crop improvement, adoption and impact of improved varieties in food crops in Sub-Saharan Africa. Edited by Thomas S. Walker, Jeffrey Alwang. Published by CGIAR Consortium of International Agricultural Research Centers and CABInternational, 2015 https://ispc.cgiar.org/workstreams/impact-assessment/projects/diffusion-and-impacts-improved-varieties-africa-diiva-2010 - *Adoption of improved varieties of cassava in sub-Saharan Africa, 2009. Improved varieties 36% of the total area 30% of which planted with materials containing IITA germplasm or directly related to IITA activities.* - *Adoption of improved yam varieties in sub-Saharan Africa, 2009. Improved varieties 26% of the total area 13% of which planted with materials containing IITA germplasm or directly related to CG Center activities.* - *Adoption of improved varieties of potato in Ethiopia, Rwanda, Kenya, Uganda and Malawi, 2010. Weighted average adoption across the five countries is about 35%. CIP-related clones figure prominently in the list of adopted improved varieties. Victoria is the leading variety in Uganda with more than 50% of potato-growing area and the second most popular improved clone in Kenya.* - *Adoption of improved varieties of sweetpotato in Burundi, Mozambique, Rwanda, Tanzania and Uganda, 2010. The weighted average for aggregate adoption of modern varieties across the five countries is 7%. This estimate does not include landraces that were officially released. Inclusion of those materials gives a*	2015	

	weighted average estimate in the range of 35–40% in most countries. Varieties coming from CIP crosses are in the very early stages of their diffusion process and have only reached 1% of the total area under sweetpotato.		
	Bellon, M.R.; Gotor, E.; Caracciolo, F. (2015) Assessing the effectiveness of projects supporting on-farm conservation of native crops: evidence from the high Andes of South America. World Development 70 p. 162-170 ISSN: 0305-750X http://hdl.handle.net/10568/68400 *This paper presents an approach for assessing the effectiveness of projects aimed at creating incentives for smallholder farmers to continue maintaining crop diversity under evolution on their farms in relevant centers of genetic diversity—a process known as on-farm conservation. It is applied to five projects involving native crops in the High Andes of South America. Results show evidence that projects have been effective at supporting farmers to maintain crop diversity on-farm while generating positive livelihood outcomes. Implications and challenges of both the approach and the results for sustainable use and conservation of crop biodiversity are discussed.*	2015	
	Awotide, B., Abdoulaye, T., Alene, A. & Manyong, V. (2014). Assessing the extent and determinants of adoption of improved cassava varieties in south-western Nigeria. Journal of Development and Agricultural Economics, 6(9), 376-385. http://hdl.handle.net/10568/76040 *Based on farm household survey of 841 households in south- western Nigeria, this study provided empirical information on the positive effect of access to hired labor, access to credit and access to information on the level of adoption of improved varieties. Also, it showed that farmers that own their farmland are more likely to adopt than those that practice farming on rented farmland; that female-headed households and younger farmers are more likely to adopt improved varieties.*	2014	
	Tarawali, G., Abdoulaye, T., Ellis-Jones, J., Asumugha, G., Dixon, A., Okechukwu, R., ... & Ekpere, J. (2013). An impact assessment of the cassava enterprise development project (p. 62). Ibadan: IITA http://hdl.handle.net/10568/87898 *The Cassava Enterprise Development Project promoted the dissemination of new CMD resistant varieties that were planted on 19,185 ha by the end of the project (2010). Based on individual survey of 680 farmers (51% male and 49% female) in 11 Nigerian states, this study showed that the yield obtained with new varieties was more than double than the one of local varieties. This trend was observed both through farmer recall and by measuring yields from sample plots.*	2013	

	Kaguongo, W.; Ortmann, G.; Wale, E.; Darroch, M.; Low, J. 2012. Factors influencing adoption and intensity of adoption of orange flesh sweet potato varieties: Evidence from an extension intervention in Nyanza and Western provinces, Kenya. African Journal of Agricultural Research. ISSN 1991-637X. 7(3):493-503. http://hdl.handle.net/10568/66522 *This study applied logit and transformed logit regression to examine factors affecting the adoption of orange flesh sweetpotatoes, and intensity of such adoption, by a representative sample of 340 farmers in the Busia and Rachuonyo* *(OFSP) districts of Kenya in 2009. The results suggest that the district where the farmer comes from, knowledge e on value addition and nutritional benefits, and availability of vines were the key factors for adoption. The results also suggest that participation in a value chain extension programme enhanced the probability of adoption. Factors affecting intensity of adoption were site, value addition, vines availability, level of commercialization and having a child of up to five years.*	2012	
	Developing capacity for agricultural market chain innovation: Experience with the 'PMCA' in Uganda. Journal of International Development, 22, 367-389. Horton, D., Oros, R., Paz Ybarnegaray, R., López, G., Velasco, C., Rodríguez, F. Escobar, E., Rotondo, E., Hareau, G., Thiele, G. 2011 https://doi.org/10.1002/jid.1694 *The aim of the Participatory Market Chain Approach (PMCA) is to foster pro-poor innovation in potato market chains. After promising results in Peru and Bolivia, it was applied in Uganda. The Ugandan experience indicates that the PMCA can stimulate technological and institutional innovation in locally relevant agricultural commodity chains by promoting new collaborative arrangements between researchers and development professionals and other diverse stakeholders, including small farmers, market agents and policy makers. Successful introduction of this new arrangements relies on intensive capacity-development process that fosters the development of social networks, changes in attitudes, and the acquisition of social as well as technical knowledge and skills.*	2011	
	Cavatassi, R.; Gonzales-Flores, M.; Winters, P.; Andrade-Piedra, J.L.; Espinosa, P.; Thiele, G. 2011. Linking smallholders to the new agricultural economy: The case of the Plataformas de Concertacion in Ecuador. Journal of Development Studies. (UK). ISSN 0022-0388. 47(10):1545-1573. http://hdl.handle.net/10568/67694 *This article examines the challenges of linking smallholders to high-value food markets by looking at the experience of the Plataformas programme in the Ecuadorian Sierra. Multiple evaluation methods are employed to ensure identification of program impact. The findings suggest that the programme successfully improved the welfare of beneficiary farmers, as measured by yields and gross margins. These benefits are achieved through improving the efficiency of agricultural production and through selling at higher prices. No significant*	2011	

	secondary health or environmental effects were found. Overall, the programme provides clear evidence that combining production support with facilitating market access can be successful.		
	Tenkouano, A., Pillay, M. & Coulibaly, O. (2011). Hybrid distribution to farmers: adoption and challenges. In M. Pillay and A. Tenkouano, Banana breeding: progress and challenges (p. 305-319). Boca Raton: Taylor & Francis. http://hdl.handle.net/10568/82888 *The adoption of new banana cultivars by large-scale producers is a relatively straightforward process when the commercial incentives for adoption are high or when there are no other alternatives. This was evidenced by the replacement of 'Gros Michel' by the Cavendish varieties. Therefore, this chapter will consider hybrid distribution to smallholder farmers who are responsible for the bulk of banana and plantain production in developing countries, usually under complex cultural and technological circumstances.*	2011	
1.2. 30 million people, of which 50% are women, assisted to exit poverty	Dontsop-Nguezet, P.M., Manyong, V., Abdoulaye, T., Arega, A., Amato, M.S., Ainembabazi, J.H.,.... & Okafor, C. (2016). Non-farm activities and adoption of improved cassava and beans varieties in South-Kivu, DR Congo. Tropicultura, 34(3): 262-275. http://hdl.handle.net/10568/77858 *Non-farm activities have been generally considered as important strategy for overcoming credit constraints faced by rural households as well as for reducing poverty through income effect. This paper employs binary probit and average treatment effect to estimate the impact of participation in non-farm activities on adoption of improved cassava and beans varieties in South-Kivu, DR Congo. Results showed on one hand that the participation rate in non-farm activities in South-Kivu was 38% and 52.1% respectively for crafts and small businesses. On the other hand, the rate of adoption of new cassava and beans varieties were 14 and 28% respectively. Factors affecting the adoption rate were gender, education, household size, the presence of non-farm activities, household assets in terms of livestock owned, market access and access to the information on new technologies. These results demonstrate the tendency of rural households to include the practice of non-farm activities among their strategies for survival and diversify their sources of income or supplement farm income. Results of this study indicate a positive relationship between engagement of rural households in non-farm activities and their propensity to adopt improved varieties. There is still a huge gap between potential adoption rate and actual rate of adoption for cassava and beans improved varieties in the study area. Therefore, actors involved in the development of the agricultural sector have to be aware of the importance of these factors even when they are working for the promotion of purely agricultural activities.*	2016	

	Impact of agricultural technology adoption on asset ownership: the case of improved cassava varieties in Nigeria. Awotide, B.A., Alene, A.D., Abdoulaye, T. et al. Food Sec. (2015) 7: 1239. https://doi.org/10.1007/s12571-015-0500-7 *Using household survey data from a sample of about 850 households selected from six States in south-west Nigeria, this paper analyses the effects of the adoption of improved cassava varieties (ICVs) on asset ownership among smallholder farmers. The results of the linear regression with endogenous treatment effects showed that adoption of ICVs is positively related to asset ownership. The results further showed that ICVs had greater impact on asset ownership among female-headed households. The impact analysis using propensity score matching (PSM) showed a significant and positive effect of adoption of ICVs on asset ownership and a negative effect on asset poverty. The empirical results suggest that improved agricultural technologies can play a key role in strengthening asset ownership of smallholder farmers for increased agricultural productivity and income generation.*	2015	
	Ayedun, B., Okuneye, P.A., Dipeolu, A. & Abdoulaye, T. (2013). Socioeconomic assessment of adoption of production and processing technologies on farming households in Nigeria. Journal of Agricultural Management and Rural Development 4 (1) 137-147. http://hdl.handle.net/10568/77455 *Using multistage sampling techniques, 480 farming households from Intervention villages - IVs and the Non-Intervention villages - NIVs were sampled from South Zones of Nigeria and interviewed. This study was carried out to provide credible evidence of the impact of IITA-ICP (International Institute of Tropical Agriculture, Integrated Cassava Project) research on cassava and to draw lessons from these interventions. Using descriptive and econometric tools, the result showed that cassava occupies 43% of the total field cultivated for crops. Awareness and adoption of production and processing technology were generally poor: for production technology, it was highest for improved cassava sett both in awareness (87%) and adoption (68%) and IVs took the lead. In processing technology among households, grating machine had the highest awareness (88%) and adoption rate (78%) followed by pressing machine. In many cases, intervention households and enterprises had better awareness and adoption rates. Poverty status estimation revealed that less people were below poverty lines among adopters compared to non-adopters, and among IVs compared to counterfactuals. Using logit model, variables that had poverty reducing effect included 'being from intervention villages, adoption of grater machine for processing cassava, having non-farm income, and being educated.*	2013	

	Mignouna, D.B., Abdoulaye, T, Alene, A, Aighewi, B., Pelemo, O., Manyong, V., … & Akoroda, M. (2013). Economic analysis of seed yam production systems in Nigeria. Journal of Root Crops Vol. 39 (2) 221-229. http://hdl.handle.net/10568/77440 *The study three scenarios of yam seed production: 1) minisetts, 2) minisetts combined with vine cuttings; 3) ware yam to seed yam via vine cuttings. From the net present value (NPV) and benefit : cost ratio (BCR) analyses, the seed yam production systems including minisetts were more viable than current traditional seed yam production systems (scenario 3).*	2013	
	Rusike, J., Lukombo, S.S., Msemo, J., Osei-sarfoh, A., Fannah, S., Okechukwu, R. ...& Chibeba, A.M. (2012). Evaluating the effects of -Unleashing the power of cassava in response to the food price crisis in Africa- (UPoCA) prior to implementation: taking stock of where we were. In: Proceedings of the 11th triennial Symposium of the ISTRC-AB held at Memling Hotel: Tropical roots and tuber crops and the challenges of globalization and climate changes, (pp. 312-325), 4-8 October, Kinshasa, Democratic Republic of Congo. http://hdl.handle.net/10568/80437 *Most development researchers and practitioners agree that the sharp rise in international prices for agricultural commodities that emerged in 2003 and peaked in 2008 resulted in a global food crisis. To combat the crisis, IITA and national partners in seven African countries are evaluating the effects of cassava research for development approach on increasing the productivity of production and processing of cassava for home consumption and marketing surplus produce. This paper uses farm household and econometric modeling with baseline and counterfactual data to predict the impact of implementing the project prior to its full implementation. The results show that cassava is at different stages of transformation from a famine reserve, food security crop and rural food staple to a cash crop for urban consumption and manufacture of industrial products. The impact of UPOCA will likely depend on the stage of transformation of the cassava sector in the country. UPoCA will likely have the most impact if interventions are aligned with the stage reached by the country.*	2012	
2.1. Improve the rate of yield increase for major food staples from current <1% to 1.2-1.5% per year	Rusike, J., Mahungu, N.M., Lukombo, S.S., Kendenga, T., Bidiaka, S.M., Alene, A. ...& Manyong, V.M. (2012). The impact of the emergency response to the outbreak of the cassava mosaic disease in the Democratic Republic of Congo. In: Proceedings of the 11th triennial Symposium of the ISTRC-AB held at Memling Hotel: Tropical roots and tuber crops and the challenges of globalization and climate changes, (pp. 3-30), 4-8 October, Kinshasa, Democratic Republic of Congo. http://hdl.handle.net/10568/80508 *This paper evaluates the impact of an emergency research for development project implemented in the Democratic Republic of Congo from 2000 to 2009 by various actors including the International Institute of*	2012	

	Tropical Agriculture in response to the outbreak of the Cassava Mosaic Disease that threatened the national food security. It applies methods developed in the econometric and statistical treatment effects literature on evaluation of social programs. The study evaluates impact by analyzing changes over time of outcomes of sample households in the project areas compared to neighboring non-project areas. We find that the project had statistically significant positive effects on technology adoption, area planted cassava, productivity, profitability, household food security and aggregate supply response. The effects are strongest among lower tails of distribution of outcomes mostly made up of female-headed households who grew the crop mainly for food. These findings are useful for informing agricultural and food policy debates in Africa.		
	Robinson, J. & Srinivasan, C.S. 2013. Case-studies on the impact of germplasm collection, conservation, characterization and evaluation (GCCCE) in the CGIAR. https://ispc.cgiar.org/publications/GCCCE-in-the-cgiar - *Kasetsart 50 (KU 50) is a highly productive hybrid cassava variety developed through active collaboration between CIAT (Centro Internacional de Agricultura Tropical), the Department of Agriculture of Thailand and Kasetsart University in Thailand. KU 50 is currently grown on over one million ha in Thailand and Vietnam (where it is known as KM 94) and has also been adopted in Indonesia, Cambodia and possibly China. It is estimated that the aggregate economic benefits accruing from adoption of KU 50 in Thailand (released in 1992) and Vietnam (released in 1995) currently exceed USD 44 million and USD 53 million respectively (at adoption levels of about 60% and 75%).* - *Cooperation-88 (C88) is a widely adapted, high yielding potato variety developed through a joint programme established between CIP (Centro Internacional de la Papa) and Chinese NARS to improve late blight resistance in potato adapted to the sub-tropical highlands. C88 is currently grown on about 400,000 ha in five provinces of southwestern China, the largest area being planted in Yunnan. It is estimated that the economic benefits accruing from C88 adoption in China at the level of adoption in 2010 were USD 350 million and will increase to USD 465million per year if an adoption ceiling of 600,000 ha is reached in 6-8 years. C88 has also stimulated growth in the potato processing industry, as it is suitable for both the table and chipping. The adoption of C88 is having a substantial impact on poverty, providing economic benefits to the poor estimated at USD 192 million a year in 2010, a figure that is set to increase as adoption increases.*	2013	
2.2. 30 million more people, of which 50% are women, meeting minimum dietary	Mignouna, D.B., Abdoulaye, T., Alene, A., Manyong, V.M., Dontsop, P.N., Ainembabazi, J.H. & Asiedu, R. (2015). A Microeconometric analysis of household consumption expenditure determinants in yam-growing areas of Nigeria and Ghana. TROPICULTURA, 33(3), 226-237. http://hdl.handle.net/10568/72997 *This paper provides an analysis of microeconomic factors that explain household consumption expenditure in rural areas using cross-sectional data obtained from 1400 randomly selected yam producing households of*	2015	

energy requirements	*Nigeria and Ghana. The correlates of consumption expenditure were examined using two techniques: ordinary least squares (OLS) and a quantile regression (QR) approach for a more comprehensive picture at different points of the distribution. Determinants of consumption expenditure are markedly different between the regressions and across the conditional quantiles of the expenditure in both countries. Results further indicate that age, education, and household size were important in explaining consumption expenditure using OLS. However, via conditional QR, the following additional factors became evident: membership of formal and informal institutions, main occupation, family structure, and farm size. Only education was consistently significant in both regressions and across the conditional quantiles, suggesting that responses to investments in education lead to increase in expenditure that will stimulate other sectors of the economy.*		
2.3. 150 million more people, of which 50% are women, without deficiencies in one or more essential micronutrients	Alan de Brauw, Patrick Eozenou & Mourad Moursi (2015) Programme Participation Intensity and Children's Nutritional Status: Evidence from a Randomised Control Trial in Mozambique, The Journal of Development Studies, 51:8, 996-1015, DOI: 10.1080/00220388.2015.1018907 https://doi.org/10.1080/00220388.2015.1018907 *Agricultural interventions are thought to have the potential to improve nutrition, but little rigorous evidence is available about programmes that link the two. In this article, we study impacts of an integrated agricultural and nutritional biofortification project, the REU in Mozambique. We first provide evidence on dietary impacts of the programme and then examine impacts of the programme by participation intensity. Using OLS and IV techniques, we find that more intense participation in both project components led to larger impacts. The results therefore have important implications for refining the design of future projects attempting to link agricultural and nutrition interventions.*	2015	
	KELLY M. JONES and ALAN DE BRAUW (2015), Using Agriculture to Improve Child Health: Promoting Orange Sweet Potatoes Reduces Diarrhea http://dx.doi.org/10.1016/j.worlddev.2015.04.007 *Vitamin A deficiency (VAD) is prevalent throughout the developing world, and causes night blindness and increases child morbidity and mortality. We studied the health benefits of biofortification in reducing VAD, using a cluster-randomized impact evaluation in 36 villages in northern Mozambique. Based on a sample of 1,321 observations of children under the age 5, biofortification reduced diarrhea prevalence by 11.4 percentage points (95% CI 2.0–20.8), and by 18.9 percentage points in children under the age three (95% CI 6.6–68.3). Diarrhea duration was also reduced. This is promising evidence that child health can be improved through agricultural interventions such as biofortification.*	2015	

	Loechl, C.; Lubowa, A.; Cole, C.; Prain, G.; Low, J. 2010. School-based nutrition education and promotion of orange-fleshed sweetpotato in urban and peri-urban areas of Kampala: Impacts and lessons learnt. Lima (Peru). International Potato Center (CIP) Urban Harvest. 50 p. Urban Harvest Working Paper Series. no.6 http://hdl.handle.net/10568/67219 *The study provides evidence of the results of the project Promotion of Orange-Fleshed Sweetpotato Varieties through Schools in Urban and Peri-urban Communities of Kampala, Uganda. Results are assessed in terms of changes: 1) in vitamin A-related knowledge, attitudes and practices among schoolchildren, mothers and other childcare; 2) in consumption of orange-fleshed sweetpotatoes and other vitamin A-rich foods among 2-6-year-old children. Four groups, defined based on the type of the project intervention, were compared in the study: Group 1: Agricultural Technologies/Extension & Nutrition Education; Group 2: Agricultural Technologies/Extension only; Group 3: Nutrition Education only; Group 4: No intervention (control).*	2010	

TABLE A-2: LIST OF NEW OUTCOME CASE STUDIES FROM THIS REPORTING YEAR (SPHERE OF INFLUENCE)

Title of outcome case study	No. of Sub-IDO	Links to evidence*	Space for additional, very brief details, including on cross-cutting issues
Adoption of improved cassava varieties in Nigeria gives 64% productivity gain as a result of adoption of improved cassava varieties	1.4.3 - Enhanced genetic gain; 1.4.2 - Closed yield gaps through improved agronomic and animal husbandry practices	http://hdl.handle.net/10568/80706	See narrative in section 1
Adoption of improved potato varieties in Peru by 62% of potato farmers	1.4.3 - Enhanced genetic gain; 1.4.2 - Closed yield gaps through improved agronomic and animal husbandry practices	http://hdl.handle.net/10568/83497	See narrative in section 1
A network of more than 270 economically viable decentralized seed multipliers in Kenya, Ethiopia and Malawi has been established and improved farmer access to quality seed potato.	1.3.1 - Diversified enterprise opportunities	Project reports	See narrative in section 1
Making 'invisible' woman's contributions to the value chain 'visible' with gender Responsive Tools: Experience from Roots, Tubers and Bananas Value Chains in Uganda and Ecuador	B.1.3 - Improved capacity of women and young people to participate in decision-making; D.1.1 - Enhanced institutional capacity of partner research organizations	http://gender.cgiar.org/webinar-gender-mainstreaming-participatory-market-chain-approach-pmca/	See narrative in section 1
Over 1,100 registered vine multipliers in 14 countries in SSA result in over 0.5 million households reached with improved sweetpotato varieties, mostly orange-fleshed types for nutrition enhancement.	1.3.1 - Diversified enterprise opportunities; 2.1.2 - Increased access to diverse nutrient-rich foods	Project reports	See narrative in section 1
Young women and men in Congo improve on-farm production and processing of cassava in 10 rural communities.	B.1.3 - Improved capacity of women and young people to participate in decision-making; 1.3.1 - Diversified enterprise opportunities	Project reports and newsletters	See narrative in section 1
Advocacy for biofortification strategies in Nigeria, Tanzania and Regional	C.1.3 - Conducive agricultural policy environment; D.1.1 - Enhanced institutional capacity of partner research organizations	Project reports and studies	See narrative in section 1

*Please submit outcome case studies in MARLO, MEL or other MIS, and provide links, using the outcome case study template.

TABLE B: STATUS OF PLANNED MILESTONES

FP	Mapped and contributing to Sub-IDO	2022 CRP outcomes (from proposal)	Milestone*	2017 milestones status	Provide evidence for completed milestones** or explanation for extended or cancelled
1	Enhanced genetic gains	Outcome 1,1: For each RTB crop, populations with at least 3 end-users preferred traits and adapted to 2 targeted regions are available (For more details please refer to Table FP1,4)	M1.1 Advanced tools applied for genomic mapping and editing for all RTB crops	**Completed**	DI1.2.1.2/10627 - Genome-Wide Association Mapping of Correlated Traits in Cassava: Dry Matter and Total Carotenoid Content (https://cgspace.cgiar.org/handle/10568/83065) this paper shows evidence that negative correlation between DM and carotenoid content in cassava is not a pleiotropic effect, and thus is possible to break this correlation by breeding. DI1.2.1.3/6334 - Candidate gene sequencing and validation of SNP markers linked to carotenoid content in cassava (Manihot esculenta Crantz) (https://doi.org/10.1007/s11032-017-0718-5) DI1.2.1.2/8845 - QTL markers associated with tolerance to cassava brown streak disease (CBSD), cassava mosaic disease (CMD), and cassava green mite (CGM) (https://cgspace.cgiar.org/handle/10568/82972) (https://cgspace.cgiar.org/handle/10568/82970). DI1.2.1.2/10912 - A time series transcriptome analysis of cassava (Manihot esculenta Crantz.) varieties challenged with Ugandan cassava brown streak (https://cgspace.cgiar.org/handle/10568/89689) DI1.2.3.2/11032 - Whole genome sequencing of guinea yam and marker development for sex determination (https://cgspace.cgiar.org/handle/10568/89726). DI1.2.3.2/6356 - Evolution of the banana genome (Musa acuminata) is impacted by large chromosomal translocations (http://hdl.handle.net/10568/81504).

FP	Mapped and contributing to Sub-IDO	2022 CRP outcomes (from proposal)	Milestone*	2017 milestones status	Provide evidence for completed milestones** or explanation for extended or cancelled
					DI1.2.5.1/6378 - Musa pan genome database developed (http://panmusa.greenphyl.org/).
1	Enhanced genetic gains Increased conservation and use of genetic resources	Outcome 1,2: Across RTB crops, average 25% reduction of time needed for traits discovery and incorporation into breeding pipelines	M1.2 Participatory methods for trait definition and selection (including at least 30% of female participants) used in at least (5) RTB/partners' joint assessments	**Completed**	DI1.1.3.2/8676 - Participatory Varietal Selection of potato clones using the Mother & Baby Trial design a gender responsive trainer's guide (http://hdl.handle.net/10568/81221) associated with the electronic field book and analytical software HIDAP (https://research.cip.cgiar.org/gtdms/hidap/) was used by researchers of CIP and partners in LAC (Peru and Colombia) and Asia (India, Nepal, Bhutan and Bangladesh). DI1.1.5.3/5837 - Participatory variety selection (PVS) process to identify and understand farmers criteria for selection and adoption of new yam varieties realized in West Africa (Nigeria and Ghana). (internal report)
1	Enrichment of plant and animal biodiversity for multiple goods and services	Outcome 1,3: Conservation status of wild relatives and landraces of at least 3 RTB crops improved in 3 key hotspots	M1.3 Best practices and existing systems for assessing and monitoring the conservation status of RTB wild relatives and landraces identified	**Completed**	DI1.4.1.2/5866 - Targeted exploration and collection missions (East coast of Papua New Guinea) for Musa wild and cultivar diversity (http://hdl.handle.net/10568/89857). DI1.4.3.1/8519 - MGIS: Managing banana (Musa spp.) genetic resources information (http://hdl.handle.net/10568/82646). DI1.4.3.5/5946 - Baseline catalogue for a Peruvian potato diversity hotspot (Junín) (http://hdl.handle.net/10568/89110). DI1.4.1.4/5883 - Training manual for hotspot based monitoring methods of potato diversity at different scales. (Reported file not uploaded in public repository)
1	Enhanced adaptive capacity to climate risks	Outcome 1,4: At least 20% of newly developed RTB breeding populations with enhanced resilience	M1.4 SMART targets for traits linked with enhanced resilience of RTB populations to climate	**Extended**	DI1.1.5.2/10634 - Roots, Tubers and Bananas: Planning and research for climate resilience. A six-step framework for climate-smart breeding is presented in this article (https://doi.org/10.1515/opag-2017-0039).

FP	Mapped and contributing to Sub-IDO	2022 CRP outcomes (from proposal)	Milestone*	2017 milestones status	Provide evidence for completed milestones** or explanation for extended or cancelled
	Enhanced capacity to deal with climatic risks and extremes	to climatic shocks available for testing in FP2	shocks formulated and included in breeding program designed for at least 2 RTB crops		DI1.1.2.1/5809 - Working Document on SMART* trait objectives for RTB crops Breeding (*Specific, Measurable, Attainable, Realistic, and Time bound) (Internal document). *Explanation: Preliminary review of ongoing RTB crops breeding programs and identification of SMART targets for traits is being realized.*
1	Enhanced institutional capacity of partner research organizations	Outcome 1,5: Collaboration for more effective breeding enhanced through a breeding community of practices including at least 40 stakeholders in 10 countries	M1.5 Breeding community of practice established in collaboration with at least 15 stakeholders in 6 countries	**Completed**	DI1.1.1.1/8659 and 11307 – Workshop Report: RTB Breeding community of practice and NextGen breeding clusters: foundation and planning workshop (http://hdl.handle.net/10568/89161) and Asia Cassava Breeder Network's Meeting Report, Bangkok, 3rd - 9th December, 2017 (http://www.acb-net.com/home/contact.aspx). Support to sweetpotato breeding CoP in Africa for germplasm sharing, variety development and training (http://www.sweetpotatoknowledge.org/topics/breeding/).
1	Enhanced individual capacity in partner research organizations through training and exchange	Outcome 1,6: Enhanced capacity in genomic selection and advanced breeding methods of at least 150 R&D partners, of which at least 30% are female, through short and long-term trainings	M1.6 Trainings for breeders and geneticists on gender roles and consumer preferences organized	**Completed**	Workshops and webinars organized within the framework of the CGIAR Gender and Breeding Initiative, coordinated by the RTB and CIP. (http://www.rtb.cgiar.org/gender-breeding-initiative/activities/) See also Table D, Indicator C-4, for more details
2	Diversified enterprise opportunities	Outcome 2,1: 20,000,000 people (4,000,000 HH), of which 50% are women, increased their annual income by increasing RTB sales and diversifying market strategies	M2.1 Rapid multiplication techniques for seed/planting material validated for at least 2 RTB crops and framework to support best fitting options for different seed	**Completed**	CA2.3.4.2/5108 - Three Semi-Autotropic Hydroponics (SAH) labs have been established in three locations in Nigeria. One in an international research center (IITA, Ibadan), another in a national research center (NRCRI, Umudike) and one in a private sector enterprise (Nigeria Flour Mills, Ilorin) as part of BASICS project. (Donor report). SW2.6.4.2/11421 - Sand, Storage, Sprouting: Triple S Flipchart (Flyer in MEL)

FP	Mapped and contributing to Sub-IDO	2022 CRP outcomes (from proposal)	Milestone*	2017 milestones status	Provide evidence for completed milestones** or explanation for extended or cancelled
			multipliers categories developed		SW2.6.4.2/ 8396 - Specialised Sweetpotato Vine Multiplication in Lake Zone, Tanzania: What "Sticks" and What Changes? (http://hdl.handle.net/10568/81127). YA2.7.3.1/5301 - Public and private partners trained to enhance technical capacity on functional aeroponics systems for pre-basic and basic seed yam production. Manual for aeroponics in Nigeria and Ghana (http://yiifswa.iita.org/wp-content/uploads/2017/10/Manual-for-Clean-Foundation-Seed-Yam-Final.pdf). YA2.7.3.1/5306 - Fully functional temporary Immersion Bioreactor systems (TIB) in the research institutes established and operational -24 units of the SETIS type Temporary Immersion Bioreactor System with 4 programmable logic control points were installed for production of Breeder seed yam plantlets at the National Centre for Genetic Resources and Biotechnology, and staff trained. Short report (Internal document) YA2.7.3.1/8687 - Semi-autotrophic hydroponics system (SAH) for yam multiplication evaluated- Yam SAH has proven to be as successful as cassava SAH showing good multiplication rates in the lab and produces seed tubers when transplanted to the field. Short report (Internal document)
2	Closed yield gaps through improved agronomic and animal husbandry practices Enhanced genetic gains	Outcome 2,2: At least 5,000,000 HH increased their annual RTB yield by at least 10%	M2.2 Crop-specific evidence collected on the effect of genotype, management and environment on seed degeneration rate	**Completed**	CC2.1.2.3/11268 - A Risk Assessment Framework for Seed Degeneration: Informing an Integrated Seed Health Strategy for Vegetatively Propagated Crops (http://hdl.handle.net/10568/81225). SW2.6.4.2/11555 - Effect of sources of sweetpotato planting material for quality vine and root yield (http://hdl.handle.net/10568/83095). Comparison of net tunnel material vs healthy looking vines from field for 4 varieties.

FP	Mapped and contributing to Sub-IDO	2022 CRP outcomes (from proposal)	Milestone*	2017 milestones status	Provide evidence for completed milestones** or explanation for extended or cancelled
2	Increased conservation and use of genetic resources	Outcome 2,3: Targeted breeding programs increased by 10% the diversity of the genetic base used (e.g. number of banana wild species used as parental lines)	M2.3 Gender-differentiated users-need and preferences for trait selection assessed in 4 countries and results communicated to orient breeding programs	**Extended**	BA2.2.6.4/5031 - Consumer preferences of EMBRAPA dessert bananas hybrids recorded in Uganda. (Summary report to donor). BA2.2.1.1/11147 - Tools for understanding the agricultural production systems and their socio-economic context in target regions for the introduction of new banana cultivars - Baseline intra-household survey – (http://hdl.handle.net/10568/89321) *Explanation: ongoing research and publications expected in 2018, additional funds mobilized through RTBFoods project.*
2	Increased availability of diverse nutrient-rich foods	Outcome 2,4: Annual production of at least one nutrient-rich RTB crop increased by 5-10% in 10 targeted countries	M2.4 At least one RTB candidate variety rich in vitamins and/or micronutrients proposed in (10) target countries for national trials	**Extended**	BA2.2.2.10/11146 - Sensory evaluation of provitamin A carotenoid-rich banana cultivars on trial for potential adoption in Burundi and Eastern Democratic Republic of Congo. (http://hdl.handle.net/10568/90576) BA2.2.3.5/4936-4937-4938 - Total carotenoid and pVAC content established in plantain 64 varieties, 58 hybrids and 50 diploid AA. Top 5 plantain varieties with highest mean total carotenoids can be considered for fast-track delivery of high provitaminA varieties. (Donor report) CA2.3.1.4/5079 - Biofortification regional trial report for Cameroon-multilocation trial results. (Summary technical report) Eight OFSP varieties released in Ethiopia, Tanzania and Madagascar in 2016/2017. (SPHI report, September 2017) *Explanation: OFSP and Vit-A rich cassava and banana varieties already released in more than 10 countries. Ongoing efforts to release further improved varieties and in more countries.*
2	Enhanced adaptive capacity to climate risks	Outcome 2,5: Capacity to deal with climate risks and extremes increased for at least 1,000,000 HH	M2.5 Climate responsive breeding targets developed for 3 RTB crops in at least 5 target environments	**Extended**	See M1.4 SMART targets for traits linked with enhanced resilience of RTB populations to climate shocks formulated and included in breeding program designed for at least 2 RTB crops

FP	Mapped and contributing to Sub-IDO	2022 CRP outcomes (from proposal)	Milestone*	2017 milestones status	Provide evidence for completed milestones** or explanation for extended or cancelled
	Enhanced capacity to deal with climatic risks and extremes				
2	Gender-equitable control of productive assets and resources	Outcome 2,6: At least 35% increase in number of female and young beneficiaries of at least 500,000 HH perceive to have better control over assets and resources	M2.6 Baseline of gender roles in seed multiplication and/or crop production and/or varietal selection available in five countries/crops	**Extended**	CC2.1.2.4/6265 - Best practice guidelines for integrating gender into seed systems and the RTB seed systems framework (file in MEL). https://mel.cgiar.org/uploads/reporting/7h5zuU40YNtr2WZ0an3zRIcyS3f9Nx.pdf CC2.1.2.4/10238 - Gender-responsive banana seed-system characterization in Uganda (file in MEL). https://mel.cgiar.org/uploads/reporting/KzA1SHo61cP7aIqvPHyBoYQo5zR1R0.docx *Explanation: Gender roles assessed in one country*
2	Conducive agricultural policy environment	Outcome 2,7: Regulatory frameworks for seed production and seed quality control (including QDS) under implementation in10 countries	M2.7 Regulatory frameworks for seed production and seed quality control (including QDS) under discussion in 5 countries	**Extended**	CC2.1.5.2/6294 - Certification guidelines for cassava in Tanzania (file in MEL). https://mel.cgiar.org/uploads/reporting/HzXJoXt3rKxIPkGBvW793djzhm7IhS.pdf Breeder and commercial cassava seed certification standards discussed with NASC officials (Nigeria) including training on certification protocols and facilitation of regional exchanges (fact finding trip in East African countries). (Donor report). CC2.1.6.2/6299 - Seed Tracker for RTB Crops (http://seedtracker.org/). *Explanation: Regulatory frameworks analyzed and under discussion in two countries*
2	Enhanced individual capacity in partner	Outcome 2,8: Every year, 8,000 R&D stakeholders (50% female) trained through short term	M2.8 75 individuals (50% female) trained through long term programs (e.g. MSc and PhD students)		See Table D, Indicator C-4, for more details

FP	Mapped and contributing to Sub-IDO	2022 CRP outcomes (from proposal)	Milestone*	2017 milestones status	Provide evidence for completed milestones** or explanation for extended or cancelled
	research organizations through training and exchange	programs on designing and implementing smallholder-oriented breeding programs and sustainable seed systems			
3	Reduced pre- and post-harvest losses, incl. climate change Closed yield gaps through improved agronomic and animal husbandry practices	Outcome 3.1: In areas affected by pests and diseases, RTB yield restored to pre-infection conditions for at least at least 1,500,000 farmer HH, of which at least 25% are female headed households	M3.1 Baseline of pest incidence and damage available for 4 countries	**Completed**	CC3.1.1.1/8890 - First Report of Cassava Common Mosaic Disease and Cassava common mosaic virus Infecting Cassava (Manihot esculenta) in Peru (https://doi.org/10.1094/PDIS-10-16-1540-PDN) CC3.1.3.1/2738 - Population structure of Ralstonia solanacearum in Peru (https://doi.org/10.3389/fpls.2017.01221) CC3.1.5.2/2784 - Phytoplasma infection of a tropical root crop triggers bottom-up cascades by favoring generalist over specialist herbivores (https://doi.org/10.1371/journal.pone.0182766) BA3.4.4.1/10626 - Relative susceptibility of Musa genotypes to banana bunchy top disease in Cameroon and implication for disease management (http://hdl.handle.net/10568/83214) CA3.6.2.1/10933-Spatial analysis of cassava mosaic disease epidemics (https://doi.org/10.1094/PHYTO-03-17-0105-FI) CA3.6.2.1/10941-Cassava mosaic begomoviruses and interactions with cassava varieties in Zambia (http://hdl.handle.net/10568/89937)
			M3.2 Global Pest Risk Analysis (PRA) available for at least 3 target RTB pests and diseases	**Extended**	CC3.1.2.1/2697 - PRA document for potato pests Tuta absoluta and Tecia solanivora for Kivu region (working document) CC3.1.2.1/2699-PRA for the bud midge Prodiplosis longifila for SSA countries (working document)

FP	Mapped and contributing to Sub-IDO	2022 CRP outcomes (from proposal)	Milestone*	2017 milestones status	Provide evidence for completed milestones** or explanation for extended or cancelled
					CC3.1.2.1/2701 – Pest Risk Analysis document for cassava green mite (Mononychellus mcgregori/ tanajoa) (working document) CC3.1.2.2/2708 - Pest Risk Analysis for Xanthomonas campestris pv. musacearum, causative organism of Xanthomonas wilt on banana plants-for-planting (working document) 2711-PRA documents for banana diseases (Xanthomonas Wilt of Banana, BBTD and Fusarium TR4) in east and central Africa finalized (working document) *Explanation: PRAs in draft form. To be finalized and made publicly available.*
3	Increased resilience of agro-ecosystems and communities, especially those including smallholders	Outcome 3.2: 1,800,000 ha of current RTB production area converted to sustainable cropping systems	M3.3 At least 5 gender-sensitive and site-specific practices for crop, soil fertility and water management tested under diverse agro-ecologies	**Completed**	CC3.1.5.7/2864 - IPM strategies for RTB production systems (https://cgspace.cgiar.org/handle/10568/91969). CC3.1.5.7/2867, 2868, 2869 - Hand held decision support systems for potato late blight management (http://cip.mentagalactica.com/index.html). CC3.2.1.1/8829, 8830, 8832 - Smartphone-based decision support tool (beta version) with suite of SOPs, ODK forms and training material for standardized data collection in cassava agronomy trials (https://mel.cgiar.org/uploads/reporting/S0meufttr2Fhpr6ri5JhzScRVOkldJ.pdf) BA3.3.5.1/8620, 8621, 8623 - Symptomless banana suckers sourced from Xanthomonas wilt infected fields are a viable alternative for seed within infected banana-based landscapes lacking access to clean planting materials (http://hdl.handle.net/10568/89644). A control package revolving around the removal of single diseased banana stems is effective for the restoration of Xanthomonas wilt infected fields (http://hdl.handle.net/10568/82867). Bacterial diseases of bananas and enset: current state of knowledge and integrated approaches toward sustainable management (http://hdl.handle.net/10568/82896).

FP	Mapped and contributing to Sub-IDO	2022 CRP outcomes (from proposal)	Milestone*	2017 milestones status	Provide evidence for completed milestones** or explanation for extended or cancelled
					CA3.6.3.3/4619 - Community phytosanitation to manage cassava brown streak disease (http://dx.doi.org/10.1016/j.virusres.2017.04.020)
3	Enhanced adaptive capacity to climate risks Enhanced capacity to deal with climatic risks and extremes	Outcome 3.3: Capacity to deal with climate risks and extremes increased for at least 1,000,000 HH	M3.4 Downscaled climate change models linked to insect disease modelling for at least 5 major pest/regional combinations	**Extended**	CC3.1.4.1/8528, 8529, 8531 - A new module called "Geographical simulation by point" was added to ILCYM software. It allows to easily locate the estimated risk index values in georeferenced points and is linked to the temperature database. (https://research.cip.cgiar.org/confluence/display/ilcym/Home) CC3.2.1.6/9036 - Climate change impact on global potato production (https://doi.org/10.1016/j.eja.2017.11.008). See also: M3.2 Global Pest Risk Analysis (PRA) available for at least 3 target RTB pests and diseases
3	Gender-equitable control of productive assets and resources	Outcome 3.4: New technologies and practices have been equally adopted women and men farmers	M3.5 Gender differentiated needs assessment of capacity development available in at least 8 pest/country combinations		BA3.4.5.3/9084, 9085 - Baseline study to evaluate gender dynamics in banana seed systems in Cameroon, Nigeria and Benin + Lessons on gender-responsive approaches in banana seed systems management (internal reports) CC3.1.2.3/8743 - Crowd-sourcing platform (http://www.pestdisplace.org)
3	Conducive agricultural policy environment	Outcome 3.5: 25 National and 5 regional plant protection agencies with strategies for containment and management under implementation	M3.6 Cost effective diagnostic tools and protocols developed for at least 3 key pests and diseases	**Completed**	CA3.6.2.1/10935 - Transfer learning to develop artificial intelligence systems for diagnosing cassava diseases (https://doi.org/10.3389/fpls.2017.01852). BA3.4.3.1/3258-Digital diagnostics platform for BBTV surveillance and diagnosis. The Crop Disease Surveillance (CDS) is a digital application for rapid reporting of pest occurrence and pest diagnosis by visual inspection of 'specimens' submitted as 'digital images'. The CDS app can be used with any internet enabled device such as smartphone, tablet, computer or other. The CDS features enable follow-up inspections, lab confirmatory testing, and solutions to prevent and control crop pests. (Brochure in MEL) (https://mel.cgiar.org/uploads/reporting/6a4F2bUvi9UlvDH9mNerWY0d5AsmK6.pdf)

FP	Mapped and contributing to Sub-IDO	2022 CRP outcomes (from proposal)	Milestone*	2017 milestones status	Provide evidence for completed milestones** or explanation for extended or cancelled
					CC3.1.5.7/2867, 2868, 2869 - Hand held decision support systems for potato late blight management (http://cip.mentagalactica.com/index.html).
3	Increased capacity for innovation in partner development organizations and in poor and vulnerable communities	Outcome 3.6: Growing number of extension services (governmental org., NGOs and private sector) providing advice on improved ICM and IPDM increased	M3.7 Engagement of stakeholders in impact pathway analysis for ICM/IPDM in at least 3 cluster/country combination	**Completed**	BA3.3.1.2/11080-Proceedings for 3.3 Banana Wilts Cluster Planning meeting (available in MEL). Stakeholder workshop analyzed current situation and future actions for blood disease, bugtok, Foc TR4 and bacterial wilts (BXW) in Malawi, Mozambique, Tanzania, Uganda, China, India, Indonesia, Philippines and Australia. CA3.5.1.2/2957-Mitigation plan for CMD outbreaks in Cambodia (internal document)
4	Diversified enterprise opportunities	Outcome 4.1: 700,000 households, 25% of which are female headed, have increased their income by 15-20% by increasing and diversifying RTB sales (food, feed, industrial raw material and seeds)	M4.1 RTB value chains, including processing supply chains and fresh market chains, analyzed in 5 countries, with a gender-sensitive approach, to identify opportunities for products improvement/ development	**Completed**	CC4.1.3.6/11337 - Economic Viability of Ware Potato Storage in Ambient Stores in Eastern Uganda (http://hdl.handle.net/10568/88017). CC4.1.3.6/11338 - Market and Value Chain Analysis of Ware Potato from Eastern Uganda with a focus on postharvest management practices and losses (http://hdl.handle.net/10568/89337) SW4.4.2.3/9067 – Project report – Gender-sensitive development of roots and tuber crops (cassava, potato, sweetpotato) in Malawi. (Internal document) CA4.2.5.1/10854 - Analysis of the cassava value chain in Ivory Coast (external link) CA4.2.5.2/11148 - Gender analysis of cassava production and processing into gari in Central and Southern Benin (file in MEL) CA4.2.5.2/4854 - Consumption patterns of ugali in Tanzania by gender, social level and age. Working papers (files in MEL)

FP	Mapped and contributing to Sub-IDO	2022 CRP outcomes (from proposal)	Milestone*	2017 milestones status	Provide evidence for completed milestones** or explanation for extended or cancelled
4	More efficient use of inputs	Outcome 4.2: 20,000 small scale processors, 30 % of which are female, reduced water- and energy- related production costs by 15-20% in cassava sector with growing spillover in other RTB crops	M4.2 Baseline of efficiencies and processing losses available for 5 local SME types in 3 countries	**Extended**	CA4.2.1.2/4813 - Publication on Physical Properties of cassava grits before and after pneumatic drying (https://doi.org/10.1111/jfpe.12397) CA4.2.1.2/4814 - MSc thesis: Effect of cassava root hardness on rasping performance (file in MEL) CA4.2.1.4/4817 - Improved energy performance of small-scale pneumatic dryers used for processing cassava in Africa (http://dx.doi.org/10.1016/j.biosystemseng.2016.10.001) *Explanation: Further assessment and equipment adaptation planned in 2018.*
4	Reduced pre- and post-harvest losses, incl. climate change	Outcome 4.3: Post-harvest physical and quality losses reduced in at least 10 countries through better post-harvest management, improved storage, and utilization of waste across RTB crops	M4.3 RTB value chains analyzed in 5 countries to identify priority entry points for reducing post-harvest losses, improving storage, and stepping up waste utilization	**Completed**	CC4.1.3.1/11047 - Reducing postharvest losses and promoting product differentiation in the cooking banana value chain (http://hdl.handle.net/10568/82704, http://hdl.handle.net/10568/89514). CC4.1.3.5/11311 - Sweet potato wastes in major pig producing districts in Uganda: an opportunity for investment in silage technologies (http://hdl.handle.net/10568/89395) CA4.2.4.2/4847 - Technical data on wastewater from selected cassava processing technologies. Thesis (file in MEL) See also: M4.1 RTB value chains, including processing supply chains and fresh market chains, analyzed in 5 countries, with a gender-sensitive approach, to identify opportunities for products improvement/ development
4	Optimized consumption of diverse nutrient-rich foods	Outcome 4.4: Diet quality indices increased by 20% for at least 2,000,000 farmer households and urban/rural consumers	M4.4 For ongoing dissemination of OFSP, biofortified cassava, and other nutritious RTB crops: nutrition education/counseling and SBCC methodologies, partnerships, metrics and	**Completed**	CA4.3.5.1/6536 – Country (Nigeria and Tanzania) and regional advocacy plans for scaling up biofortified crops for nutrition security (file in MEL) CA4.3.5.3/6543 - Nutrition education for behavior change communication (BCC) programs. (https://cipotato.org/bnfb/four-orange-fleshed-sweetpotato-ofsp-vines-gold-capacity-development-impact/)

FP	Mapped and contributing to Sub-IDO	2022 CRP outcomes (from proposal)	Milestone*	2017 milestones status	Provide evidence for completed milestones** or explanation for extended or cancelled
			results documented and analyzed in 10 countries		Report: A situational Analysis of Regional Investments, Policies, Legislation and Advocacy Efforts on Food-based Approaches to Combating Micronutrient Deficiency in Sub-Saharan Africa: Focus on Biofortification (external link) SW4.4.1.1/5254 - Nutrition education and counseling model for out-scaling in Tanzania. Internal report on activities organized to improve nutritional knowledge and practices and diversified use of OFSP by both female and male caregivers of children under 5 years. (internal document – VISTA project). SW4.4.1.1/9079 - Design and develop at least 3 nutrition sensitive SBCC and Information, Education and Communication (IEC) materials. - Video in Swahili -add English subtitles and post on-line - Draft Recipe book - MISST Project Orange-Fleshed Sweet potato (OFSP), Soya Beans, Millet, Sorghum, Pigeon Peas, Quality Protein and Provitamin a Maize; utilization and Processing SW4.4.3.2/13430 - An Orphan Crop, The Orange-Fleshed Sweet potato, in West Africa: Can We Reposition it? (http://www.rroij.com/open-access/an-orphan-crop-the-orangefleshed-sweet-potato-in-west-africacan-we-reposition-it-.pdf)
4	Gender-equitable control of productive assets and resources	Outcome 4.5: At least 35% increase in number of women and youth beneficiaries in at least 200,000 HH who perceive to have better control over assets and resources	M4.5 Gender analysis of RTB value chains and RTB post-harvest intervention approaches documented in 4 countries	**Completed**	See also: M4.1 RTB value chains, including processing supply chains and fresh market chains, analyzed in 5 countries, with a gender-sensitive approach, to identify opportunities for products improvement/ development and Milestone 5.6 CC4.1.5.1/10987 - Formative Gender Evaluation: Technical Report on the Viable Sweetpotato Technologies in Africa – Tanzania project (http://hdl.handle.net/10568/82707)

FP	Mapped and contributing to Sub-IDO	2022 CRP outcomes (from proposal)	Milestone*	2017 milestones status	Provide evidence for completed milestones** or explanation for extended or cancelled
					Blog: Creating a niche for acceptance of vitamin A cassava in Nigeria: Women as key actors (https://greatagriculture.org/content/news/blog/creating-niche-acceptance-vitamin-cassava-nigeria-women-key-actors) SW4.4.1.3/5262 - Commercialization of Sweetpotato based silage: can women entrepreneurs compete favorably? (internal document) CC4.1.5.1/4571 - Gender mainstreamed guidelines for designing RTB post-harvest technologies and RTB interventions in Uganda (file in MEL). CC4.1.5.1/11258 - Assessing selected agricultural policies for gender-responsive upgrading of the cooking banana value chain (internal document)
4	Conducive agricultural policy environment	Outcome 4.6: Food-based nutrition programs/ initiatives promoting RTB crops under implementation in at least 10 countries	M4.6 RTB crops and products compliant with national nutrition and safety standards for inclusion in mainstream national nutrition programs in at least 2 countries	**Completed**	CC4.3.1.2/6514 - Report on Genotypes with best physiochemical properties identified. Evaluation of proximate composition and pasting properties of high quality cassava flour (HQCF) from cassava genotypes (Manihot esculenta Crantz) of b-carotene-enriched roots (http://hdl.handle.net/10568/83228). CA4.2.2.1/4819 - Nutritional and sensory properties: Snack food made from high-quality cassava flour and legume blend (http://dx.doi.org/10.1002/fsn3.464) Consumer's acceptability and willingness-to-pay for composite bread baked with high quality cassava flour from yellow-fleshed cassava roots http://hdl.handle.net/10568/91691 CA4.2.3.3/10857 - Retention of Pro-vitamin A carotenoid in Composite Bread baked with High Quality Cassava Flour from Yellow-fleshed Cassava Roots. Working paper presented at the 13th Triennial Symposium of the International Society for Tropical Root Crops-Africa Branch, White Sands Hotel, Dar es Salaam, Tanzania, March 5 – 10, 2017.

FP	Mapped and contributing to Sub-IDO	2022 CRP outcomes (from proposal)	Milestone*	2017 milestones status	Provide evidence for completed milestones** or explanation for extended or cancelled
					SW4.4.2.2/9071 - Root and tuber crops for agricultural transformation in Malawi RTC-ACTION Malawi - Semiannual report (homemade products such as doughnuts, juice, porridge, and mandazi (pancakes) + OFSP purée and cookies) (donor report). SW4.4.2.2/5269 - Food safety knowledge, attitude and practices of orange flesh sweetpotato puree handlers in Kenya (http://hdl.handle.net/10568/91984). CC4.1.2.1/ 9344 - Effects of Simulated Human Gastrointestinal Digestion of Two Purple-Fleshed Potato Cultivars on Anthocyanin Composition and Cytotoxicity in Colonic Cancer and Non-Tumorigenic Cells. (https://doi.org/10.3390/nu9090953)
4	Increased capacity for innovation in partner development organizations and in poor and vulnerable communities	Outcome 4.7: 60 development-focused organizations, including women's networks and alliances, having increased their capacity for innovation (e.g. enhanced human capital and improved collaboration network in relevant domains) to scale up fuller utilization of RTB	M4.7 Partnership models and value chain approaches tested to strengthen institutional capacity for scaling	**Completed**	CA4.2.4.1/10974 - Scaling HQCP mash production in Nigeria and Tanzania: creating new enterprises – engaging processors. (file in MEL) SW4.4.3.2/5279 - From lab to life: Making storable orange-fleshed sweetpotato purée a commercial reality (http://hdl.handle.net/10568/91985) Tackling vitamin-A deficiency with biofortified sweetpotato in sub-Saharan Africa (https://cgspace.cgiar.org/handle/10568/81126) Success Factors for Commercializing Agricultural Research. Lessons from Feed the Future Partnering for Innovation (link) SW4.4.3.4 – Does Information on Food Production Technology Affect Consumers' Acceptance of Biofortified Foods? Evidence from a Field Experiment in Kenya (https://doi.org/10.1080/10496505.2017.1383914) Effect of Farmers' Multidimensional Beliefs on Adoption of Biofortified Crops Evidence from Sweetpotato Farmers in Tanzania (http://hdl.handle.net/10568/90959)

FP	Mapped and contributing to Sub-IDO	2022 CRP outcomes (from proposal)	Milestone*	2017 milestones status	Provide evidence for completed milestones** or explanation for extended or cancelled
5	Diversified enterprise opportunities	Outcome 5.1: Income increased by 20% for at least 550,000 HH	M5.1 Trade-offs and synergies among different SDI options for market-driven household income improvement in RTB-based farming systems analyzed in at least 2 target countries	**Completed**	CC5.2.2.1/7543 - Effects of Xanthomonas wilt and other banana diseases on ecosystem services in banana-based agroecosystems (Conference paper http://library.wur.nl/WebQuery/wurpubs/511969) Agro-ecological integration of shade- and drought-tolerant food/feed crops for year-round productivity in banana-based systems under rain-fed conditions in central Africa (Conference paper http://library.wur.nl/WebQuery/wurpubs/511968)
5	Closed yield gaps through improved agronomic and animal husbandry practices	Outcome 5.2: Whole-farm productivity increased by 25% for at least 1,000,000 HH	M5.2 Scaling strategies assessed and recommendations formulated in at least two technology x country combinations	**Completed**	CC5.4.2.3/7083 - Scaling readiness: Accelerating the scaling of RTB interventions. Newsletter No.3 (http://hdl.handle.net/10568/90666)
5	Optimized consumption of diverse nutrient-rich foods	Outcome 5.3: Diet quality indices increased by 20% for at least 300,000 farmer households	M5.3 Partnership arrangements in RTB-related agriculture for nutrition interventions documented in target countries	**Completed**	See: M4.7 Partnership models and value chain approaches tested to strengthen institutional capacity for scaling
5	Agricultural systems diversified and intensified in ways that protect soils and water	Outcome 5.4: Improved soil management practices adopted on at least 200,000 ha cultivated by smallholder farmers	M5.4 In at least 3 RTB-related farming systems, effects of selected SDI approaches on soil water and nutrient cycles assessed and documented	**Completed**	CC5.2.1.1/7536 - Characterization of potato-based systems. Key ecosystem services and ecological intensification of agriculture in the tropical high-Andean Puna as affected by land-use and climate change (https://cgspace.cgiar.org/handle/10568/80557) Soil organic carbon stocks and fractionation under different land uses in the Peruvian high-Andean Puna (https://cgspace.cgiar.org/handle/10568/90584) SWOT analysis of potato cultivation under arid conditions in western Rajasthan (India) (https://cgspace.cgiar.org/handle/10568/90670) CC5.2.1.1/7537 - Typologies of RTB systems based on agrobiodiversity trends. Farming and the geography of nutrient production for human use: a transdisciplinary analysis (http://hdl.handle.net/10568/80813)

FP	Mapped and contributing to Sub-IDO	2022 CRP outcomes (from proposal)	Milestone*	2017 milestones status	Provide evidence for completed milestones** or explanation for extended or cancelled
					Dietary species richness as a measure of food biodiversity and nutritional quality of diets (http://hdl.handle.net/10568/89861) CC5.2.2.2/7549, 10536 - The Role of RTB in livelihoods in North West Vietnam - Opportunities for SID for better nutrition. Report - Using Optifoods to Model Potential of Roots, Tubers and Bananas to Improve Diet Quality (Working paper) Report - The Role of Roots, Tubers, and Bananas in the Diets of Children And Women in Mai Son, Vietnam (Working paper) Blog: https://www.bioversityinternational.org/news/detail/improving-diets-in-vietnam-with-roots-tubers-and-bananas/ CC5.2.2.2/9089 - An Innovative Approach to Sustainable Intensification: Using Diets as an Entry Point (Working paper)
5	Enhanced adaptive capacity to climate risks Enhanced capacity to deal with climatic risks and extremes	Outcome 5.5: Capacity to deal with climate risks and extremes increased for at least 500,000 HH	M5.5 Households options for improving their resilience to climate risks and extremes assessed in RTB-related farming systems in 5 countries		CC5.3.1.7/10929 - Indigenous Knowledge Systems and Climate Change Management in Africa (Book) (https://publications.cta.int/en/publications/publication/2009/)
5	Gender-equitable control of productive assets and resources	Outcome 5.6: At least 35% increase in number of female and young beneficiaries of at least 200,000 HH perceive to have better control over assets and resources	M5.6 Gender-responsive assessments of RTB value chains realized in at least two countries	**Completed**	See also Milestone 4.5 SW4.4.3.2/5279 - Mudege, Netsayi N. Sarah Mayanja, and Tawanda Muzhingi, 2017. Women and men farmer perceptions of economic and health benefits of orange fleshed sweet potato (OFSP) in Phalombe and Chikwawa districts in Malawi. (http://hdl.handle.net/10568/80900) Mayanja, S., Grant, F.K., Kakuhenzire, R. & Okuku, H.S. (2017). Rapid market assessment: Viable Sweetpotato. Technologies in Africa – Tanzania. Technical

FP	Mapped and contributing to Sub-IDO	2022 CRP outcomes (from proposal)	Milestone*	2017 milestones status	Provide evidence for completed milestones** or explanation for extended or cancelled
					Report. International Potato Center (CIP). (http://hdl.handle.net/10568/89085)
5	Improved capacity of women and young people to participate in decision-making	Outcome 5.7: RTB delivery flagships and at least 55 research and development partner organizations with more gender-responsive planning and implementation processes, reflected in at least 5 additional collaborative arrangements with public sector and civil society organizations supporting gender transformation	M5.7 Tools and methods for CapDev on gender responsive and transformative approaches developed	**Completed**	GBI newsletters and webinars: http://www.rtb.cgiar.org/gender-breeding-initiative/ CC4.1.5.1/4571 - Gender mainstreaming in root, tuber and banana crops' postharvest technologies and interventions: Identification of lessons learnt and gaps. Lima (Peru). CGIAR Research Program on Roots, Tubers and Bananas (RTB). RTB Working Paper (http://hdl.handle.net/10568/89806) CC5.3.1.5/7641 - The role of gender norms in access to agricultural training in Chikwawa and Phalombe, Malawi (https://cgspace.cgiar.org/handle/10568/89051) CC5.3.2.1/4574 - CRP Report on gender and other social determinants of agricultural innovations among farmers in RTB systems (GENNOVATE). (https://cgspace.cgiar.org/handle/10568/83498) Blog: Mudege, Netsayi N and S Mayanja (2017) Why gender matters in collective marketing http://www.rtb.cgiar.org/blog/publication/gender-matters-collective-action-agricultural-innovation/ Blog: Mudege, Netsayi N (2017) Why gender matters in developing post-harvest technologies http://www.rtb.cgiar.org/blog/publication/gender-matters-developing-post-harvest-technologies/ Video: Why gender matters agricultural research https://youtu.be/xKhzRikEoQo Video: Why is gender important for agricultural research https://www.youtube.com/watch?v=fUaPUfRNeyI

FP	Mapped and contributing to Sub-IDO	2022 CRP outcomes (from proposal)	Milestone*	2017 milestones status	Provide evidence for completed milestones** or explanation for extended or cancelled
					Video: What did you learn from the gender training and how do you use it in your work? https://youtu.be/5tISoc95Fqo Kawarazuka, N., Kharlyngdoh, A., Marbaniang, E., Syndor, A. (2017). Gender-responsive participatory videos: a guide for facilitators. English and Vietnamese versions available at https://genderinagr.wordpress.com/other-document/
5	Increased capacity of beneficiaries to adopt research outputs	Outcome 5.8: At least 66 cases where RTB crops/technologies are newly included in policies or programs executed by government agencies, NGOs, and/or private sector	M5.8 At least 1 systems innovation coalition established in 5 countries selected for site integration and problem identification and prioritization exercises conducted	**Completed**	CC5.4.2.3/7091 - Synthesis of mature multi-stakeholder collaborations and platforms in AR4D (http://hdl.handle.net/10568/78379) CC5.4.2.3/7093 - Synthesis of innovation platform compositional dynamics (http://hdl.handle.net/10568/80715) CC5.4.2.3/7092 - Second Edition of Rapid Appraisal of Agricultural Innovation Systems (RAAIS) toolkit (http://hdl.handle.net/20.500.11766/7525) CC5.4.2.3/7090 - Guidelines for effective use of multi-stakeholder platforms in AR4D (http://hdl.handle.net/10568/82550)
			M5.9 At least 4 ex post impact studies completed	**Completed**	See Table I-1 for more details
5	Enhanced institutional capacity of partner research organizations Enhanced individual capacity in partner research	Outcome 5.9: At least 1,500 research/development staff in RTB and in mixed-type partner organizations across prime target countries with strengthened research and innovation capacities including gender-responsive and transformative research	M5.10 20 individuals (50% female) trained through long term programs (e.g. MSc and PhD students)		See Table D, Indicator C-4, for more details

FP	Mapped and contributing to Sub-IDO	2022 CRP outcomes (from proposal)	Milestone*	2017 milestones status	Provide evidence for completed milestones** or explanation for extended or cancelled
	organizations through training and exchange				
5	Increased capacity for innovation in partner development organizations and in poor and vulnerable communities	Outcome 5.10: At least 5 partnerships and scaling models tested in a minimum of 5 target countries and adjusted to be fit for purpose	M5.11 Comparative assessment of scaling models (desk study)	**Completed**	CC5.4.2.EF2/10837 - What kinds of 'systems' are we dealing with? Implications for systems research and scaling (http://hdl.handle.net/10568/90255) CC5.4.2.EF2/10836 - Systems research in the CGIAR as an arena of struggle: competing discourses on the embedding of research in development (https://blackwells.co.uk/bookshop/product/Agronomy-for-Development-by-James-Sumberg-editor/9781138240315) CC5.4.2.EF2/10835 - Reforming the research policy and impact culture in the CGIAR: Integrating science and systemic capacity development (http://hdl.handle.net/10568/88119) Hermans F, Sartas M, van Schagen B, van Asten P, Schut M (2017) Social network analysis of multi-stakeholder platforms in agricultural research for development: Opportunities and constraints for innovation and scaling. PLoS ONE 12(2): e0169634. (https://doi.org/10.1371/journal.pone.0169634)

* Milestones include both outputs, output use and outcomes along the impact pathways.
** Provide link to any relevant open accessible document.

TABLE C: CROSS-CUTTING ASPECT OF OUTPUTS

Cross-cutting	Number (%) scored 2 (Principal)	Number (%) scored 1 (significant)	Number (%) scored 0	Total overall number of outputs
Gender	21 (6%)	54 (16%)	262 (78%)	337
Youth	5 (1%)	17 (5%)	315 (93%)	
CapDev	27 (8%)	75 (22%)	235 (70%)	

The main areas where outputs have been scored as principal for **gender** relevance are:

1) **breeding and variety selection.** Here the focus is on the identification of gender-differentiated constraints and needs that may help in orienting breeding targets (examples are: CA2.3.3.1 - Prioritized cassava breeding traits utilizing data to support gender disaggregated trait preferences in at least two countries; BA2.2.1.2 - Gender-differentiated constraints/expectations/priorities of farmers and other actors of local banana value-chain in the Caribbean documented) and on the development of tools and approaches to implement gender-sensitive variety selection (examples are: DI1.1.3.2 - Trait dictionary and ontology with gender-responsive scoring for Participatory variety selection (PVS) for RTB crops is available in the Crop-Ontology platform for use by RTB trial management systems; DI1.1.3.8 - Methodologies for the inclusion of gender integrated data from PVS into RTB crop breeding);
2) **seed systems.** Here the gender-sensitive research work focus on the identification and development of methods and best practices for assessing and mainstreaming gender equity in the seed system interventions (examples are: CC2.1.1.1 - Protocol to understand the complementarity among the linked products, combine and use them in a systematic way and gender responsive way; CC2.1.2.4 - Best practice guidelines for integrating gender into seed systems ; CC2.1.4.1 - Characterization of seed systems at farm and community level (informal and interface informal / formal; PO2.5.3.1 - Identify gender-based constraints and opportunities and provide gender-responsive interventions);
3) **pest and disease management.** Better understanding of gender roles in production systems and development of gender-sensitive practices characterize this research area (examples are: BA3.3.3.3 - Gender roles and contribution in production recovery and in improving banana-based household livelihoods; CC5.2.1.1 - Characterization of RTB farming households and existing sustainable intensification and diversification interventions.BA3.4.5.3 - Tools for analysis of role of gender and generation in banana and cropping system management, banana marketing and in community BBTD recovery strategies; CC3.1.1.4 - Gender-responsive research protocols, methods, guidelines and manuals developed to strengthen research and impact of IPM; CC3.1.5.1 - Farmers pest and disease management practices in RTB crops and gender related aspects evaluated and documented for at least 12 targeted countries in Africa, Asia and Latin America);
4) **inclusive value chains.** Methodologies and tools are developed to assess and support the design of market-oriented interventions. (examples are: CA4.2.5.2 - Case study on the gender implications of the transition from traditional to industrial cassava markets in at least two countries: Surveys and data interpretations; CA4.3.3.1 - Gender-sensitive tools to identify key acceptability criteria of biofortified cassava varieties by end users and consumers, for different types of cassava-based products; CC4.1.5.1 - Guidelines for designing gender responsive post-harvest technology and RTB innovations to improve marketing and value addition for RTB products; CC4.1.5.3 - Improved methods for value chain development: The case of the gender sensitive Participatory Market Chain Approach);
5) **design and implementation of gender-sensitive R4D initiatives**. Evidences on the effects on gender equity are provided and recommendations formulated to foster gender-sensitive and gender-transformative approaches (examples are: CC4.1.5.2 - Recommendations to contribute to the design of research and development initiatives that promote agricultural innovation linked to food security

and nutrition with a gender perspective; CC5.3.2.2 - Journal papers and policy briefs on the role of gender norms in agricultural transformation and women empowerment targeting policy makers and donors; CC5.3.2.4 - Gender and technology development and adoption; CC5.3.4.1 - Capacity development materials and approaches on strategic gender and youth research and gender data analysis developed and tested in the different flagships).

The main areas where outputs have been scored as principal for **youth** relevance are:

1) **Strategy and framing document.** (CC5.3.3.1 - Strategy for improving youth's access to productive resources and decision-making processes at household community, farm and landscape level developed and shared with next users; CC5.3.3.2 - A framework for private public partnerships to promote youth employment and agripreneurship);
2) **capacity development approaches.** (CC5.3.4.1 - Capacity development materials and approaches on strategic gender and youth research and gender data analysis developed and tested in the different flagships; CC5.3.3.3 - Establishing global youth connections).

The main areas where outputs have been scored as principal for **capacity development** relevance are:

1) **networks and platforms.** (examples are: DI1.1.1.2 - Web-based portal for repository of contacts, protocols, tools and training materials for clonal crop breeding; DI1.2.5.2 - Open access databases for management of phenotypic and genotypic information with integrated analysis and decision support tools; SW2.6.5.3 - Intensification of sweetpotato breeders network in Asia; YA2.7.1.1 - Network of yam breeding programs in West Africa sharing germplasm, testing advanced clones and releasing varieties; BA2.2.4.4 - Comprehensive portal on wild Musa species; CC3.1.1.1 - Knowledge bank (online data bank) for PRAs, surveillance, diagnostics, species distribution, pest and disease modeling and risk mapping, new and updated IPM strategies in RTB crops generated, and regularly updated; CC5.4.3.2 - Well-functioning ProMusa platform).
2) **capacity development approaches and toolkits.** (examples are: CC2.1.2.4 - Best practice guidelines for integrating gender into seed systems and the RTB seed systems framework are developed and shared with scientists and partners working on seed systems; CA3.5.2.3 - User-friendly toolkits & associated adult education materials for disease surveillance & diagnostics devised and tested in at least 2 target countries of Asia and Latin America (2018); CA4.2.2.1 - Participatory approach with processors and consumers in the adoption of an improved variety or technological process developed and tested in at least two countries for a combination of two varieties and two processes; CC5.3.4.1 - Capacity development materials and approaches on strategic gender and youth research and gender data analysis developed and tested in the different flagships).

TABLE D: COMMON RESULTS REPORTING INDICATORS

DATA COLLECTION ON THESE INDICATORS IS ONGOING

TABLE D-1: KEY CRP RESULTS FROM 2017, IN NUMBERS

Please complete the table on the common reporting indicators below. See instructions in separate guidance in the common results indicators manual (available early 2018). Please note that supporting evidence must either be uploaded to an MIS system (MARLO, MEL or others) or keep evidence on file for possible checking.]

Sphere	Indicators	Data	Comments
Influence	I1/I2*. Projected uptake (women and men) /hectares from current CRP investments (for innovations at user-ready or scaling stage only – see indicator C1)		
	I3. Number of policies/ investments (etc) modified in 2017, informed by CGIAR research	(1) A national advocacy brief prepared by the Federal Ministry of Budgets and Planning in Nigeria, (2) The food security and nutrition strategy (2016–2025) of the Federal Ministry of Agriculture and Rural Development of Nigeria (FMARD) and (3) The Ministry of Agriculture, Livestock and Fisheries' Food Security plan and the Food and Nutrition Centre (TFNC) 5-year strategic plan in Tanzania.	Ref. Outcome case study: Advocacy for biofortification strategies in Nigeria, Tanzania and Regional
Control	C1. Number of innovations by phase - new in 2017	(2) Stage 1: end of research phase (1) Stage 2: end of piloting phase (6) Stage 2: end of piloting phase (22) Stage 3: available for uptake (17) Stage 4: uptake by next user (48) Total	
	C2. Number of formal partnerships in 2017, by purpose (ongoing + new)	(77) Phase 1: Discovery/Proof of concept (37) Phase 2: Piloting (7) Phase 2: Piloting & Phase 3: Scaling up and scaling out (97) Phase 3: Scaling up and scaling out (218) Total	
	C3. Participants in CGIAR activities 2017 (new +ongoing)	Trials and studies: TOT 2,011 (NA% Women) Knowledge exchange: TOT 12,826 (NA% Women) Scaling activities: TOT 52,977 (NA% Women)	
	C4. People trained in 2017	Academic Degree (PhD, MSc, BSc): TOT 222 (43% Women) Research placement or training visit: TOT 75 (41% Women) Short term trainings: TOT 53,500 (NA% Women)	
	C5. Number of peer-reviewed publications	TOTAL 132 peer reviewed journal articles published in 2017 [link to full list of CRP publications] of which 110 (83%) are published in ISI journals of which 103 (78%) are open access	682 authors from 65 organizations contributed in the journal articles in the list
	C6. Altmetrics	See narrative assessment in the box below	

*Please note: I = Sphere of Influence and C = Sphere of Control

C6. Altmetric Narrative assessment

With an overall attention score of 103 points, RTB's top scoring publication in 2017 was 'Genomic prediction unifies animal and plant breeding programs to form platforms for biological discovery' published in journal Nature Genetics. Altmetric registered two news stories about the publication, although one is in fact a press release published on the website of the UK Biotechnology and Biological Sciences Research Council, which was involved with the study, and the other is a republishing of that release by the website SeedQuest. Altmetric also registered one blog about the publication, which was actually the same press release it already captured as a news story, raising questions around the accuracy of scoring. The research received significant social media attention with 148 tweets and one public Facebook post, following promotion by the authors and their respective institutions. It should also be noted that this publication was found through a manual search and was not included in the list of RTB publications exported from Altmetric, despite being tagged RTB and featuring in the program's CGSpace collection. It is unclear why it was not captured in the Altmetric export and whether other high-ranking publications may have been missed.

The second highest scoring RTB publication with 46 points was 'Evolution of the banana genome (Musa acuminata) is impacted by large chromosomal translocations' published in the journal Molecular Biology and Evolution. Stories based on the research were published by five news outlets including Science Daily and Phys.org, and appear to be the result of a press release published by Oxford University Press that was disseminated through EurekAlert. The article received modest attention on social media, with 14 tweets and one publicly accessible Facebook post. When compared to the top scoring publication, this indicates the importance of a high volume of content such as tweets for calculating an Altmetric score. The third highest scoring publication with 32 points was 'Tackling vitamin A deficiency with biofortified sweetpotato in sub-Saharan Africa' by CIP scientists, which received 38 tweets and was mentioned in three blog posts. 'Trait variation and genetic diversity in a banana genomic selection training population' was the fourth highest scoring publication in 2017 with a score of 22. The publication link was included in one blog and 23 tweets. The four publications are within the top 5% of all research outputs scored by Altmetric.

In addition to the press release registered twice as a news story and a blog, a further anomaly was found in the results reported by Altmetric. Specifically, the absence of the publication 'Gender in agricultural change: Towards more inclusive innovation in farming communities'. This publication was featured and linked in two RTB blogs in 2017, 'Skilled youth hold the key to the future of farming' and 'Understanding gender norms to improve effectiveness of interventions'. At the time of writing, RTB is awaiting confirmation as to whether Altmetric includes the RTB blog in its manually curated list of 9,000 blogs, which may explain why these posts and potentially others were not captured.

As the social media promotion of RTB publications is mostly done by sharing blogs that highlight and link to the publication, rather than a direct link to the publication itself, it appears RTB's own social media accounts contribute little to Altmetric scores. This approach is taken to position the research within content that draws out the key findings and which is more appropriate for broader and non-scientific audiences. Additionally, it is an approach that increases traffic to the RTB website, another important goal for the program's social media use. A complementary approach will be considered to increase the contribution of RTB social media to Altmetric scores.

Similarly, the use of traditional media to publicize publications will be prioritized as it is a key channel to promote research. In 2017, research by RTB was featured in news outlets with a combined audience of over 12 million readers, according to the media monitoring service used by the program, Meltwater. Despite this, only a small number of news articles were registered by Altmetric, signifying the need to ensure (where possible) that the correct link to a publication is included in a press release or a news story.

TABLE D-2: LIST OF CRP INNOVATIONS IN 2017 (FROM INDICATOR #C1 IN TABLE D-1)

FP	Cluster	Name of Innovation:	Stage	Contribution	Innovation Type	Geographic Scope:
1	1.1	BrAPI - Application programming interface (API) for breeding RTB community	Stage 4: uptake by next user	RTB	Research and Communication Methodologies and Tools	Global
1	1.2	Breeder-ready markers for leaf blight and virus resistance in potato	Stage 4: uptake by next user	RTB	Research and Communication Methodologies and Tools	Global
2	2.1	Positive selection to improve on-farm seed potato management	Stage 4: uptake by next user	RTB	Production Systems and Management Practices	In the Andes (Bolivia, Ecuador, and Peru) and in Africa (Ethiopia, Uganda, Kenya, Rwanda and Malawi)
2	2.4	Varieties for mid altitude, humid subtropical agro-ecologies in SSA, focusing on heat tolerance, late blight and virus resistance Climate smart mid altitude potato	Stage 4: uptake by next user	RTB	Genetic (varieties and breeds)	Kenya, Rwanda, Ethiopia, Cameroon, Nigeria and Malawi
2	2.6	Triple S – Storing Sweetpotato Roots in Sand and Sprouting	Stage 4: uptake by next user	RTB	Production Systems and Management Practices	Uganda, Ethiopia, Mozambique, Mozambique, Tanzania, Kenya, Nigeria, Malawi, Ghana, Burkina Faso
2	2.1	Use of low cost Net Tunnels for Management of Sweetpotato Viruses among Famer-multipliers	Stage 4: uptake by next user	RTB	Production Systems and Management Practices	East Africa, South East Asia
2	2.4	Apical cuttings for seed potato systems	Stage 4: uptake by next user	RTB	Production Systems and Management Practices	Kenya
2	2.2	Addressing vitamin A deficiency through vitamin A-rich banana cultivars in East African farming and food systems	Stage 2: end of piloting phase (if relevant)	RTB	Genetic (varieties and breeds)	Burundi, Congo
2	2.2	NARITA hybrids for East Africa	Stage 2: end of piloting phase (if relevant)	RTB	Genetic (varieties and breeds)	Uganda, Tanzania
2	2.1	Multi-stakeholder framework for intervening in RTB seed systems	Stage 4: uptake by next user	RTB	Social science	Ethiopia, Ecuador, Nigeria, Tanzania

FP	Cluster	Name of Innovation:	Stage	Contribution	Innovation Type	Geographic Scope:
2	2.1	Impact network analysis (INA) validated as a tool to understand and describe RTB seed systems	Stage 4: uptake by next user	RTB	Social science	Ethiopia, Ecuador, Georgia, Kenya, Vietnam, Cambodia
2	2.1	Integrated seed health approach	Stage 3: available for uptake	RTB	Production Systems and Management Practices	Georgia, Nigeria, Kenya, Uganda
2	2.1	Seed Tracker	Stage 3: available for uptake	RTB	Research and Communication Methodologies and Tools	Nigeria
2	2.2	NABIO (matooke) hybrids	Stage 3: available for uptake	RTB	Genetic (varieties and breeds)	Uganda
2	2.4	Decentralized seed multiplier approach to seed potato production	Stage 4: uptake by next user	RTB	Social science	Ethiopia, Kenya, Malawi
2	2.4	Varieties for humid tropical and sub-tropical highlands, focusing on late blight resistance	Stage 4: uptake by next user	RTB, CCAFS	Genetic (varieties and breeds)	Kenya, Tanzania, Rwanda, Ethiopia, Cameroon, Nigeria and Malawi
2	2.4	Varieties for mid-altitude, semi-humid subtropical agro-ecologies in SSA, focusing on heat, drought and virus tolerance	Stage 4: uptake by next user	RTB	Genetic (varieties and breeds)	Kenya, Tanzania, Rwanda, Ethiopia, Cameroon and Malawi
3	3.2	Scaling out dual CBSD and CMD resistant varieties for the mid-altitude agro-ecologies of East and Central Africa	Stage 3: available for uptake	RTB	Genetic (varieties and breeds)	Malawi, Mozambique, Kenya, Tanzania, Uganda
3	3.3	Out-scaling Single Diseased Stem Removal (SDSR) for quick and effective banana recovery in XW affected regions	Stage 4: uptake by next user	RTB	Production Systems and Management Practices	DR Congo, Rwanda, Uganda and Burundi
3	3.1	Hand-Held Decision Support System for Potato Late Blight Management (HH-DSS)	Stage 2: end of piloting phase (if relevant)	RTB	Research and Communication Methodologies and Tools	Ecuador
3	3.1	AdiosMacho-*Po*® and AdiosMacho-*St*®: innovative biorational products to control potato pests	Stage 3: available for uptake	RTB	Production Systems and Management Practices	Peru, Bolivia, Ecuador, Bhutan, Nepal, Australia
3	3.4	Recovering Banana Production from Bunchy Top Disease	Stage 3: available for uptake	RTB	Production Systems and Management Practices	Malawi, Nigeria, DR Congo
3	3.6	Community action to manage cassava brown streak disease	Stage 2: end of piloting phase (if relevant)	RTB	Production Systems and Management Practices	Tanzania

FP	Cluster	Name of Innovation:	Stage	Contribution	Innovation Type	Geographic Scope:
3	3.2	Developing decision support tools to scale agronomic technologies for cassava	Stage 2: end of piloting phase (if relevant)	RTB	Production Systems and Management Practices	Nigeria, Tanzania
3	3.1	Insect Life Cycle Modeling software (ILCYM)	Stage 3: available for uptake	RTB	Biophysical research	Global
3	3.4	BBTV CDS surveillance and reporting mobile app	Stage 3: available for uptake	RTB	Research and Communication Methodologies and Tools	Nigeria
3	3.4	BBTV tolerant Musa varieties and hybrids	Stage 3: available for uptake	RTB	Genetic (varieties and breeds)	Cameroon
3	3.5	Crop disease Surveillance platform	Stage 2: end of piloting phase	RTB	Research and Communication Methodologies and Tools	Global
3	3.5	Field detection of pathogens	Stage 3: available for uptake	RTB	Research and Communication Methodologies and Tools	Global
3	3.6	Absolute quantification of cassava brown streak viruses using standard curves	Stage 3: available for uptake	RTB	Research and Communication Methodologies and Tools	Global
4	4.1	Waxing: A technology for extending the shelf-life of fresh cassava roots in Africa	Stage 3: available for uptake	RTB	Production Systems and Management Practices	Uganda, Nigeria
4	4.2	High quality cassava peel for animal feed	Stage 3: available for uptake	RTB	Production Systems and Management Practices	Nigeria and Tanzania
4	4.1	Sweetpotato silage-based diet for pig feeding	Stage 3: available for uptake	RTB	Production Systems and Management Practices	Uganda
4	4.4	Orange-fleshed Sweetpotato Purée for Bakery Applications in Kenya	Stage 3: available for uptake	RTB	Production Systems and Management Practices	Sub-Saharan Africa
4	4.2	Flash dryer for cassava	Stage 3: available for uptake	RTB	Production Systems and Management Practices	Colombia, Nigeria, Uganda, Tanzania
4	4.3	Regional Investments, Policies, Legislation and Advocacy Efforts on Food-based Approaches to Combating Micronutrient Deficiency in Sub-Saharan Africa: Focus on Biofortification	Stage 4: uptake by next user	RTB	Social science	Sub-Saharan Africa

FP	Cluster	Name of Innovation:	Stage	Contribution	Innovation Type	Geographic Scope:
4	4.4	Nutrition and health education model for out-scaling the use of OFSP	Stage 4: uptake by next user	RTB	Social science	Sub-Saharan Africa
4	4.2	Development of cassava-based products and consumer preference of the products to identify the preferred products	Stage 3: available for uptake	RTB	Production Systems and Management Practices	DR Congo, Nigeria, Zambia
4	4.3	Retention of PVAC in cassava bread	Stage 3: available for uptake	RTB	Production Systems and Management Practices	Nigeria
4	4.3	Cassava genotypes with best physiochemical properties	Stage 3: available for uptake	RTB	Genetic (varieties and breeds)	Global
5	5.2	Basket of alternative shade and drought tolerant food/feed crop options to sustainably manage banana based systems under rein-fed conditions in Central Africa	Stage 1: end of research phase (discovery /proof of concept)	RTB	Social science	Central Africa
5	5.3	Youth agri-preneurs: a vehicle to make RTB innovations an attractive business for the next generation	Stage 3: available for uptake	RTB	Social science	DR Congo
5	5.3	Best practice guidelines for integrating gender into seed systems and the RTB seed systems framework are developed and shared with scientists and partners working on seed systems	Stage 1: end of research phase (discovery /proof of concept)	RTB	Social science	Global
5	5.4	Gender sensitive M&E tool for the Participatory Market Chain Approach	Stage 3: available for uptake	RTB	Social science	Ecuador, Uganda
5	5.4	Guidelines for innovation platforms in agricultural research for development: decision support for research, development and funding agencies on how to design, budget and implement impactful innovation platforms	Stage 4: uptake by next user	RTB	Social science	Global
5	5.4	Social Network Approach for Guiding and Leveraging R4D Investments	Stage 3: available for uptake	RTB	Social science	Rwanda, Burundi, DRC
5	5.4	Rapid Appraisal of Agricultural Innovation Systems (RAAIS) Toolkit	Stage 4: uptake by next user	RTB	Social science	Global
5	5.4	Scaling readiness approach - A science-based approach to develop scaling strategies	Stage 2: end of piloting	RTB	Social science	Global

FP	Cluster	Name of Innovation:	Stage	Contribution	Innovation Type	Geographic Scope:
			phase (if relevant)			

TABLE E: INTELLECTUAL ASSETS

Year reported	Applicant(s) / owner(s) (Center or partner)	Patent or PVP Title	Additional information*	Link or PDF of published application/ registration	Public communication relevant to the application/registration
2017	NA	NA	NA	NA	NA

* For patents, please indicate: (a) type of filling: provisional / non-provisional; national direct, national designated; multi-territory; (b) patent status: filled, pending, matured to non-provisional, discontinued, registered or lapsed; (c) application / registration; (d) date of filling; (e) Date of Registration; (f) Date of Expiry / renewal
* For PVP, please indicate: (i) variety name, (ii) status, (iii) country; (iv) application/registration number, (v) date of filling, (vi) date of registration/grant; (vii) date of expiry/renewal, (viii) breeder and crop

TABLE F: MAIN AREAS OF W1/2 EXPENDITURE IN 2017

Expenditure area *	Estimated percentage of total W1/2 funding in 2017**	Space for your comments [please remove notes below]
Planned research: principal or sole funding source	40.99%	Promoting collaboration and learning across centers/crops and with other CRPs on core science domains (e.g. advanced breeding, seed systems, pest risk assessment under climate change scenarios, post-harvest and processing) and integrative, cross-cutting areas (gender, science of scaling, site integration)
Planned research: Leveraging W3/bilateral funding	22.00%	Strategic allocations to crop-specific research areas (e.g. development and use of advanced breeding methods, management of major pest and diseases, post-harvesting and processing).
Catalyzing new research areas	8.93%	"Seed funding" allocated to cross-center research teams looking at better integration of sustainable intensification and diversification pathways into RTB initiatives.
Gender	12.28%	Gender coordination by PMU, cluster to strategic research on gender and youth dimensions in RTB agri-food systems, three main areas of gender integrated research (breeding, seed systems, pest and disease management)
Youth	3.16%	Development and implementation of RTB approach to better include youth in program portfolio
Capacity development	4.18%	Support to DI1.1-Breeding community of practice as learning a brokering space connecting crop-specific breeding communities and feeding them with inputs (e.g. User preferences, emergence of new pests and diseases) coming from other flagships. ***NB.*** *Other funds allocated to CapDev are included in the two lines dedicated to Planned research.*
Start-up or maintenance of partnerships (internal or external)	4.11%	Strategic partnerships on discovery, post-harvesting and scaling research
Monitoring, learning and self-evaluation	3.25%	ME&L coordination and support by PMU, workshops and capacity development, development and maintenance of online platform (MEL), annual meeting
Evaluation studies and Impact Assessment studies	8.33%	Dedicated cluster, collaboration with PIM on foresight studies
Emergency/contingency		
Other	5.46%	PMU costs, ISC costs, annual meetings
TOTAL FUNDING (AMOUNT)	112.69%	

*use these categories wherever possible, delete unneeded rows and add rows if none of these are suitable.
**we recognize that (i) some funding may fit more than one category but please try to apportion funding to its principal use and (ii) percentages may not add up to 100%

TABLE G: LIST OF KEY EXTERNAL PARTNERSHIPS

FP	Stage of research*	Name of partner	Partner type*	Main area of partnership*
1, 2, 4	Phase 1: Discovery/Proof of concept	Natural Resources Institute	Academic and Research	Development of gender-aware user-preferred product profiles for RTB breeding under the RTBFoods project taking into account, food science and economic considerations as well. Methods to be shared widely with RTB Breeding teams as appropriate.
1	Phase 2: Piloting	Intertek Lab	Private Sector	The High throughput genotyping platform (HTPG) is a genotyping project. The service is provided by Intertek Lab which became operational in 2017 and offers high-throughput single-plex SNP assay for forward breeding (marker-assisted selection) at competitive rates.
1	Phase 1: Discovery/Proof of concept	Cornell University	Academic and Research	Genomic Open-source Breeding Informatics Initiative (GOBII) is a system-wide initiative composed of computational infrastructure and analysis pipelines designed for breeders serving smallholders in the developing world to apply high density genomic information in cultivar development to increase the rate of genetic gain delivered to farmers. Members of the DI1.2 cluster collaborate closely with GOBII to ensure that the 'omics' tools developed in the project are available for use in breeding programs.
1	Phase 2: Piloting	Donald Danforth Plant Science Center, USA	Academic and Research	DDPSC leads the development of virus resistant cassava in SSA (VIRCA project). The technology, the partners, and the studies needed to obtain commercial approval are very similar to those future GCT products lead by RTB centers. Hence, we have established a partnership to harmonize our strategies to develop regulatory studies, solving stewardship issues, and interactions with regulatory and biosafety authorities.
2	Phase 3: Scaling up and scaling out	University of Florida	Academic and Research	Development of biophysical tools and tools linking biophysical and socio-economic components of RTB seed systems: impact network analysis, degeneration models, and management performance mapping.
2	Phase 3: Scaling up and scaling out	County governments, Kenya	Government	Capacity building of diverse institutions developed into partnerships, supporting RBM approach that emphasises partnerships to drive the theory of change. In Kenya, county governments and NGOs lead activities on the ground. Through these partnerships, CIP has access to the wide-spread networks of county government and NGO officers situated to reach dispersed farming communities enabling wide scaling-out of technologies and innovations. A case supporting the partnership model whereby a central center provides technical backstopping and communications support, handing over implementation to partners.
2	Phase 2: Piloting	Stokman Rozen, Kenya Genetcis technologies	Private Sector	Private sector partnerships continue to develop to contribute to seed potato production through technical backstopping, and jointly attending several agricultural trade shows and field days. The main opportunity to address is increasing market opportunities for apical cuttings to shift from the initial project support to market demand sustaining private sector investment and

FP	Stage of research*	Name of partner	Partner type*	Main area of partnership*
		international Limited, Kenya		production. Extending the model to smaller-scale producers is being piloted. This will inform seed business models targeting differing profiles of entrepreneur.
2	Phase 3: Scaling up and scaling out	Borlaugh Vision	Development organizations	Intensification of potato in rice fallow in North West Bengal. A baseline survey of 120 households was conducted to study and document the cropping systems and socio-economic conditions of farmers in North Bengal to bring rice fallow under potato in lowland, mid-hill and uplands. More than 1100 farmers trained on improved potato production practices and double transplanting of boro rice to bring non-traditional area under potato.
2	Phase 1: Discovery/Proof of concept	North Carolina State University	Academic and Research	In collaboration with the North Carolina State University we are developing new tools and mapping populations for sweetpotato. Worth noting the Beauregard x Tanzania 6x mapping population and M9 x M19 2x mapping population are hold in trust at CIP's genebank in Lima (about 100 genotypes / breeding material) and these populations became very important in research and development across countries.
2	Phase 1: Discovery/Proof of concept	University of Canberra	Academic and Research	In collaboration with the Diversity Arrays Technology at the University of Canberra, Australia we are searching for DArT marker associations with sweetpotato virus disease resistance (SPVD) and its components sweetpotato chlorotic stunt virus (SPCSV) and sweetpotato feathery mottle virus (SPFMV). Woth noting DArT marker are so far the only fast through-put marker system avaible for sweetpotato and this system is also used through this collaboration by CIP's genebank for checking genotypes true to identity and phylogenetic relationships.
3	Phase 1: Discovery/Proof of concept	University of Wisconsin - Madison	Academic and Research	A collaboration has been made possible between UoW-M, CIP and IITA through a project funded by BMGF on Next generation phytosanitation. UoW-M is developing in this project a microfluidic molecular pathogen detection system based on isothermal amplification that can be used in the field. It will be loaded with targets for major potato, sweetpotato, yam and banana viruses. If validated the tool can be applied for international phytosanitation, surveillance and monitoring or quality control in seed systems. UoW-M brings in expertise on diagnostic hardware development that we were completely lacking and which can be complementary to other tools developed in this cluster.
3	Phase 2: Piloting	National Root Crops Research Institute (NRCRI), Nigeria	NARES/NARS	Collaboration in ACAI project, stepwise acquisition of responsibility for the activities conducted by the development partners on Cassava fertilizer recommendations, best planting practices, scheduled planting and harvesting and intercropping.
3	Phase 2: Piloting	University of Cornell (GREAT)	Academic and Research	Collaboration with BMGF Gender-Responsive Researchers Equipped for Agricultural Transformation (GREAT) project to use tools and study designs to assess the household and community variety preference choices. To our members, L Nkangala and A Bonaventure Aman, are serving as advisory board members.

FP	Stage of research*	Name of partner	Partner type*	Main area of partnership*
3	Phase 3: Scaling up and scaling out	General Directorate of Agriculture (GDA), Cambodia	Government	To tackle emerging cassava mosaic disease issue in the country, GDA and CIAT had an enthusiastic collaboration in 2017 including hands-on field survey training and development of mitigation plan for CMD outbreaks.
3	Phase 2: Piloting	Penn State University, USA	Academic and Research	Artificial intelligence for smartphone-based cassava disease and pest damage identification
4	Phase 1: Discovery/Proof of concept	Kwame Nkrumah University of Science and Technology (KNUST), Ghana	Academic and Research	The main activities involve quality evaluation of the physico-chemical, functional and sensory characteristics, and the consumer acceptability of boiled/pounded yam made from selected yam varieties. Starch extraction and functional properties have been completed.
4	Phase 3: Scaling up and scaling out	NAZYA Foods Plot 23280, PHI, Lusaka, Zambia	Private Sector	Received training on production of High quality cassava flour (HQCF) and the company is also collecting HQCF from IITA- Cassava processing center operated by the IITA-Zambia Youth Agripreneurs. The company has their products all over supermarkets in Lusaka.
4	Phase 3: Scaling up and scaling out	Forum for Agricultural Research in Africa (FARA)	Development organizations	Within the framework of the Building Nutritious Food Baskets (BNFB) Project, collaboration with FARA allowed for better policy engagement and advocacy at regional level.
4	Phase 2: Piloting	Natural Resources Institute, UK	Academic and Research	Partnership with NRI is contributing to: 1) the assessment of the energy efficiency of a small-scale cassava flash dryer; 2) the analysis of the correlations between physicochemical and textural characteristics, sensory attributes and consumption patterns of traditional cassava products in Tanzania.
5	Phase 3: Scaling up and scaling out	Department of Agricultural and Applied Economics, Virginia Tech	Academic and Research	Major role in developing the ISPC paper and the position paper on rural transformation; M.Sc. thesis on adoption of potato varieties in Peru approved; partners in GeneBank and C88 impact studies (draft papers).
5	Phase 3: Scaling up and scaling out	Michigan State University	Academic and Research	Leading role and major collaborator in the SIAC project; collaborator for the rural transformation study.
5	Phase 3: Scaling up and scaling out	Swedish University of Agricultural Sciences	Academic and Research	Leading role major collaborator in the consumer/market studies of biofortified sweetpotato
5	Phase 3: Scaling up and scaling out	Cornell University, USA, Makerere University, Uganda	Academic and Research	RTB collaborated with the Gender-responsive Researchers Equipped for Agricultural Transformation (GREAT) project to build capacity of researchers within RTB to integrate gender into research and analysis. Additionally, the gender team collaborated with others within centers to integrate gender into development of training modules.

FP	Stage of research*	Name of partner	Partner type*	Main area of partnership*
5	Phase 1: Discovery/Proof of concept	Leibniz Institute of Agricultural Development in Transition Economies (IAMO), Germany	Academic and Research	Developing and testing ICT tools to support scaling of BXW control and prevention strategies using GIS and Social Network Analysis.

* See instructions in the common results indicators manual (available early 2018).

TABLE H: STATUS OF INTERNAL (CGIAR) COLLABORATIONS AMONG PROGRAMS AND BETWEEN THE PROGRAM AND PLATFORMS

Name of CRP or Platform	Brief description of collaboration (give and take among CRPs) and value added*	Relevant FP
CRP on Policies, Institutions and Markets, PIM	In collaboration with PIM, through the project "Making seed systems and markets for vegetatively propagated crops (VPCs) work for the poor" we conducted three case studies: Kenya (potato); Nigeria (cassava) and Vietnam (potato and cassava). The cross crop and country study will allow us to understand and draw out insights on: the types of public policies, regulations or regulatory reforms are in place or not viz quality assurance for the seed of RTB crops; the current level of access, availability, and quality of RTB planting material; and the level/type of quality assurance that is effective to increase access, availability, and quality of RTB planting material. The findings will form an evidence base for a more informed dialogue with regulatory bodies on options for the types of public policies, regulations or regulatory reforms are required to provide effective quality assurance for VPC planting material.	2
CRP on Policies, Institutions and Markets, PIM	Contributions to foresight analysis, policy and institutional analysis, co-location of scientists and joint/complementary investments in tools development and partnering. A peer reviewed paper generated in 2017. New funding leveraged for 2018: the proposal "Changing world, changing climate: Meeting complex demands with nutritious roots, tubers and bananas value chains" was approved and will be a joint RTB-PIM collaboration.	5
CRP on Policies, Institutions and Markets, PIM	RTB researchers worked closely with researchers from PIM on "Approaches and tools for value chain development" based on 6 case studies from Uganda. The study analyzed the design and implementation of inclusive value chains considering bottlenecks, gaps and challenges faced in facilitating the process with smallholders[1]. Additionally, to enhance the engagement of women in value chain development, a "Gender sensitive M&E tool for the participatory Market Chain Approach" was developed[2].	4, 5
CRP on Policies, Institutions and Markets, PIM	The PIM FP4 team worked closely in 2017 with researchers from RTB based at CIP to explore the potential for a study on social protection and agriculture among potato growing households in the Andes. These discussions culminated in a workshop in December 2017 involving government officials to discuss how to design the study. Staff from the IFPRI FP4 team traveled from Washington DC to Lima to participate in the workshop.	5
Big Data	Data management and analytics using RTBbases (sweetpotatobase) and complementary tools such as HIDAP that can be shared across programs and platforms via BrAPI. Worth noting: (currently HIDAP can be used to analyze not only breeding data but also participatory variety selection, and in future agronomic data which all make up big data) We will be adapting all this to sweetpotato and sharing with RTB teams.	2, 3
Big Data	Smartphone image based diagnostics, pioneered/developed in cassava with help of Big Data, to be expanded into diseases of other crops (e.g. banana) in RTB. Could be further expanded into other crop specific CRPs.	2, 3
Excellence in Breeding	RTB is linked to each of the modules of EiB plaform. While it is early, we anticipated collaborations, complementarities and synergies in efforts.	1, 2

[1] Naziri, D.; Mayanja, S.; Ssemwanga, J.; Donovan, J. 2017. Approaches and tools for inclusive value chain development: lessons from Uganda for improved impact. Enterprise Development and Microfinance. ISSN 1755-1978. 28(4):323-341. http://hdl.handle.net/10568/91979

[2] Webinar on gender mainstreaming through PMCA: http://gender.cgiar.org/webinar-gender-mainstreaming-participatory-market-chain-approach-pmca/

Name of CRP or Platform	Brief description of collaboration (give and take among CRPs) and value added*	Relevant FP
	The RTB breeding and discovery flagships are tightly linked to the EiB platform and present opportunities for mutual benefits.	
Genebank Platform	Links between ex situ and in situ conservation and use for RTB crops.	1, 2
Genebank Platform	Sharing knowledge and tools (BBTV indexing tools) for Genebank international distribution of Musa germplasm efforts	3
Genebank Platform	There is substantial collaboration on virus elimination work from cassava landraces and breeding lines. Capacity for this technology is being strengthened at KEPHIS for virus elimination in landraces for conservation purposes, supported by the Genetic Resources Platform, but a spin-off from this is the ability to efficiently eliminate viruses from elite cassava germplasm, to be fed into 'clean seed systems' for dissemination. CA3.6.3.1 - Harmonized international germplasm exchange protocols is also being conducted in conjunction with the Genebank Platform's GHU component	3
Rice	Exploring opportunities for integrating RTB crops in rice-based systems (notably sweetpotato) in Rwanda and DR Congo	2, 5
CRP on Water, Land and Ecosystems	WLE FS5 Seeks to lever evidence-based policy advocacy geared towards sustainable intensification at the landscape scale. It will rely on farm-to-landscape level inputs from CC5.2, while in turn giving feedback on large (global, regional, national and catchment) scale processes affecting sustainability of intensification practices at farm to landscape level. The collaboration is envisaged to be piloted on case studies in Uganda in RTB systems.	5
CCAFS	Contribution in the scientific conference and writeshop held in Galway, Ireland. Exploration of options for climate smart breeding. Participation in climate smart agriculture meeting and interactions among CRPs and centers.	1, 2, 3
A4NH	Collaboration in Tanzania and Nigeria on building advocacy for promotion of biofortification.	2, 4
Gender platform	2 projects awarded for seed system work are jointly funded by RTB centers.	

*e.g. scientific or efficiency benefits

TABLE I: MONITORING, EVALUATION, IMPACT ASSESSMENT AND LEARNING

TABLE I-1: STATUS OF EVALUATIONS, IMPACT ASSESSMENTS AND OTHER LEARNING EXERCISES PLANNED IN THE 2017 POWB

Studies/learning exercises in 2017 (from POWB)	Status	Comments
FORESIGHT ANALYSIS		
CC5.1.1.2 - RTB crops productivity projections under alternative socioeconomic and climate scenarios	Manuscript submitted to Global Food Security as part of a joint special issue developed with PIM.	The role of roots, tubers and bananas (RT&B) in achieving nutritional security and providing income opportunities for the poor under changing socioeconomic and climate scenarios is analyzed in this paper.
EX-ANTE ASSESSMENT STUDIES		
Fusarium oxysporum f. sp. cubense tropical race 4 of bananas: Disease spread and global loss projections (CC5.1.2.1/10846)	Brief available	Scientists have recently estimated that tropical race 4 of the fungal pathogen Fusarium oxysporum f. sp. cubense (Foc TR4) could spread to 1.65 million ha of current banana lands by 2040 if no significant interventions are instituted (Scheerer et al 2016). This is about 17% of the current area under production. The annual production potential of this area is estimated at 36 million tonnes with an estimated value of over 10 billion dollars at current prices. This estimate does not even take into consideration the impact of production loss on livelihoods along the banana value chains and on the environment.
Setting priorities for potato research under different future change scenarios (CC5.1.2.1/5995)	Manuscript accepted. It will be published in 2018	This article examines how the estimated impacts of crop technologies vary with alternate methods and assumptions, and also discusses the implications of these differences for the design of studies to inform research prioritization. Drawing on international potato research, it shows how foresight scenarios, realized by a multi-period global multi-commodity equilibrium model, can affect the estimated magnitudes of welfare impacts and the ranking of different potato research options, as opposed to the static, single-commodity, and country assumptions of the economic surplus model which is commonly used in priority setting studies.
CC5.1.2.2 - Ex-ante analysis of economic benefits and returns on	Manuscript submitted.	The Yam Improvement for Income and Food Security in West Africa (YIIFSWA) project promoted the development, deployment and dissemination of an array of technologies and agronomic interventions in Nigeria and Ghana to address constraints affecting yam productivity. Key technologies deployed include: adaptive yam minisett technique (AYMT), vine rooting technique, conventional tissue culture (CTC), aeroponics system (AS), temporary

investments in yam seed systems		immersion bioreactor system (TIBS), somatic embryogenesis (SE), varieties adapted to various stresses, diagnostic tools for seed health management, nematode resistant cultivars, crop management and postharvest practices. This study assesses the potential economic returns, the number of beneficiaries and poverty reduction resulting from the use of technologies/intervention options for yam production. The technologies are expected to reach not less than 18.7 million households by 2037 in Nigeria and Ghana.
EX-POST IMPACT ASSESSMENT STUDIES		
CC5.1.3.3 - Comprehensive database on cassava varieties used by farmers in Cauca & Vietnam	Floro IV, Victorino O.; Labarta, Ricardo A.; Becerra López-Lavalle, Luis Augusto; Martinez, Jose M.; Ovalle, Tatiana. 2017. Household Determinants of the Adoption of Improved Cassava Varieties using DNA Fingerprinting to Identify Varieties in Farmer Fields: A Case Study in Colombia. Journal of Agricultural Economics 1-19 p. http://hdl.handle.net/10568/89044 Dataset available for Vietnam	The study examines factors affecting the adoption of improved cassava varieties of 217 households in the Cauca Department in southwest Colombia. Using DNA fingerprinting through Single Nucleotide Polymorphisms (SNPs) different cultivars were identified in farmers' fields. This information was used to remove possible bias in the adoption model that could have resulted from a misclassification of improved varieties (IVs). As a result, we found that farmers substantially overestimate their use of IVs and there are important differences in the determinants of adoption between farmer self-identification and DNA fingerprinting. This finding implies that the incorporation of DNA fingerprinting in IV adoption studies is important to ensure the accuracy of future agricultural economic research and the relevance of subsequent policy recommendations. In terms of acreage, DNA fingerprinting found that only 12.6% of land was cultivated with IVs while farmer self-identification pegged this figure at 24.4% or an overestimation of the number of ha by 11.8%.
CC5.1.3.4 - Outcomes of crop germplasm improvement research: potatoes and sweetpotatoes varietal release and adoption in Asia	6803-Use of expert panels for ex ante and ex post food security impact assessment of root and tuber crops technologies validated in Asia (SIAC 2.1) Datasets available	
CC5.1.3.5 - Impacts of potato variety Cooperation 88 (C88) in Yunnan	6809-M.S. thesis and journal article assessing impacts of potato variety Cooperation 88 (C88) in Yunnan Province of China	

Province of China assessed		
CC5.1.6.8 - Adoption determinants of potato varieties in Peru	Pradel, W.; Hareau, G.; Quintanilla, L.; Suarez, V. 2017. Adopcion e impacto de variedades mejoradas de papa en el Peru: Resultado de una encuesta a nivel nacional (2013). Lima (Peru). Centro Internacional de la Papa. ISBN 978-92-9060-211-8. 48 p. http://hdl.handle.net/10568/83497	See section 1.1 for a summary
CC5.1.3.8 - Ex-post analysis of the livelihood impacts of cassava improved varieties in Nigeria	Wossen, T., G. Tessema., T. Abdoulaye, I. Rabbi, A. Olanrewaju, A. Alene, S. Feleke, P. Kulakow, G. Asumugha, A. Adebayo, and V. Manyong. 2017. The cassava monitoring survey in Nigeria final report. IITA, Ibadan, Nigeria. ISBN 978-978-8444-81-7. 66 pp. http://hdl.handle.net/10568/80706 Wossen, T., T. Abdoulaye, A. Alene, S. Feleke, I. Rabbi, G. Asumugha, P. Kulakow, and V. Manyong. 2017. Impact of improved cassava varieties in Nigeria final report. RTB / IITA, Ibadan, Nigeria	Report 1: Results from CMS showed that more than 60% of farm households have adopted improved cassava varieties in Nigeria. The distribution of adoption by gender also revealed that the adoption rate among male-headed households (MHHs) was about 61.5% while among female-headed households (FHHs) it was relatively low, about 48.6%. While combining DNA fingerprinted data with the CMS socioeconomic data, average adoption rates tended to be similar, the misclassification rate is large. Misclassification happens when farmers who think they are growing improved varieties grow local varieties or when farmers who think they are growing local varieties grow improved varieties. Therefore, for examining the determinants of adoption, the measurement of "improved varieties" matters as the determinants of adoption are different while using farmers' self-reported and DNA fingerprinted data. Three sources of heterogeneity largely explain the probability of correctly classifying cassava into improved and local varieties. These include level of education, access to information (such as mobile phone ownership and access to extension access), membership of formal and informal organizations, and location. Report 2: This report answers the following key research question: Does adoption of improved cassava varieties have any significant causal effects on productivity and poverty? The results of this project showed that about 60% of the farmers growing cassava have adopted improved varieties. However, when adoption was measured using DNA-fingerprinting approach, it was found that about 66% of the farmers have adopted improved cassava varieties. Despite higher adoption rates, the intensification rate of improved cassava varieties was found to be about 38%, which is quite modest. The productivity effect of adoption of improved cassava varieties was estimated using alternative measures of adoption (using self-reported adoption data from household surveys and DNA-fingerprinted adoption data) as well as specifications (OLS and IV estimation strategies). Using OLS estimation strategy, we found that the effect of adoption of improved cassava varieties on cassava yield is about 55%. Further, IV estimation results suggest a 64% productivity gain as a result of adoption of improved cassava varieties. Using a poverty line of USD1.25 per person per day, adoption has led to a 4.7% and 4.02% poverty

		reduction in the closed economy and small open economy case, respectively. This poverty reduction role of adoption at USD1.25 per person per day poverty line implies that 6.2%-7.15% of the rural poor cassava producers have escaped poverty in the current year due to adoption of improved cassava varieties. Similarly, at the poverty line of USD1.9 per person per day poverty line, adoption has led to a 2.06% to 2.92% poverty reduction in a small open economy and closed economy, respectively. These changes correspond to a 2.9%-4% poverty reduction among rural poor cassava producers.
CC5.1.3.9 - Ex-post analysis of the Impacts of yam seed technologies in Nigeria and Ghana	Impact Assessment Report of YIIFSWA Project Linked with: CC5.1.3.1 - Database on yam producing household in Nigeria and Ghana and impact indicators	This study focused on providing an answer to the question of how much impact the adaptive yam minisett technique (AYMT) interventions of YIIFSWA project had had on rural farm households' income and food security and how this has contributed to the reduction of poverty in Nigeria. We started by documenting the rate of AYMT awareness and adoption among the sampled farmers. The result showed that the AYMT adoption rate was about 18%; the awareness rate was 23%. Furthermore, the proportion of adopters among the exposed farmers was 75%, confirming that awareness / exposure is very important in achieving a high rate of AYMT adoption. Therefore, policy and programs that would further increase the farmers' awareness were recommended. In addition, the existing extension program was encouraged to be well rehabilitated and supported to improve the performance of extension agents and increase the number of contacts with farmers to improve their awareness.
CC5.1.3.11 - Ex-post analysis of the livelihood impacts of cassava technologies in Tanzania and DRC	Preliminary report available Linked with: CC5.1.3.2 - Database with information on cassava producing household surveys in DRC and Tanzania	
CC5.1.3.12 - Impacts of RTB crop technologies on rural transformation	10726-Pathways from research on improved staple crop germplasm to poverty reduction for smallholder farmers Alwang, E., Agricultural Systems (2017), http://dx.doi.org/10.1016/j.agsy.2017.10.005	Innovations to improve staple crop germplasm can reduce poverty and otherwise improve farmer livelihoods through complex and multiple pathways. This paper reviews the evidence for one prominent pathway—through increased incomes (in cash and kind) for poor farmers who adopt the technology. An important determinant of poverty reduction is the ability of poor producers to adopt productivity-enhancing varieties, and the paper analyzes recent household-level data from two African countries to examine if poor producers face unique barriers to adoption. A second determinant of poverty reduction is the area available to plant these varieties and whether the intensity of adoption is great enough to significantly reduce poverty. The paper uses a double-hurdle estimation framework to model the adoption/area planted joint decision for maize farmers in Ethiopia and sweetpotato farmers in Uganda. The

		focus of the analysis is the effect of poverty-related variables on adoption/area planted decisions. Farmer wealth, landholding, education, location, and access to support and information services are included to understand how correlates of poverty affect adoption decisions. We find evidence that landholding size is an important barrier to poverty reduction; poor farmers are able to adopt improved varieties, but their intensity is constrained by land availability. In Uganda, farmers at the 95th percentile of adoption area received about USD 0.13 per person per day from the incremental yield, covering < 50% of the mean household poverty gap. This gain only comes under optimistic assumptions and most adopters do not have sufficient area for the direct income effect to be large. The evidence suggests that direct, short-term impacts of increased productivity to increased income may be limited in magnitude. Nonetheless, we recognize that other, less direct pathways may be important, particularly over longer times. Impacts through indirect pathways are, however, more difficult to measure. This has implications for the design of M & E and the crafting of appropriate targets for outcomes of research on staple crops which should focus perhaps on the other pathways where poverty reduction is more probable.
CC5.1.6.17 - An ex post assessment of impact of BXW disease and the control practices on different household livelihood options in East and Central Africa	Donor report and Manuscript available	
CC5.1.6.20 - Ex-post analysis of the impacts of improved cassava varieties on smallholder livelihoods in Sierra Leone	Dataset and preliminary report available Linked with: CC5.1.6.20 - Ex-post analysis of the impacts of improved cassava varieties on smallholder livelihoods in Sierra Leone	
Assessing the efficiency of sweetpotato	Jote, A., Feleke, S., Tufa, A., Manyong, V., & Lemma, T. (2017). Assessing the efficiency of sweetpotato producers in the southern region of Ethiopia.	Applying stochastic frontier Cobb–Douglas production function, the study assessed the efficiency of sweetpotato (Ipomoea batatas) producers in the Southern region of Ethiopia. The study revealed the existence of fairly large technical inefficiency in sweetpotato production.

Producers in the southern region of Ethiopia	Experimental agriculture, 1-16. Https://doi.org/10.1017/s0014479717000199	The technical efficiency ranged from 12.6 to 93.7%, with more than half of the producers above the mean efficiency level (66.1%). This suggests that there is room for output gains through technical efficiency improvement. If the average producers in the study region are to achieve the technical efficiency level of the most efficient producer in the sample (93.7%), they can realize nearly 30% output gains. The analysis of allocative efficiency also revealed that sweetpotato producers were producing sweetpotato with sub-optimal utilization of production inputs, suggesting that potential for output gains remains to be exploited through reconfiguration of the existing resource use. They can make more value out of their sweetpotato production by reconfiguring their current utilization of production inputs in favour of more land and manure but less seed rate. Furthermore, age and education are important determinants of the efficiency of sweetpotato production. In view of these findings, it is advisable to put in place appropriate extension intervention programmes that enable sweetpotato producers to exploit the potential gains in sweetpotato output through technical and allocative efficiency improvement.

TABLE I-2: UPDATE ON ACTIONS TAKEN IN RESPONSE TO RELEVANT EVALUATIONS (IEA, CCEES AND OTHERS)

NB: *This table provides an update on the implementation status of the action plan prepared as part of the management response to the RTB independent evaluation realized in 2015 (IEA – 2015) under the supervision of Independent Evaluation Arrangement (IEA). The first management response was presented the 24th January 2016, the last column of the table indicates the current status of each action planned.*

Name of the evaluation	Recommendation	Management response	Action Plan	By whom	By when	Status (Updated)
IEA - 2015 The first management response was presented the 24th January 2016	**RELEVANCE**					
	Recommendation 1 (integrated breeding programs): RTB needs to make further efforts to enhance integration beyond individual time-bound projects. In particular, further value would be gained by fully integrating the IITA and CIAT cassava breeding programs. There is also clear potential for integration and consolidation of all RTB research on banana and plantain by IITA and Bioversity. This would likely result in rationalization of staff positions, allow better targeting of scarce W1/W2 funds and improve the ability to approach donors as an integrated program.	***Partially accepted*** Agree with the general point that RTB needs to enhance integration beyond individual projects and this will occur with design and implementation of the new RTB Program structure (based on clusters), rationalization of use of W1&2 funds and also with a CGIAR genetic gains platform currently under development which will link all Agri-Food Systems CRPs including RTB. Cassava program: Cassava breeders in IITA and CIAT note that "fully integrating" cassava breeding comes with some caveats. Breeding program objectives are different in the three important cassava growing regions, and LAC cassava material is very sensitive to viruses prevalent in Africa and quarantine issues prevent transfer of material. Hence full integration is desirable, but within the context of recognized regionally specific objectives and constraints. Banana program: More interaction between the IITA breeders with the Bioversity scientists, within the framework of RTB, will ensure that breeder and end user preferred traits are characterized and integrated into breeding programs.	1.1 Joint leadership of varietal development clusters of cassava and banana, as well as cross-cutting clusters, under FP1 (Discovery flagship) 1.2 Evaluation of progress in cross center clusters for varietal development in cassava and bananas and FP 1 clusters 1.3 Active and effective breeding platform cluster	1.1 IITA, CIAT, Bioversity (and PMU) 1.2 PMU, flagship and cluster leaders in reporting 1.3 PMU, flagship and cluster leaders	Beginning 01/16	1.1 Done 1.2 As part of annual reporting 1.3 Established

Name of the evaluation	Recommendation	Management response	Action Plan	By whom	By when	Status (Updated)
	Recommendation 2 (coherence/ consistencies of clusters): The restructuring of the program into inter-disciplinary and integrated FPs adds coherence to RTB compared to the Theme-based structure. However, in some cases the definition of clusters of activities lacks coherence and consistency with the FP problem definition e.g. the banana disease clusters, single yam cluster and complex clusters in FP4. RTB should review and revise the clusters for improved congruence with the FP problem definition	***Fully accepted*** We fully agree that the clusters need to be revised for congruence with FP problem definition. In the light of reduction in W1&2 and donor requirements for structuring CRP Phase II, there is also a need to reduce the number of clusters. We have already reduced from 32 to 25 clusters, based on five flagships, including a reduction from three to two banana disease clusters. Given this general reduction in numbers of flagships and clusters (coherence in aggregation levels, funding size, etc.) we feel that a single yam cluster is appropriate. In comparison, there are only two clusters each for the geographically much more widely cultivated crops of potato and sweetpotato.	2.1 Prepare consolidated content for 2 banana disease clusters 2.2 Improve coherence of clusters in FP4 during preparation of full proposal 2.3 Continue congruence analysis and fit of resources to FP problem definition and numbers of beneficiaries and size of benefits	2.1 PMU, Bioversity, IITA and FP/cluster leaders 2.2 PMU, Priority Assessment Focal points in each Center 2.3 PMU, flagship and cluster leaders	2.1 03/2016 2.2 03/2016 2.3 12/2016	2.1 Done 2.2 Done 2.3 Finalizing paper congruence analysis already performed
	Recommendation 3 (fund allocation): During 2012-2015, with the exception of complementary and cross-cutting funds, RTB allocated W1/W2 funds to partner centers based on historical funding. RTB has now recognized the need to move towards more strategic allocation of these funds based on program priorities and performance. In the current environment of decreasing W1/W2 funds, RTB should ensure that W1/W2 funds are directed at the highest program priorities as informed by priority assessment and performance evaluation.	***Fully accepted*** The concept of maturing the fund allocation methodology in support of the evolution of the overall system and RTB objectives makes sense. In our view, refining the methodology should consider diverse elements such as: lessons learned, impact potential, programmatic performance (e.g. against indicators), financial performance (e.g. expenditure or absorption rates), as well as set aside needs, mechanisms to apportion funds and risks to build a sustainable program and attain an effective return on investment. We agree that priority assessment can give some insights across crops and	3.1 Finalize congruence analysis from priority assessment and take this into consideration in setting budgets by cluster/flagship in full proposal 3.2 Implement more systematic performance evaluation of base and complementary funding and at cluster level as pilot in 2016 and rom 2017 3.3 Investment flow through projectized investment at the	3.1 PMU, Priority Assessment Focal points in each Center 3.2 PMU, FP/cluster leaders 3.3 PMU	3.1 in process 3.2 & 3.3 02/2016	3.1 Considered, although reduction in W1&2 made this more challenging 3.2 Cluster level evaluation introduced from 2017 3.3 Done

Name of the evaluation	Recommendation	Management response	Action Plan	By whom	By when	Status (Updated)
		technologies but it is one element of several and would not e.g. address how much to assign to cross cutting activities or to gender research or CapDev. Also, should recognize that diminished W1&2 reduces ability to direct investment and abrupt shifts in funding may be counter to the notion of RTB as an "alliance".	cluster level.			
	Recommendation 4 (Priority Assessment): RTB should use priority assessment results for setting program priorities and in program planning, including fundraising. In doing so, RTB should also plan for continuous improvements in the data and estimates that support priority assessment.	***Partially accepted*** The assumptions behind the priority assessment results need to be cross checked in light of more recent evidence and unless sound and up to-date assumptions are used for ex-ante estimates, investment decisions could be misleading. Also need to be aware of cost implications of continuous improvements under very limited W1&2 funding. Need also to invest scarce resources in ex-post impact studies. Continuous improvement of data and estimates: Improved information should be available through M&E. But there are cost implications of continuous data improvements. More reasonable to upgrade every three years and major priority assessment every 6 years. Using priority assessment results for fundraising has its limitations as donors in majority have their own mechanisms for setting priorities.	4.1 Upgrade full set of priority assessment data every three years 4.2 Major priority assessment every 6 years	4.1 & 4.2 PMU, Priority Assessment/ Impact Assessment focal points	4.1 2018 4.2 2021	4.1 Pending 4.2 Pending
	QUALITY OF SCIENCE					
	Recommendation 5 (publications): RTB has published some excellent research papers in appropriate journals	***Fully accepted*** As the reviewers mention, there are good reasons for where RTB science	5.1 Insist on (clearer) attribution/ acknowledgement/	5.1 PMU, MC/ DDGs Research of each Center,		5.1 Done. Guidelines provided. Follow up continued.

Name of the evaluation	Recommendation	Management response	Action Plan	By whom	By when	Status (Updated)
	with high impact. At the same time, the percentage of publications in non-IF journals is disturbingly high – 39 percent. While it is recognized that most RTB crops are at a disadvantage in terms of the range of journals willing to publish on these crops and the need to target African journals to promote research findings to the most appropriate stakeholders, RTB should endeavor to assure that its science quality is consistently high in order to target and publish in higher quality journals for greater international impact.	is published. With emphasis on delivery, this kind of work does not usually go to high impact journals. Giving emphasis to discovery research in Phase II will lead to high-impact publications, but with a longer time-frame. One topic for analysis at the CGIAR-wide level is the trade-off between publication in the higher impact journals and opting for open access journals which may have lower impact factors.	branding and tagging of key words of RTB in publications. 5.2 Create incentives for more publications through reporting and performance evaluation.	communication Center Focal points 5.2 PMU, MC/DDGs Research of each Center		5.2 Done with cluster performance bonus 2017
	Recommendation 6 (monitoring quality of science): Although individual Centers are responsible for the performance of their scientists, RTB is responsible for the quality of science implemented and generated by the program. The MC in consultation with the FP leaders should play a more active role in monitoring the quality of science produced by RTB with oversight by the ISC. Reviving Commissioned External Evaluations at CRP-level would be of greatest value.	***Fully accepted*** This is a good suggestion. ToRs of both flagship project and cluster leaders will include this aspect. We also agree on the value of CRP commissioned External Evaluations; however, the frequency and intensity of these evaluations should be related to the level of available W1&2 funding, with perhaps an evaluation of one flagship per year under higher levels of funding or in alternate years under a lower funding scenario. It is not only the direct cost of implementation but also the cost of the scientists' time involved which now has to be fully budgeted for.	6.1 CRP commissioned evaluations will be included in the Evaluation plan, developed for the 2nd Phase.	6.1 PMU	01/2017	6.1 CRP commissioned evaluations not implemented.
	Recommendation 7 (strengthening breeding programs): RTB needs to further modernize and strengthen its breeding	***Partially accepted*** We agree with the idea of strengthening the breeding programs. However, this recommendation understates good progress already made and the	7.1 As part of the redesign of RTB structure a breeders' community of practice is being set up.	7.1 PMU, FP and cluster leaders 7.2 PMU and FP1	7.1 in process	7.1 Done 7.2 Done, Michael Friedmann on

Name of the evaluation	Recommendation	Management response	Action Plan	By whom	By when	Status (Updated)
	programs. Within the current funding climate, highest priority should be given to: a) Adoption of the best breeding strategies for its crops that involve harmonizing breeding approaches within crops and transferring lessons across crops, where possible; b) A benchmark study of its utilization of genomic technologies with the most adopted ones by the private sector to identify opportunities for improvement in the deployment of techniques such as gene editing and MAB; c) Deployment of precise high-throughput phenotypin5g methods, novel breeding techniques and modelling for traits such as drought and temperature stress through engagement with best practice in ARIs; d) Attracting young scientists working in genomics-led breeding, bioinformatics or omics research for both accelerating breeding and increasing genetic gains; and e) Placing more emphasis on training the next generation of plant breeders so that breeding will continue after the termination of the short term bilateral project funding.	continuous aim to use up-to-date breeding methods. The new genetic gain platform under discussion should help to address all of these points. However, also need to recognize that strengthening breeding programs requires funding and infrastructure to improve the level of excellence. A complementary option is to intensify partnership with private sector and ARIs and with other organizations to increase access to the latest advances in breeding. techniques and infrastructure The training of next generation of plant breeders is critical. However, this may be best achieved by partnering and leveraging other institutions with capabilities and resources for training the next generation of breeders that can complement our limited W1&2 funding.	7.2 RTB to strongly engage in design of proposal of new genetic gains platform and ensure articulation with RTB FP1 and the breeding community of practice. 7.3 Identify partnering opportunities for training next generation of breeders	Flagship and cluster leaders 7.3 Flagship 1 and 2 leaders and their respective clusters with DDGs Research and PMU	7.2 03/2016 7.3 12/2017	steering committee 7.3 Pending

Name of the evaluation	Recommendation	Management response	Action Plan	By whom	By when	Status (Updated)
	Recommendation 8 (NARS/consumer needs): RTB should better target client needs by delivering only two to three achievable product profiles for each mandate crop to NARS and placing even greater emphasis on farmer and consumer needs. RTB and NARS should decide together on the division of labor based on NARS capability in each target country. This will allow RTB to provide appropriate back-stopping to NARS in further development of the products into cultivar(s) for release to farmers.	***Accepted*** This is consistent with our approach to have better variety and technology delivery pipelines responding to user demand.	8.1 Revisit clusters to assure proper integration and visibility of consumer needs and feedback loops between FP1/FP2 and clusters of other FPs. 8.2 Strategic review of NARS breeding capability for key crops and targeted countries potentially linked with genetic gains platform	8.1 & 8.2 PMU, FP and cluster leaders	8.1 in process 8.2 12/2017	8.1 Considered indirectly with RTBFoods and with work in Gender and Breeding. Also, linkage to EiB 8.2 Beyond our scope, perhaps included in BPAT initiative
	EFFECTIVENESS					
	Recommendation 9 (CoP Breeding): RTB should develop a community of practice of researchers across all crop breeding undertakings for enhancing effectiveness through better synergy. It will allow the sharing of ideas on methods, data, results and user feed-back, thus leading to integrated data platforms, developing inter-center working groups on traits, enhancing the inter-disciplinarity between lab-genomics and field-breeding, establishing single RTB breeding programs for banana and cassava, and sharing experiences among those engaged in transgenic breeding.	***Partially accepted*** Fully agree on the community of practice as noted under recommendation #1, we have reservation about a single RTB breeding program for cassava. All RTB center geneticists and breeders are involved in the planning of the breeding activities for 2016 and Phase II, thus promoting collaboration and a shared mission, enhancing inter-disciplinarity.	9.1 As part of the redesign of RTB structure a breeders community of practice is being set up	9.1 PMU, FP1 and FP leaders and cluster leaders	In process	9. Done.
	Recommendation 10 (seed system): The establishment of economically	***Partially accepted*** We agree on the importance of seed work	10.1 Continue supporting work on assessing demand for quality	10.1 FP2 leader and relevant cluster	2017-2019	10.1 Done 10.2 Seed system

Name of the evaluation	Recommendation	Management response	Action Plan	By whom	By when	Status (Updated)
	sustainable seed systems for RTB crops is of core importance for program effectiveness. Priority should be given to assessing demand for clean high-quality planting material throughout the seed value chain; on understanding the incentives for small holders to purchase quality planting material; as well as mechanisms for strengthening the supply chain with links to marketing and processing. Due to the importance of seed systems research for impact, as RTB moves into scaling-up and scaling-out seed systems activities, it should recruit an expert in RTB seed systems rather than relying on short term inputs from consultants and partners as was noted in Chapter 4	in RTB because they are all clonally propagated – and have therefore set up FP2. Seed system experts should be contracted via the relevant centers and not form part of PMU. Given the volatile and limited nature of W1&2 funds this should be encouraged via the relevant bilateral or W3 project opportunities.	planting materials and market driven approaches 10.2 Enable cross crop/cross Partner collaboration on variety release and dissemination for clonally propagated crops.	leaders 10.2 PMU with FP1, FP2, FP5 Leaders and relevant cluster leaders		framework published
	Recommendation 11 (agronomy/crop management): Some aspects of crop management research, for example agronomy and soil fertility research in Theme 5, have not been well-supported. Narrowing the yield gap for farmers may require rebalancing the RTB portfolio towards agronomic and soil fertility research. In order to improve the realized yields in farmer's fields, RTB needs to better integrate research on crop improvement and crop management which have been implemented in different Themes to date and will be implemented in different FPs in the new program	***Partially accepted*** We agree that better integration and visibility in the cluster structure is needed. Agronomic aspects are mainly focused in FP3 but due to the nature/logic of the cluster set up, integrated in different clusters also under other FPs. Yield gap analysis shows a strong role for agronomy and soil fertility in improving yields. However, until recently this area of work in RTB crops often appears as more location specific and has not really demonstrated IPGs. And impact assessments with RTB have shown less clear evidence of impacts of agronomic/crop management work. However, this is an important area and	11.1 Revisit FP 3, its clusters and all other relevant clusters to assure proper integration and visibility of agronomic aspects and feedback loops with FP3.	11.1 PMU, FP and cluster leaders	In process	11.1 Pending, hampered by funding reduction (e.g. decision to protect breeding)

Name of the evaluation	Recommendation	Management response	Action Plan	By whom	By when	Status (Updated)
	structure.	inclusion of more systems work with implementation as Agri-food System CRP, RTB should strengthen human resources and bring novel approaches to bear.				
	Recommendation 12 (post-harvest research): RTB should focus post-harvest research on the crop-specific aspects of value chain improvements that can deliver added value, as these are most likely to generate global public goods. Assessing lessons from the emerging cassava Theme 6 research results should help to identify transferable lessons and strategies for other RTB crops, providing a basis for scalability of lessons learned.	***Fully accepted*** However, should note that cassava has by some distance the greatest potential currently for local value added from processing driven in part by rapid postharvest physiological deterioration and also by local food preferences. This explains why it has a cluster for post-harvest innovation. All crops have some potential. Some value chain aspects are crop related and are not easily transferable as such.	12.1 Revisit FP 4, its clusters and all other relevant clusters to assure proper integration and visibility of post-harvest lessons learnt into other clusters.	12.1 PMU, FP and cluster leaders	In process	12.1 Pending
	GENDER, CAPACITY DEVELOPMENT AND PARTNERSHIPS					
	Recommendation 13 (communication/ knowledge management): It is recommended that RTB management ensures that adequate resources are made available to develop and implement the needed strategy for communication and knowledge management. Flagship and cluster leaders as well as bilateral project leaders will need access to communication and knowledge management expertise, and be enabled to incorporate knowledge management 'experiments' into the design of new projects to achieve the ambitious intentions laid out in the pre-proposal. A strategy similar to the one proposed on capacity development (and drawing on lessons from the	***Fully accepted*** We agree with the need to include communication and knowledge management aspects in the research program. However, given shrinking share of W1&2 more of this should be embedded in bilateral and W3 projects whilst providing a critical support and oversight function at the overall program level. The M&E capability of RTB will help to underpin the design and utility of both Recommendations 13 and 14 in an integrated way.	13.1 Communication (strategy/action plan) will be integral part of the 2nd Phase proposal.	PMU, Center communication and KM focal points	01/2017	13.1 Pending

Name of the evaluation	Recommendation	Management response	Action Plan	By whom	By when	Status (Updated)
	approach adopted to address gender issues) is recommended.					
	IMPACT AND SUSTAINABILITY					
	Recommendation 14 (impact assessment): Impact assessment is strategically important for demonstrating impact, justifying resources, and informing program planning. RTB needs a clear strategy of how priority and impact assessments will be linked over time, and how the results from *ex-post* assessments, complementing *ex-ante* assessment, will inform program planning. This may lead to changes in the design of *ex-post* assessments. In formulating an impact assessment plan, RTB should scale up activities and apply lessons from the SIAC projects they are currently engaged in. It should also ensure comparable quality of efforts across crops and regions.	***Fully accepted*** However, see point on continuous updating of data for priority assessment (recommendation #4).	14.1 Finalize ongoing Impact Assessment 14.2 CRP commissioned evaluations; Impact Assessment will be included in the RBM set-up and Evaluation plan, developed for the 2nd Phase.	14.1 PMU & Impact Assessment Center focal Points 14.2 PMU, MC	14.1 During 2016 14.2 01/2017	14.1 Strategy linking ex-post and ex-ante has improved 14.2 CRP commissioned evaluations not implemented. Impact assessment is integral to RBM / M&E
	GOVERNANCE AND MANAGEMENT					
	Recommendation 15 (leadership roles/responsibilities): RTB should bring clarity to the respective roles, relationships and accountabilities of FP leaders, cluster leaders and bilateral project leaders	***Fully accepted*** The continuous improvement of leadership roles and responsibilities is seen as a natural progression in the evolution of the program. RTB intends to maximize its management effectiveness based on its	Reformulation of the Terms of Reference for all these positions as we move to flagship based program structure	PMU, MC and ISC	In process	15. Done

Name of the evaluation	Recommendation	Management response	Action Plan	By whom	By when	Status (Updated)
	within the management structures of RTB and the centers.	institutional memory and lessons learned. ToR of FP and cluster leaders, and work plans of individual scientists within centers contributing to RTB should be streamlined to clarify the contribution to RTB deliverables, and staff members should be assessed in terms of fulfillment of the commitments				
	Recommendation 16 (alliance compact): RTB partners should develop and agree on an alliance compact building on the progress already made in inter-center collaboration. Such an alliance would bring clarity and greater understanding to critical partnership questions such as: allocation and use of W1/W2 funds, handling of W3/bilateral projects, participation in RTB governance and management, alignment of management processes, handling of joint appointments, handling joint undertakings and codes of conduct in program participation.	***Partially accepted*** We appreciate the acknowledgement that "RTB has made significant progress in establishing G&M structures and processes that create new ways of working to promote the inter-dependence of the members of the RTB alliance. The creation of the ISC has improved governance and works well with the Program Management Unit." Although the concept of an alliance compact is not fully developed in the evaluation, we concur with the basic concept that a soft contractual vehicle, among centers, to better define basic rules of engagement, could strengthen the partnership. It should be noted that some of the topics indicated for this 'alliance compact' are currently under examination by the Transition Team (TT) working to establish the System Council, Systems Office and associated functions (notably the finance working group of the TT on aspects such as the allocation of W1/W2 funds, handling of W3 and bilateral projects, participation in CRP G&M, alignment of management processes…). The outcome of the TT	16. 1 Identify potential governance, operational and business relationships which could further enhance the alignment of partner objectives for strategic goals and could be included in a soft contractual vehicle such as an alliance compact or similar alternative model. 16.2. Building on analysis under 16.1, agree Strategy Statements which would constitute "soft contracts" to be achieved through Compact or other mechanisms for improving Governance and Management and agree a timeline for implementation	16.1 ISC and PMU/MC followed by CIP BoT 16.2. ISC and PMU/MC followed by CIP BoT	16.1 from 06/2016 once the new Systems Office is in place 16.2. until 11/2016	16.1 Done 16.2 Done

Name of the evaluation	Recommendation	Management response	Action Plan	By whom	By when	Status (Updated)
		work should be considered and be aligned with new mechanisms such as an 'alliance compact'.				

TABLE J: CRP FINANCIAL REPORT

	Planned budget 2017				Actual expenditure 2017*				Difference			
	W1/2	W3/ bilateral	Center Own Funds	Total	W1/2	W3/ bilateral	Center Own Funds	Total	W1/2	W3/ bilateral	Center Own Funds	Total
FP1	3,682	7,662	246	**11,591**	3,510	8,295	486	**12,292**	172	(633)	(241)	**(701)**
FP2	4,594	30,328	159	**35,081**	4,434	24,067	359	**28,861**	160	6,261	(200)	**6,220**
FP3	3,726	14,234	894	**18,855**	3,419	11,884	662	**15,965**	307	2,350	233	**2,889**
FP4	1,577	15,997	31	**17,605**	1,507	14,640	-	**16,147**	69	1,357	31	**1,457**
FP5	3,930	14,499	60	**18,489**	3,738	12,121	34	**15,893**	192	2,378	26	**2,596**
Strategic Competitive Research grant	1,063	-	-	**1,063**	98	-	-	**98**	965	-	-	**965**
CRP Management & Support Cost	2,027	2,710	-	**4,737**	1,594	2,697	-	**4,291**	432	13	-	**445**
CRP Total	**20,598**	**85,429**	**1,391**	**107,418**	**18,301**	**73,704**	**1,542**	**93,547**	**2,297**	**11,726**	**(151)**	**13,871**

*Source [Program participants Q4 Financial report]

LIST OF W2 DONORS	
DONORS	**AMOUNT (USD)**
Australian Centre for International Agriculture Research	1,112,298
Government of Switzerland	2,020,000
Department for International Development/UK Aid	6,437,364
TOTAL	**9,569,662**

RESEARCH PROGRAM ON
Roots, Tubers and Bananas

CGIAR

The CGIAR Research Program on Roots, Tubers and Bananas (RTB) is a partnership collaboration led by the International Potato Center implemented jointly with Bioversity International, the International Center for Tropical Agriculture (CIAT), the International Institute of Tropical Agriculture (IITA), and the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), that includes a growing number of research and development partners. RTB brings together research on its mandate crops: bananas and plantains, cassava, potato, sweetpotato, yams, and minor roots and tubers, to improve nutrition and food security and foster greater gender equity especially among some of the world's poorest and most vulnerable populations.

www.rtb.cgiar.org

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