



RTB Report

Stocktaking and Perspective Exercise on Adoption and Impact Studies

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JUNE 2019



RESEARCH
PROGRAM ON
Roots, Tubers
and Bananas



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Comments are invited

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Correct citation: Cooper, R. 2019. Stocktaking and Perspective Exercise on Adoption and Impact Studies. Rome (Italy). CGIAR Research Program on Roots, Tubers and Bananas (RTB). Available online at: www.rtb.cgiar.org

Published by the CGIAR Research Program on Roots, Tubers and Bananas

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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ISSN 2309-6586

DOI+ISBN

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Abstract

The CGIAR Research Program on Roots, Tubers and Bananas (RTB) is led by the International Potato Center (CIP) with Bioversity International, the International Center for tropical Agriculture (CIAT), the International Institute of Tropical Agriculture (IITA) and the French Agricultural Research Centre for International Development (CIRAD—also representing other French partners IRD, INRA, Vitropic) and includes a wide spectrum of research for development stakeholders. This collaboration, with its combined scale and capacity, will increase the ability to advance research, share knowledge, and enhance uptake to increase research and development impacts. The purpose of RTB is to exploit the underutilized potential of root, tuber, and banana crops to improve nutrition and food security and foster greater gender equity especially among some of the world’s poorest and vulnerable populations.

This document presents research on ex-post impact assessments generating evidence on the progress being made along RTB impact pathways and identifies the main gaps and possible synergies among program participants. In addition, it proposes focus areas and possible studies for future ex-post impact assessments in order to contribute to the shaping of the cluster “CC5.1 – Foresight and Impact assessment” agenda for 2019-2021. The results of the analysis reveal a concentration of ex-post impact assessments on SLO 1, *Reduced Poverty*, and a need to further assess the work being done in SLO 2, *Improved food and nutrition security and health*, and especially SLO 3, *Improved natural resource systems and ecosystem services*. The decentralized nature of earmarked funding for “CC5.1 – Foresight and Impact assessment” along with other reasons explored in the document, make strategic choices for ex-post impact studies challenging. The paper additionally explores areas for strengthened communication between flagships and clusters and the potential to increase mixed-methodologies meshing biological and social sciences to strengthen the explanatory power of ex-post impact assessments.

Acknowledgments

The author would like to thank Claudio Proietti and Elisabetta Gotor for their considerable contributions to the research and final document. Additionally, RTB scientists, including the “CC5.1 – Foresight and Impact assessment” scientists, who agreed to be interviewed for this research were generous with their time and thoughts on ex-post assessments, and the author would like to thank all for their inputs.

This research was undertaken as part of, and funded by, the CGIAR Research Program on Roots, Tubers and Bananas (RTB) and supported by [CGIAR Trust Fund contributors](#).

Stocktaking and Perspective Exercise on Adoption and Impact Studies

INTRODUCTION

RATIONALE AND SCOPE

The CGIAR Research Program on Roots, Tubers and Bananas (RTB) is led by the International Potato Center (CIP) with Bioversity International, the International Center for Tropical Agriculture (CIAT), the International Institute of Tropical Agriculture (IITA) and the French Agricultural Research Centre for International Development (CIRAD—also representing other French partners IRD, INRA, Vitropic) and includes a wide spectrum of research for development stakeholders. This collaboration, with its combined scale and capacity, will increase the ability to advance research, share knowledge, and enhance uptake to increase research and development impacts. The purpose of RTB is to exploit the underutilized potential of root, tuber, and banana crops to improve nutrition and food security and foster greater gender equity especially among some of the world's poorest and vulnerable populations.

The stocktaking and perspective exercise focuses on the adoption/impact assessment studies that generate evidence on the progress made along the program impact pathways.

The objectives of the exercise should contribute to identifying:

1. if and where evidence of progress towards outcomes/impact have been documented;
2. where are the main gaps and possible synergies among program participants (e.g. thematic areas, geographies, methods) to orient future planning.

METHODOLOGY

The stocktaking and perspective exercise utilizes three methodologies to collect, triangulate, and crosscheck findings, to generate a holistic account of RTB studies that are generating evidence along impact pathways. The methodologies employed include a literature review, semi-structured interviews with key informants, and a mapping exercise of the studies conducted from 2010 to 2018 to log the RTB impact pathways.

The literature review consists of a selection of program documents prepared by the Program Management Unit (PMU) and includes RTB programmatic documents dating back to 2013 and consisting mainly of results-based management documentation, as well as RTB Second Phase documentation, up to and including, the 2017 Annual Report.

Semi-structured interviews were held between January and March 2019 with 23 RTB program participants, who were strategically chosen by the RTB Program Management Officer and the CC5.1 Cluster Leader. Two interview schedules

were developed to collect data for Cluster CC5.1-specific participants, and for other participants. In addition to the Cluster CC5.1 Lead and scientists, interviews were held with the CRP Director, Flagship Leaders (except for Flagship 2, who was unavailable for an interview), various Cluster Leaders, Centre Focal Points, the Gender Coordinator, and other program participants. The complete interview schedule is found in Annex A.

The mapping exercise is performed on two sets of data: ex-post evaluations that have been completed, and potential ex-post evaluations. The former mapping exercise was conducted in two parts. The first part identifies all ex-post evaluations completed on RTB projects and these are sourced from an Independent Evaluation Arrangement (IEA) database and relevant deliverables as recorded in MEL under the product “CC5.1.3 - Ex post impact studies on technology adoption and adaptation”. These studies are categorized in terms of date of publication, relevant System Level Outcome (SLO), Innovation Domain (including Crop improvement, Seed systems, Pest and disease management, Cropping systems / Farming systems, Agriculture for nutrition, Post harvesting and processing, and Enabling policies and institutions), as well as type of crop or specific innovations (e.g. cooperative societies).

In the second part of the mapping, ex-post evaluations were linked to the RTB impact pathways. This was achieved by mapping studies to flagship program outcomes, which are then linked to nested Sub-IDOs, IDOs¹, and SLOs. Maps of each SLO pathway and associated studies are found in the Figures 9, 12, 16 and 23.

The second set of data that was mapped pertain to potential ex-post assessments. The raw data for the potential studies is derived from semi-structured interviews, as above. The mapping includes data on the potential study’s focus, and the associated innovation domain, crop, and geographical location. Additionally, useful “details” for the studies have been furnished where possible to provide more detail top the PMU and the CC5.1 Cluster team.

METHODOLOGICAL LIMITATIONS

Given the number of links and connections between ex-post evaluations performed and flagship outcomes, Sub-IDOs, IDOs, and SLOs, links between specific studies and impact pathways are limited to one per study. This decision was taken to simplify the mapping process in order to provide a clear representation of the main gaps in ex-post evaluations and better orient future programming.

¹ IDO – Intermediate Development Outcome

GENERATING EVIDENCE OF PROGRESS TOWARDS REACHING RTB OUTCOME/IMPACTS – CONCEPTUAL FRAMEWORK

DEFINITION OF OUTCOMES AND IMPACTS

RTB, together with partners, conducts research for development (R4D) on its mandate crops and supports options for scaling, while taking a systems perspective to ensure relevance and impact. RTB contributes to CGIAR goals – system level outcomes (SLOs) – through the achievement of specific goals which are:

- 20,000,000 people (50% women) have increased their income;
- 30,000 small and medium enterprises (SMEs) are operating profitably in the RTB seed and processing sectors;
- 8,000,000 farm HH have increased RTB crop yield through the adoption of improved varieties and sustainable management practices;
- 10,000,000 people (50% women) have improved their diet quality, and;
- 1,900,000 ha of current RTB crops production area converted to sustainable cropping systems.

The goals are being achieved via a set of outcomes identified as Intermediate Development Outcomes (IDOs) and their associated Sub – IDOs, achieved through RTB's five flagship programs (FP). The detailed alignment of goals and outcomes with the SDGs is shown in Figure 1.

Each of the five interlinked and interactive FPs has its own overall objective:

- FP 1: Discovery research for enhanced utilization of RTB genetic resources: develop and apply leading-edge science toward faster and more precise development of user-demanded varieties, and to enhance the long-term conservation and use of genetic diversity.
- FP 2: Adapted productive varieties and quality seed of RTB crops: make available good – quality planting materials of a diverse set of high-yielding RTB varieties that are adapted to the needs and preferences of different stakeholders in the value chain.
- FP 3: Resilient RTB crops: close yield gaps of RTB crops arising from biotic and abiotic threats and to develop more resilient production systems, thereby strengthening food security and improving natural resource quality.
- FP 4: Nutritious RTB food and added value through post-harvest intervention: support the fuller, equitable, and sustainable utilization of RTB crops for healthier diets and improved income opportunities.
- FP 5: Improving livelihoods at scale: improve livelihood resilience by scaling RTB solutions in agri-food systems.

SDGs	SLOs	IDOs	Sub IDOs	Flagship projects contribution				
				1	2	3	4	5
	1 Reduced Poverty	1.3 Increased incomes and employment	1.3.1 Diversified enterprise opportunities		x		x	x
			1.3.4 More efficient use of inputs				x	
		1.4 Increased productivity	1.4.1 Reduced pre- and -post production losses, including those caused by climate change			x	x	
			1.4.2 Closed yield gaps through improved agronomic and animal husbandry practices		x	x		x
			1.4.3 Enhanced genetic gain	x	x			
	2 Improved food and nutrition security and health	2.1 Improved diets for poor and vulnerable people	2.1.1 Increased availability of diverse nutrient-rich foods		x			
			2.1.3 Optimized consumption of diverse nutrient-rich foods				x	x
	3 Improved natural resources systems and ecosystems services	3.2 Enhanced benefits from ecosystem goods and services	3.2.2 Agricultural systems diversified and intensified in ways that protect soils and water					x
			3.2.3 Enrichment of plant and animal biodiversity for multiple goods and services	x				
		3.3 More sustainably managed agro-ecosystem	3.3.1 Increased resilience of agro-ecosystems and communities, especially those including smallholders			x		
			3.3.2 Enhanced adaptive capacity to climate risks	x	x	x		x
	Cross-cutting	A.1 Mitigation and adaptation achieved	A.1.4 Enhanced capacity to deal with climatic risks and extremes	x	x	x		x
		B.1 Equity and inclusion achieved	B.1.1 Gender-equitable control of productive assets and resources		x	x	x	x
			B.1.3 Improved capacity of women and young people to participate in decision-making					x
		C.1 Enabling environment improved	C.1.1 Increased capacity of beneficiaries to adopt research outputs					x
			C.1.3 Conducive agricultural policy environment		x	x	x	
		D.1 National partners and beneficiaries enabled	D.1.1 Enhanced institutional capacity of partner research organizations	x				x
			D.1.2 Enhanced individual capacity in partner research organizations through training and exchange	x	x			x
			D.1.4 Increased capacity for innovation in partner development organizations and in poor and vulnerable communities			x	x	x

Figure 1: SDGs, SLOs, IDOs, and (Sub)-IDOs: mapping with RTB flagship projects (sourced from RTB Full Proposal)

The linkages between FPs to reach CGIAR system level outcomes are presented in Figure 2. This broader program design matches commodity research with livelihood contexts and takes a broader systems perspective to accelerate the process of going to scale, guided by FP5. It includes an array of linkages with other crops, livestock, and fish in diverse agri-food systems through partnerships with other Agri-Food System CRPs in the CGIAR portfolio (described under FP5) and creates an incentive structure for systems integration with a livelihood focus among FPs and other Global Integrating CRPs (e.g. A4NH, CCAFS, PIM).



Figure 2: Interlinked and interactive FPs in RTB

RTB (Sub) – IDO targets are driven by the available evidence base and ex-ante analysis. Building on a priority assessment to identify research options with highest priority and greatest expected impact on poverty reduction for the major RTB crops, an ex-ante analysis of preferred technology options was carried out for all crops, based on quantitative assessments of adoption potentials and the use of an economic surplus model to estimate key impact variables. The technology options with highest potential impact were translated into RTB clusters in the new RTB structure (Figure 3).

DISCOVERY	DELIVERY		
FP1: Enhanced genetic resources	FP2: Productive varieties & quality seed	FP3: Resilient crops	FP4: Nutritious food & added value
DI1.1 Breeding CoP DI1.2 Next generation breeding DI1.3 Game changing traits DI1.4 Genetic diversity	CC2.1 Access to quality seeds/varieties BA2.2 User preferred banana cultivars/hybrids CA2.3 Added value cassava varieties PO2.4 Seed potato for Africa PO2.5 Potato varieties for Asia SW2.6 User preferred sweetpotato varieties YA2.7 Quality seed yam	CC3.1 (Pest/disease management) CC3.2 Crop production systems BA3.3 Banana fungal & bacterial wilts (Foc/BXW) BA3.4 Banana viral diseases (BBTD) CA3.5 Cassava biological constraints, Asia/Americas CA3.6 Cassava biological threats, Africa	CC4.1 Post-harvest innovation CA4.2 Cassava processing CA4.3 Biofortified cassava SW4.4 Nutritious sweetpotato
FP 5: Improved livelihoods at scale			
CC5.1 Foresight and impact assessment CC5.2 Sustainable intensification and diversification for improved resilience, nutrition and income CC5.3 Gender-equitable development and youth employment CC5.4 Institutional innovation and scaling			

Good match with priority assessment research option
 Partial match with one or more priority assessment research option(s)

Note: FP=Flagship; prefix indicates crop where relevant: DI = discovery, CC = crosscutting, BA = banana, CA = cassava, PO = potato, SW = sweet potato

Figure 3: Correspondence of RTB clusters with priority assessment results

RTB THEORY OF CHANGE AND IMPACT PATHWAYS

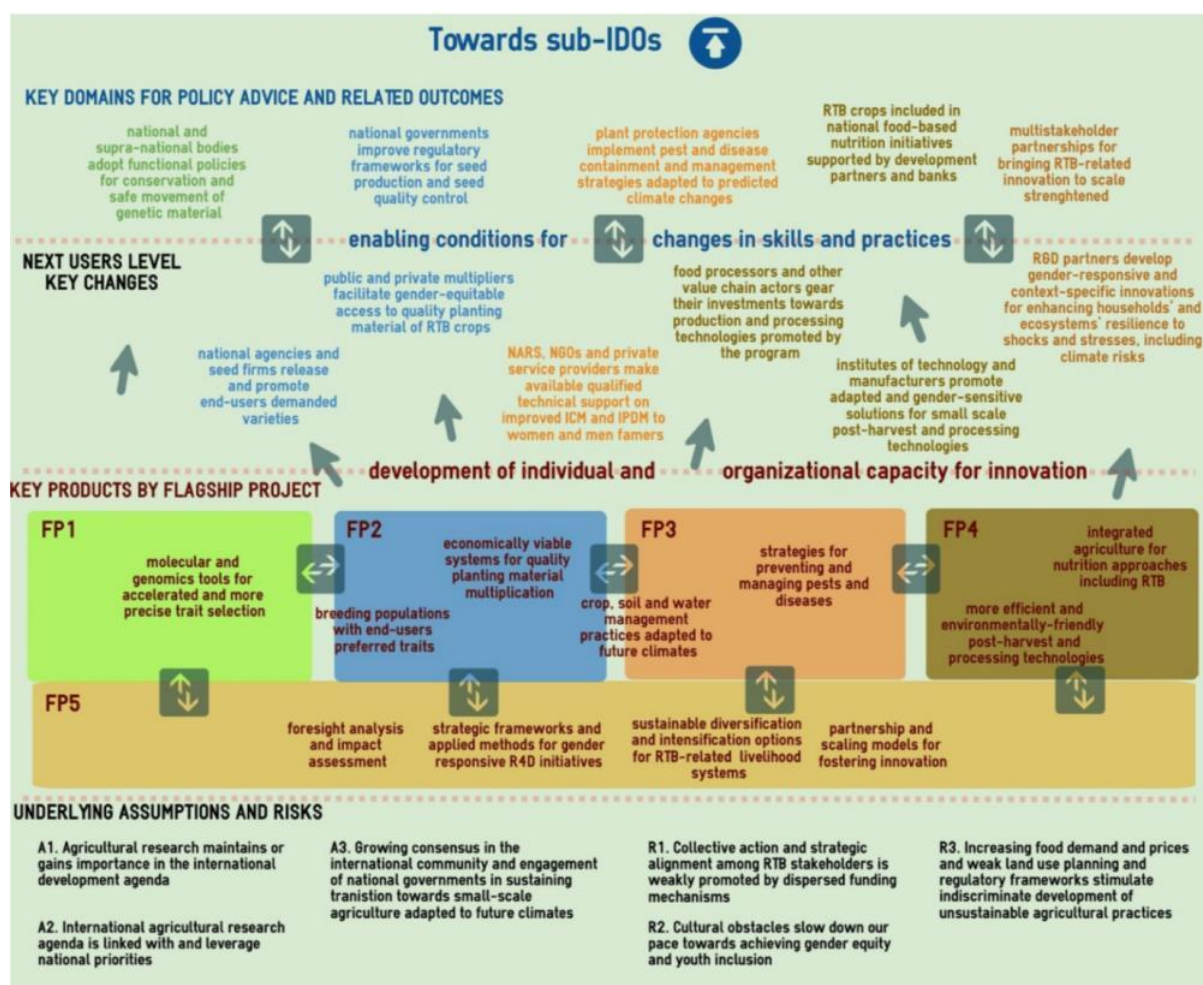
The RTB theory of change addresses poverty, food, and nutrition security, as well as sustainable development challenges by integrating contributions from all RTB FPs. A diagrammatic representation of RTB impact pathways is found in Figure 4.

FP1, which taps into underutilized genetic diversity, is informed by FP2 – FP5 on next and end user needs to make available breeding products that are used to obtain high-yielding and nutrient-rich varieties in line with consumer demand and adapted to future climates and resistant to biotic and abiotic threats. FP1 collaborates with advanced research institutes (ARIs), universities, national agricultural research systems (NARS), and other CRPs, and seeks to influence changes in policy and regulatory frameworks for enhancing conservation and safe exchange of RTB genetic diversity.

FP2 includes the upstream part of the breeding for each crop and helps to identify existing landraces with desired agronomic and user traits. It is informed by FP3–FP5 as regards the needs of next users of prototype varieties and particular constraints (e.g., disease resistance), and includes a crosscutting component on seed and approaches for demand creation. FP2 works in close relation with national breeding, genetics, and phenotyping programs, ARIs, and universities. Scaling occurs with national seed agencies, private companies (e.g., seed business, traders, processors), service providers, and development partners. At the policy level, FP2 promotes the adaptation of national regulations on seed/planting material to introduce frameworks and standards that better respond to farmers' needs.

FP3 develops an array of products for pest and disease characterization and management and improved agronomic practices for more resilient cropping systems. Pest/disease risks models related to climate change and pest risks analyses (PRAs) are developed with strategic research partners and the CRP on Climate Change, Agriculture and Food Security (CCAFS). Results are used to devise policy and technical advice for national plant protection organizations and regional and sub regional organizations. Optimized land, crop, and water management techniques are developed in collaboration with NARS and universities and promoted through well-trained extension services and other service providers. More conducive policies for ecologically sustainable intensification of RTB-related farming systems and strategies for pest/disease containment and management support NARS and development partners in going to scale. The objective of FP4 is to develop and disseminate improved and more efficient processing and post-harvest technologies and protocols for RTB-based food products that help to reduce waste and losses and make healthy and nutritious food available. It promotes collaborations among public partners (e.g., national research institutes) and private partners (e.g., food technology firms, machinery manufacturers and fabricators, small and medium processors). Moreover, FP4 provides technical evidence and policy advice to national authorities, development partners, and donors for designing and implementing agriculture for nutrition initiatives and education/communication programs. Particular attention is paid to identify value chain opportunities that generate more equitable employment and income opportunities for women and youth.

FP5 provides both a space for systems research and for providing CapDev and backstopping in support of innovation and scaling in FP1–FP4. As such, it provides a livelihoods systems-related guiding framework for all FPs to steer them toward promising institutional innovations, opportunities for advancing gender and intergenerational equity, expected and proven areas of greatest return, and scientific evidence on impactful partnership and scaling models. CapDev activities are integrated and specified in all impact pathways at cluster and FP levels. Moreover, achieving development outcomes requires strong partnerships with development stakeholders spanning public and private sector and civil society. Such multisector, multi-stakeholder partnerships have particular impact in site integration countries where, in collaboration with other CRPs, innovation and scaling processes are co-developed with ownership among local stakeholders. Research on the science of delivery with a focus on the design, implementation, and performance of partnership and scaling models and their underlying institutional arrangements is integrated into FP5 and guides cross-flagship learning.



Note: A: Assumptions, R: Risks

Figure 4: RTB Impact pathway: key products and immediate outcomes

EX-POST ASSESSMENTS PERFORMED

The stocktaking exercise examines 41 ex-post assessment studies from 2010 until 2018. The studies are sourced from an IEA database and relevant 5.1.3 deliverables as recorded in MEL. The table of studies is found in Annex B.

RTB Analysis

RTB impact pathways are structured around five flagship programs as described in Part II, and through synergistic relationships, which contribute to three SLOs, Reduced Poverty, Improved Food and Nutrition Security and Health, and improved natural resource systems and ecosystem services, as well as deliver cross-cutting impacts. The three SLO impacts are realized through related IDOs and Sub-IDOs as indicated in Figure 1.

Of the 41 ex-post evaluations analysed, 29 studies, or 71 percent pertain to SLO 1 Reduced Poverty, seven studies, or 17 percent, pertain to SLO 2 Improved Food and Nutrition Security and Health, four, or ten percent of studies, pertain to Improved Natural Resource Systems and Ecosystem Services, and one study, representing two percent of all studies pertains to cross-cutting impacts (Figure 5).

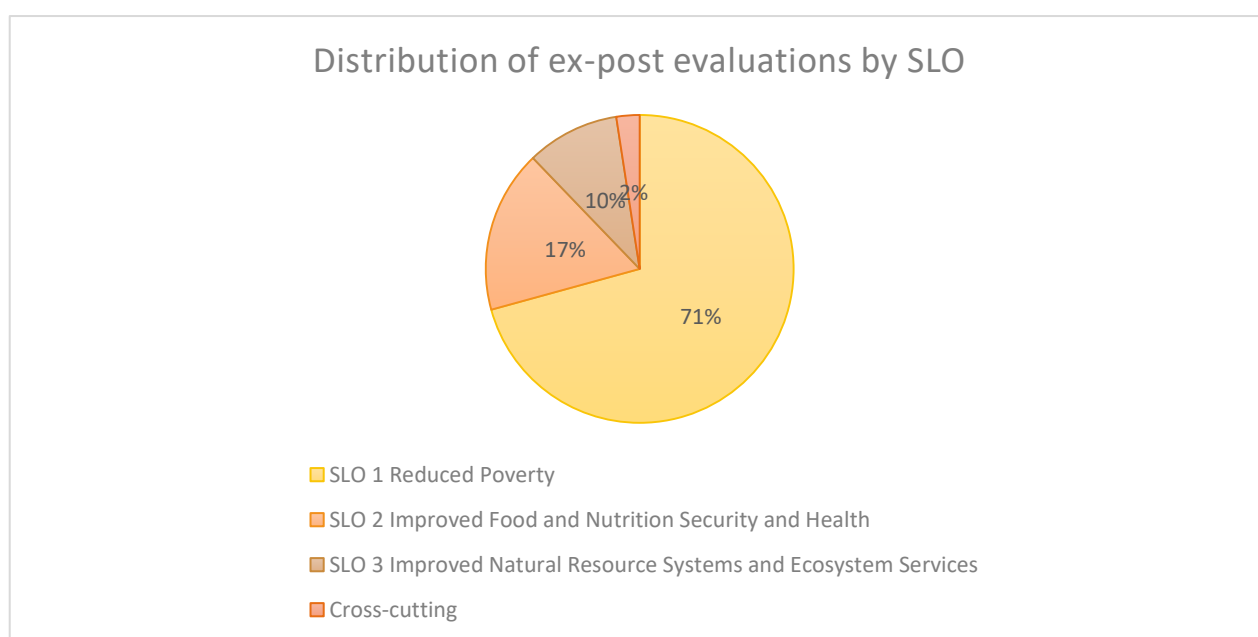


Figure 5: Distribution of ex-post evaluations by SLO

Of the 41 studies completed, 29 took place in Africa, seven in Asia, four in Latin America, and one has a global perspective. The distribution of evaluations by region is found in Figure 6.

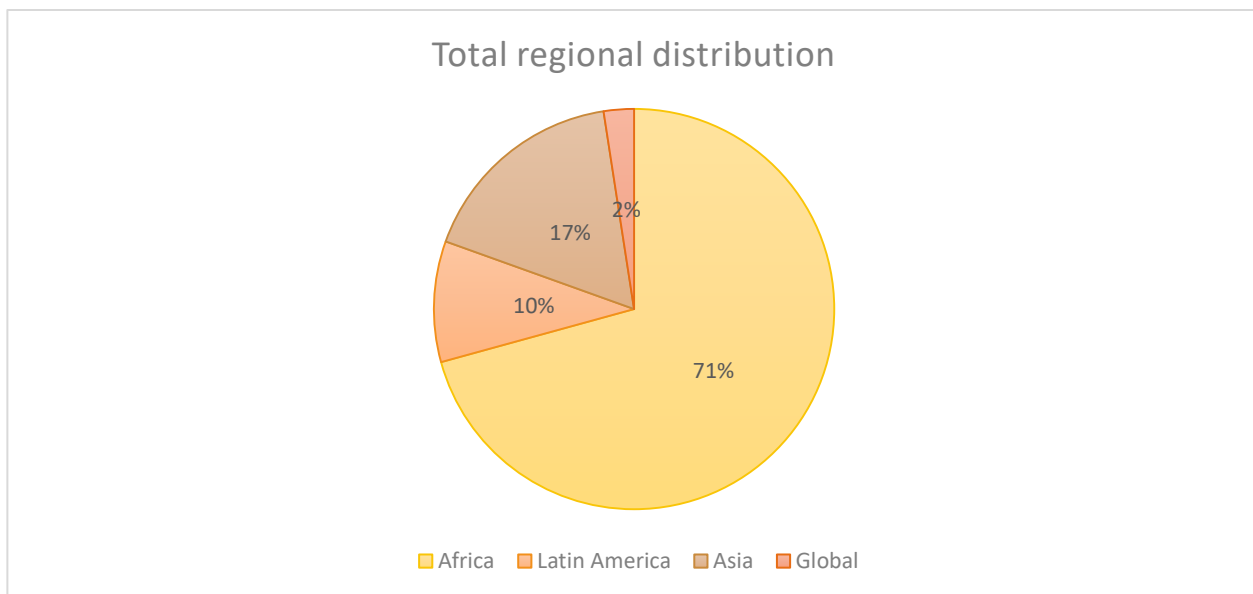


Figure 6: Total regional distribution

The majority of studies concentrate on crop improvements as the innovation domain, followed by enabling policies and institutions. The distribution of innovation domains is represented in Figure 7.

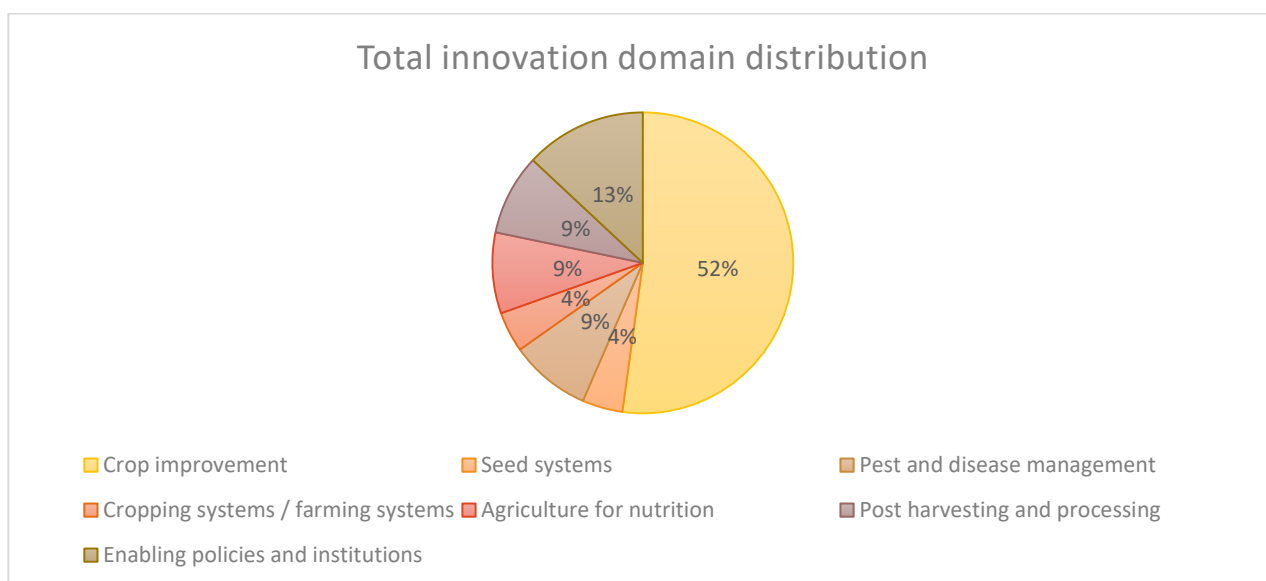


Figure 7: Total innovation domain distribution

Cassava is the leading crop studied, followed by sweet potato and potato, and yam. The distribution of crops is represented in Figure 8.

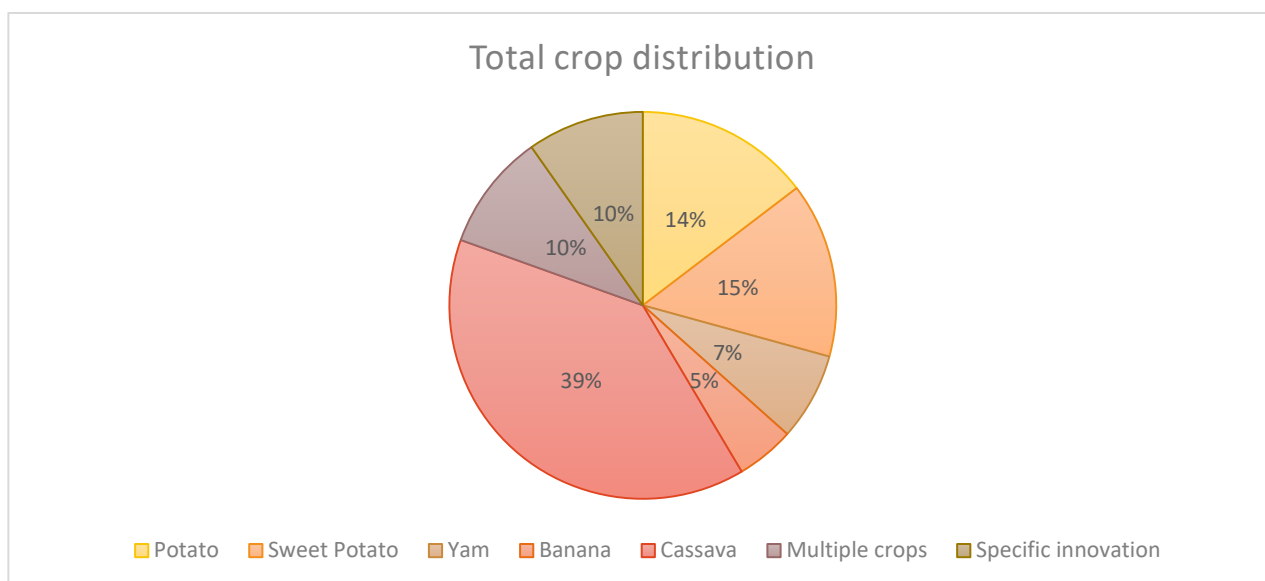


Figure 8: Total crop distribution

SLO 1

RTB achieves the impact of Reduced Poverty through the achievement of two IDOs: *increased incomes and employment* and *increased productivity*. There are ten studies linked to *increased incomes and employment* through the Sub IDOs *diversified enterprise opportunities* and *more efficient use of inputs*. There is one study related to *more efficient use of inputs*, a study on fertilizer adoption, which does not appear to link with any flagship program development outcome (see Figure 9).

There are nine studies contributing to *diversified enterprise opportunities*, which are mapped to four FP outcomes (Figure 9). The FP outcome *male and female farmers have equitable access to sufficient quantities of guaranteed high-quality RTB seed at affordable price through local, national, and regional delivery systems* does not have any studies mapped to it. Of the nine studies supporting *diversified enterprise opportunities*, five are related to FP2 outcome *Male and female processors and traders benefit from expanded market opportunities for varieties with end-user preferred traits*, two are related to FP4 outcome *SME processing sector provides sustained income and employment opportunities for women and youth, whilst reducing its environmental footprint*, and one each are mapped to FP4 outcome *RTB value chains become more efficient and diversified and generate a greater range of economic opportunities including for women and youth* and FP2 outcome *Male and female seed multipliers have increased opportunities to generate income through the profitable production and sale of diverse, locally available, high-quality RTB seed*.

SLO 1.1

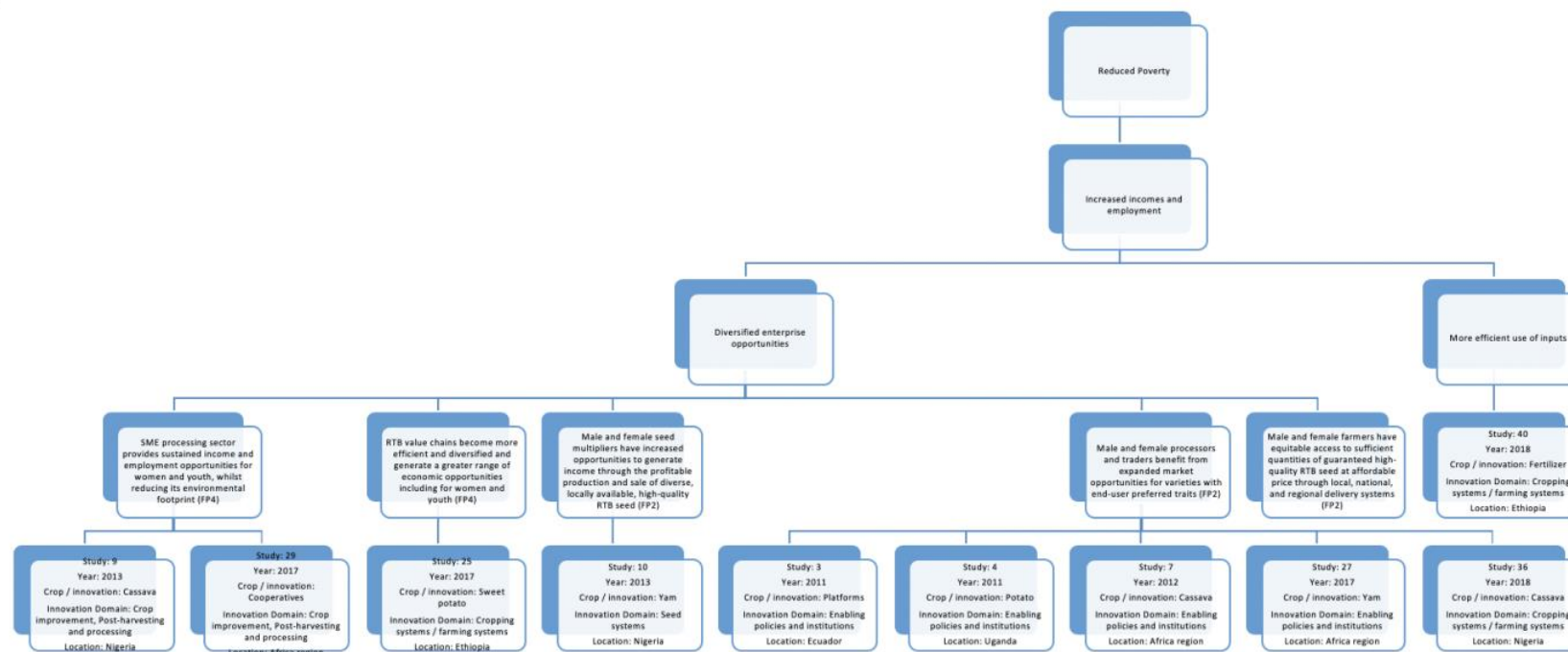


Figure 9: Impact pathway mapping of SLO 1, IDO Increased incomes and employment

Of the studies contributing to *diversified enterprise opportunities*, eight were performed in Africa and one was performed in Latin America. Figures 10 and 11 refer to the percentage of studies related to innovation domain and crop, respectively.

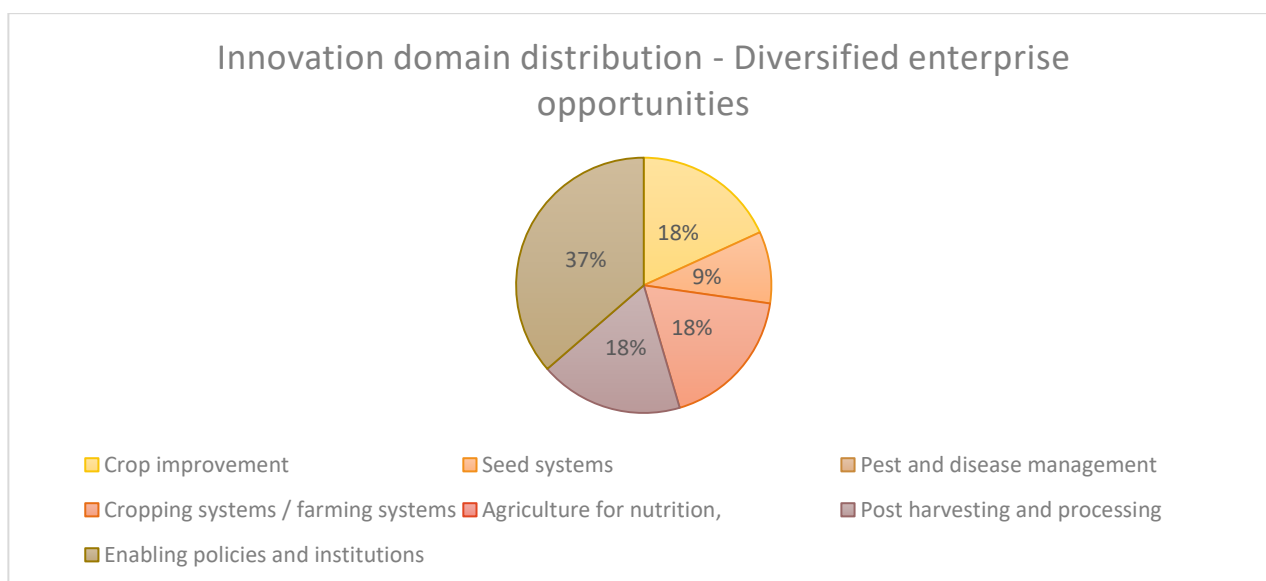


Figure 10: Innovation domain distribution - Diversified enterprise opportunities

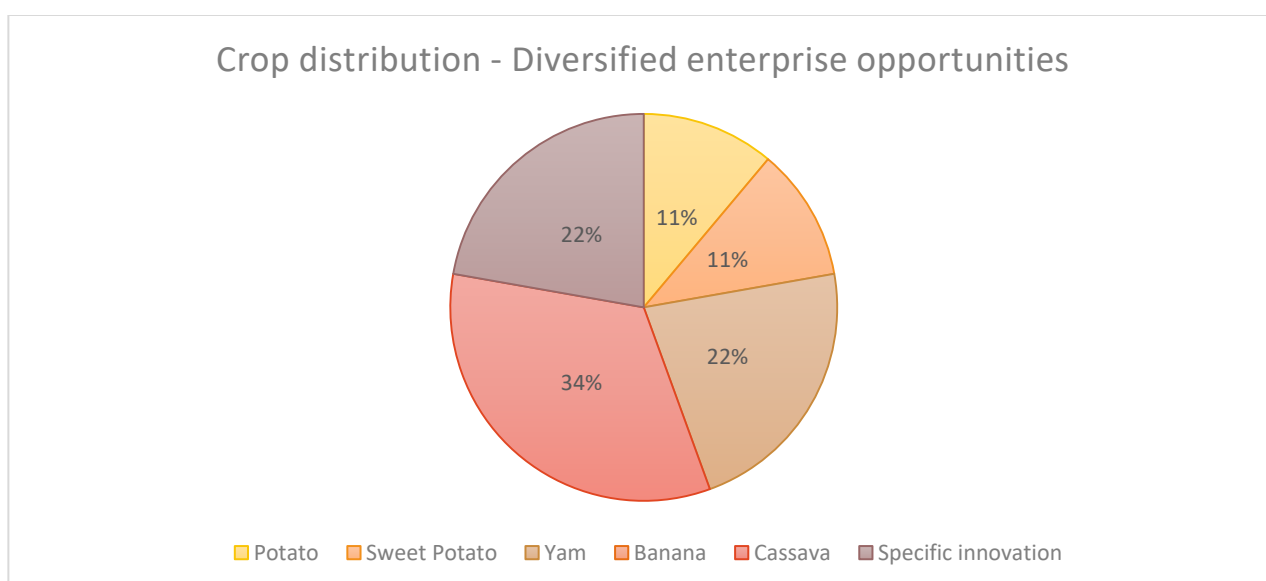


Figure 11: Crop distribution - Diversified enterprise opportunities

There are 19 ex-post studies related to the IDO *increased productivity* (Figure 12). 11 studies relate to the FP1 outcome *High-yielding candidate varieties with consumer preferred traits*, and two studies relate to the FP1 outcome *More nutritious candidate varieties*, both of which support the Sub IDO *Enhanced genetic gains*, and thus contributing almost 70 percent of ex-post studies conducted in relation to *increased productivity*. Four studies contribute to the FP2 outcome *Male and female farmers sustainably engaged in integrated production systems based on the use of high-quality seed of locally adapted high-yielding RTB varieties and innovative production practices*, and there are one study

each supporting the FP3 outcome *Farm HH manage and mitigate the effect of biotic and abiotic factors threatening the yield of RTB crops through customized and gender-sensitive management practices*, and the FP1 outcome *Improved access to RTB genetic diversity and associated scientific and farmer knowledge for maintaining, improving and utilizing genetic resources*. No studies are related to Improved access to the FP1 outcome *RTB genetic diversity and associated scientific and farmer knowledge for maintaining, improving and utilizing genetic resources*.

SLO 1.2

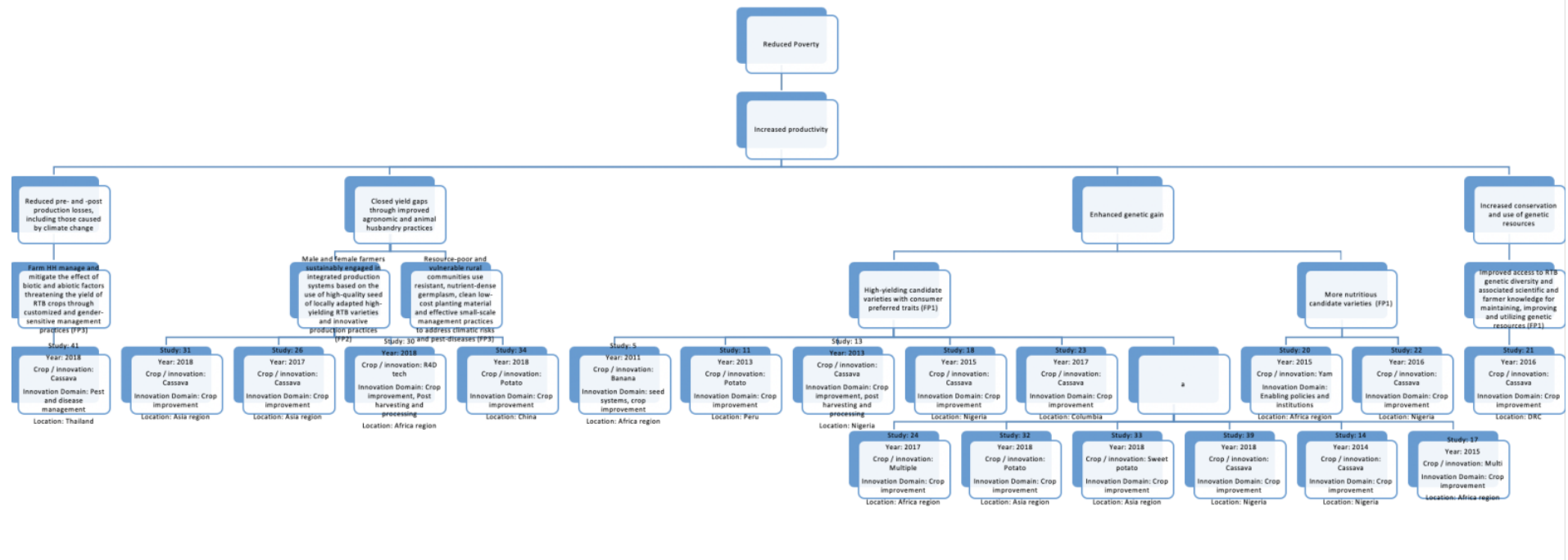


Figure 12: Impact pathway mapping of SLO 1, IDO Increased productivity

Of the studies contributing to the IDO *increased productivity*, the majority took place in Africa (Figure 13, focused on Cassava (Figure 14), and are related to the crop improvement innovation domain (Figure 15).

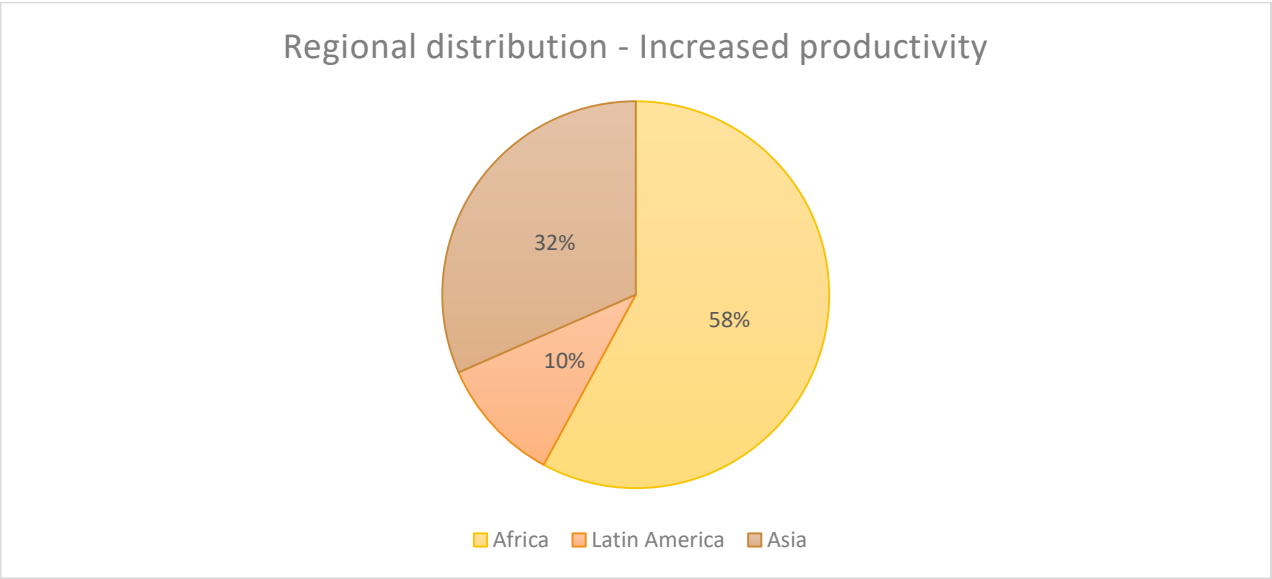


Figure 13: Regional distribution - Increased productivity

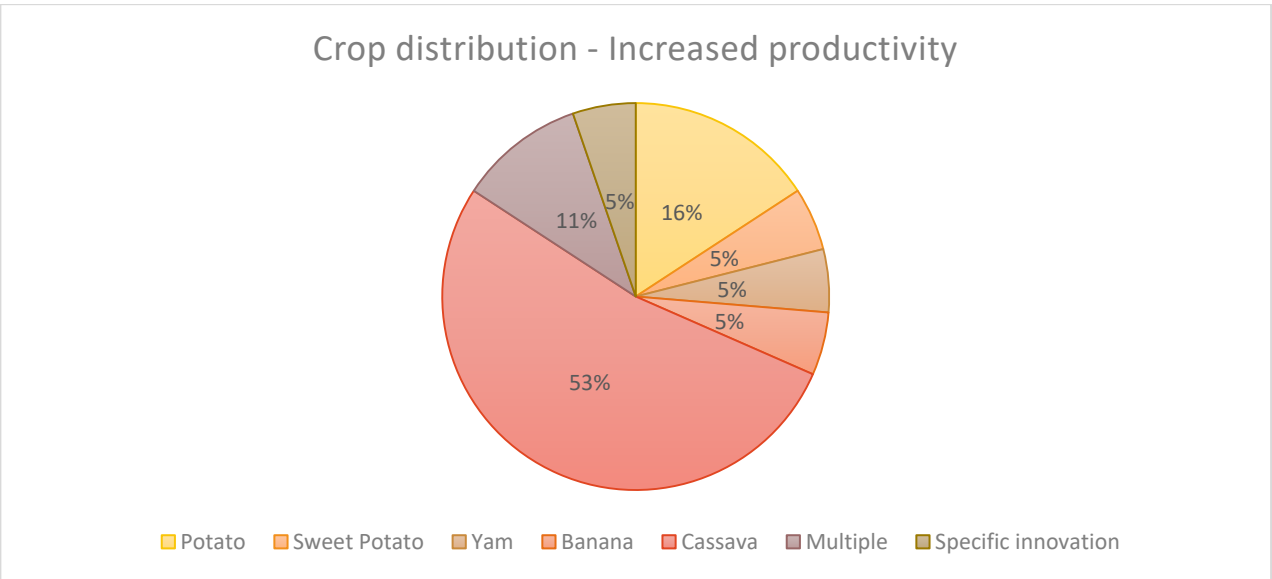


Figure 14: Crop distribution - Increased productivity

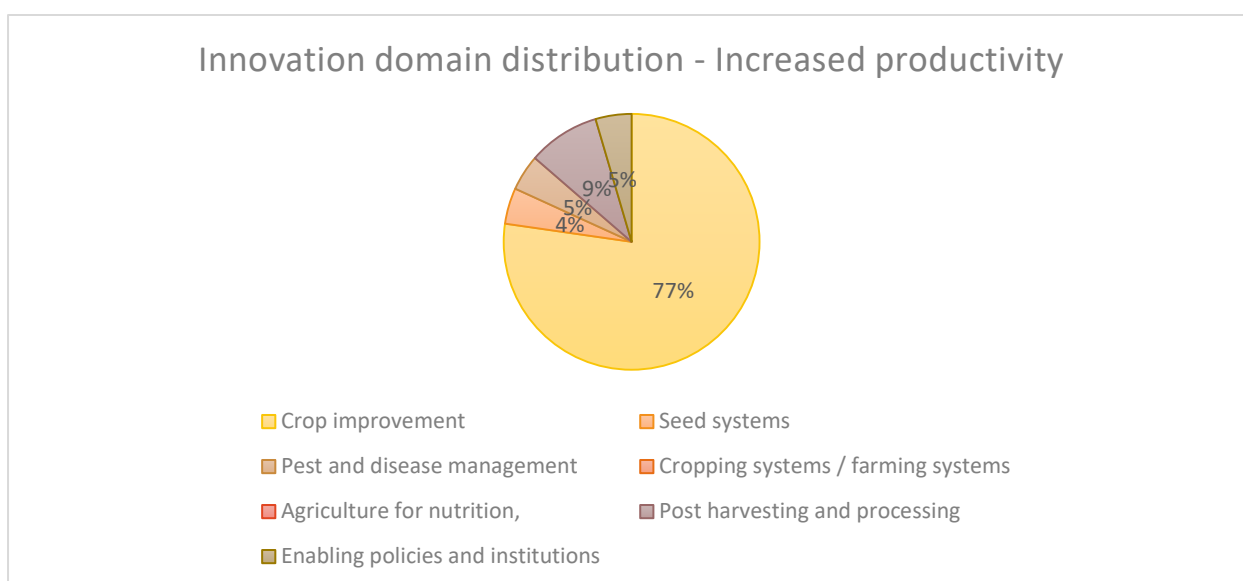


Figure 15: Innovation domain distribution - Increased productivity

SLO 2

RTB achieves SLO 2, *Improved food and nutrition security and health*, through achieving *Improved diets for poor and vulnerable people* (IDO), which in turn is achieved through *Increased availability of diverse nutrient-rich foods* (Sub IDO) and *Optimized consumption of diverse nutrient-rich foods* (Sub IDO). Seven ex-post assessments pertain to SLO 2 (Figure 16).

There are two studies that are mapped to Sub IDO *Increased availability of diverse nutrient-rich foods*, through the FP4 outcome, *Nutritious RTB crops and products reach food insecure and micro-nutrient deficient populations at scale through mainstream nutrition programs and private sector initiatives*. These studies both take place in Africa, and both pertain to the crop improvement innovation domain. One study examines cassava and the other focuses on sweet potato. No studies have been performed that are mapped to the FP2 outcome *Consumers, and in particular young children and women of child-bearing age have equitable access to nutritious RTB varieties*.

Five studies are mapped to the Sub IDO *Optimized consumption of diverse nutrient-rich foods*, through the FP4 outcome *Wide scale utilization and consumption of more nutritious and safer RTB foods especially by women and children in vulnerable target populations both rural and urban*. All studies take place in Africa and the domain innovation distribution and crop distribution are represented in Figures 17 and 18.

SLO 2

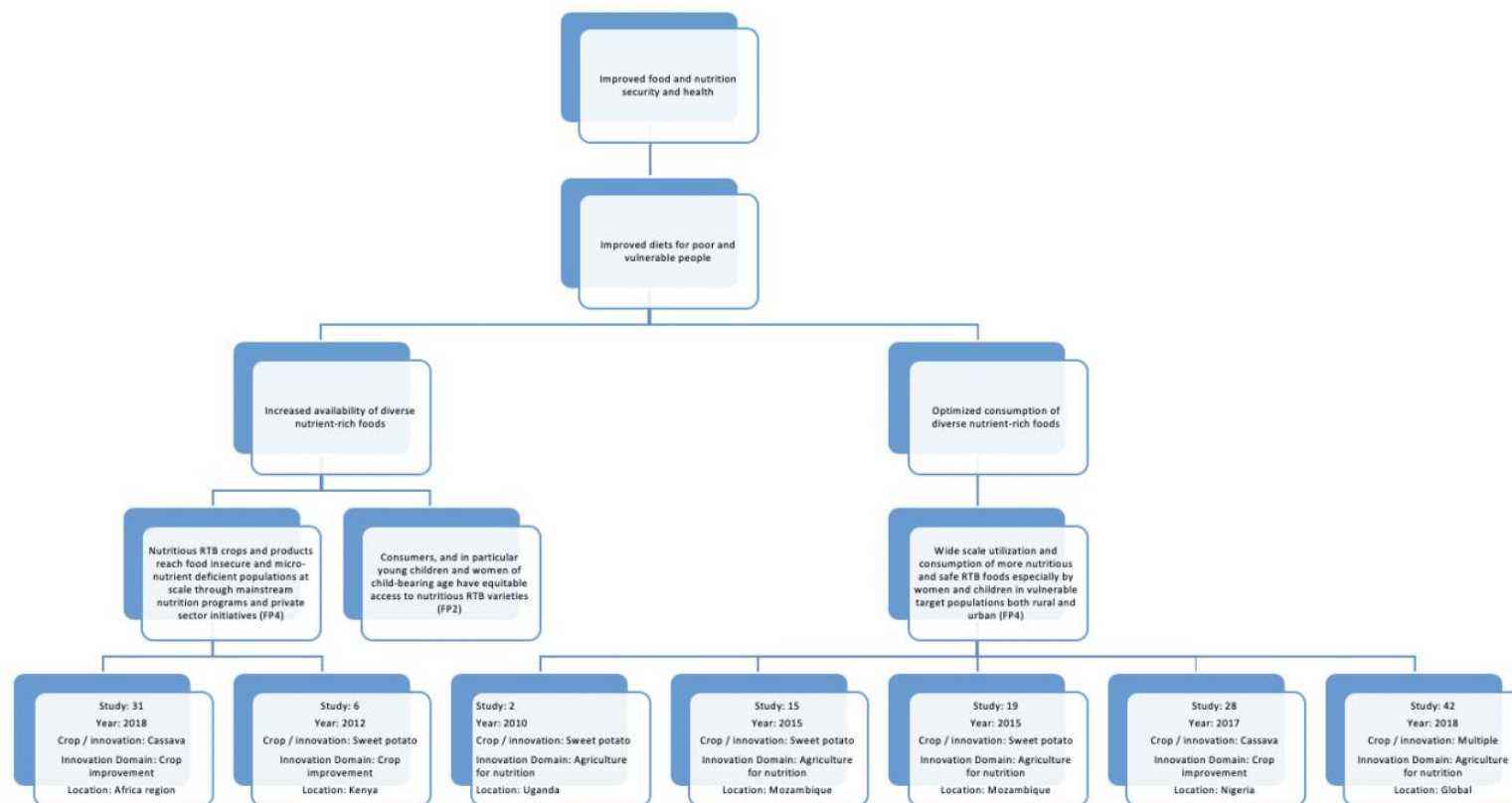


Figure 16: Impact pathway mapping of SLO 2

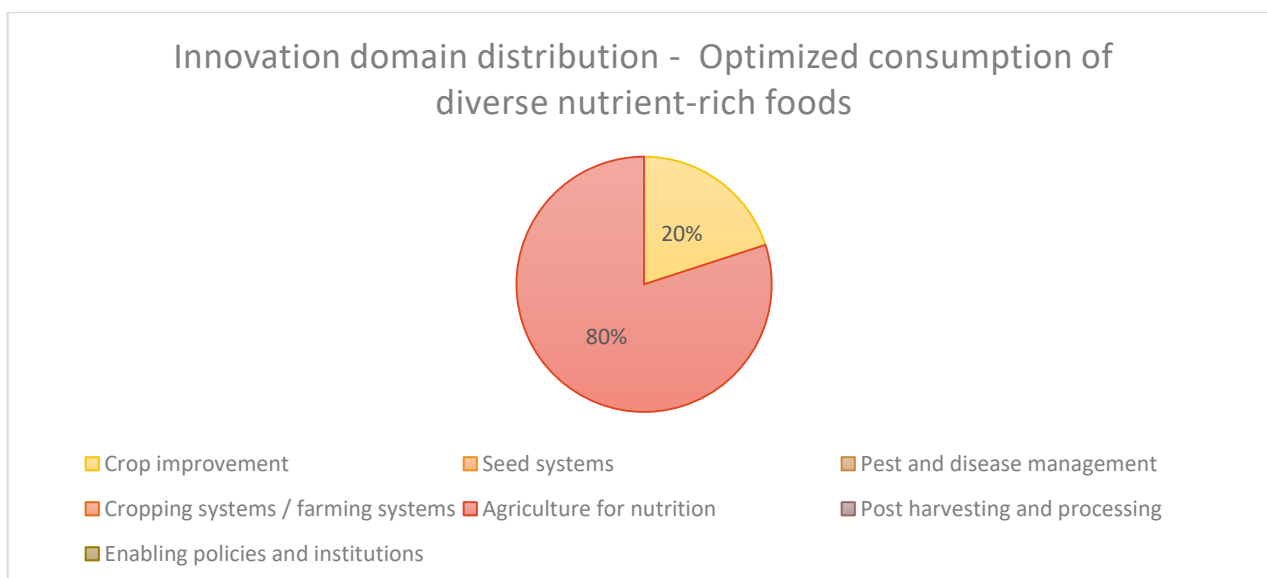


Figure 17: Innovation domain distribution - Optimized consumption of diverse nutrient-rich foods

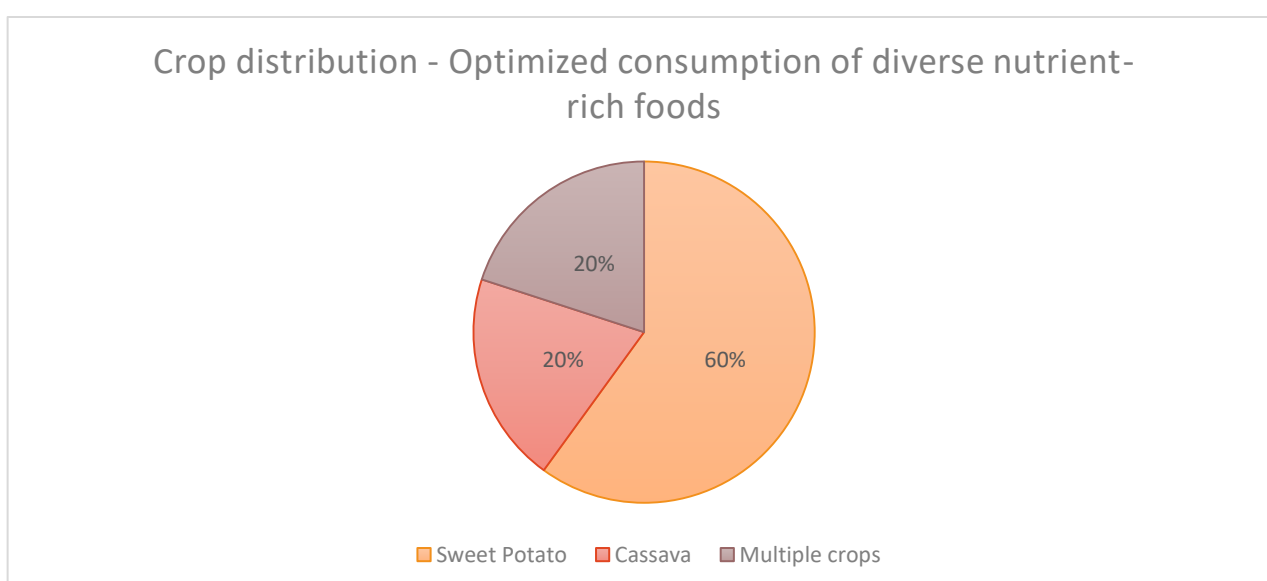


Figure 18: Crop distribution - Optimized consumption of diverse nutrient-rich foods

SLO 3

RTB achieves the 3rd SLO, *Improved natural resources systems and ecosystems services*, through two IDOs, *Enhanced benefits from ecosystem goods and services*, and *More sustainably managed agro-ecosystem*. Four ex-post evaluations examine the 3rd SLO (Figure 19).

Enhanced benefits from ecosystem goods and services is achieved through two Sub IDOs, *Enhanced benefits from ecosystem goods and services*, and *Enrichment of plant and animal biodiversity for multiple goods and services*. The former Sub IDO is mapped to FP 5 outcome *Farm HH able to identify and test SID options to bridge dietary gaps while minimizing trade-offs to income and ecosystem service resilience*, but there are no ex-post evaluations associated. FP1 outcome *Candidate varieties resistant to major pest and diseases* is mapped to *Enrichment of plant and animal biodiversity for multiple goods and services*, and there is one related ex-post assessment.

SLO 3

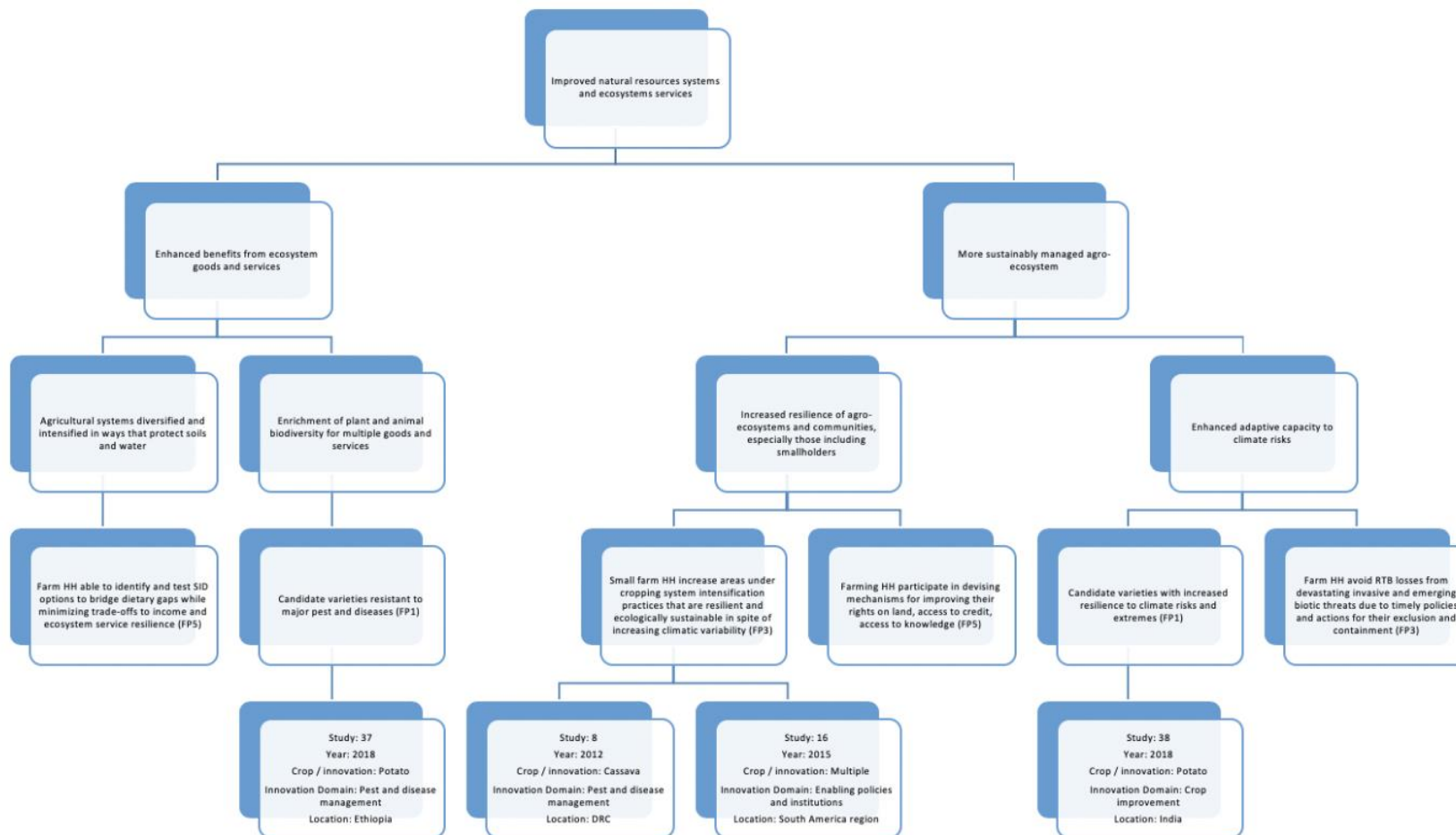


Figure 19: Impact pathway mapping of SLO 3

The IDO *More sustainably managed agro-ecosystem* is achieved through two sub IDOs, *Increased resilience of agro-ecosystems and communities, especially those including smallholders*, and *Enhanced adaptive capacity to climate risks*. Two ex-post assessments relate to the former through the FP3 outcome *Small farm HH increase areas under cropping system intensification practices that are resilient and ecologically sustainable in spite of increasing climatic variability*. No ex-post evaluations are related to FP5 outcome *Farming HH participate in devising mechanisms for improving their rights on land, access to credit, access to knowledge*. In relation to the Sub IDO *Enhanced adaptive capacity to climate risks*, one study is mapped to the FP1 outcome *Candidate varieties with increased resilience to climate risks and extremes*, and no studies have been conducted relating to the FP3 outcome *Farm HH avoid RTB losses from devastating invasive and emerging biotic threats due to timely policies and actions for their exclusion and containment*.

The regional, innovation domain, and crop distributions for SLO 3 are represented in Figures 20, 21, and 22, respectively.

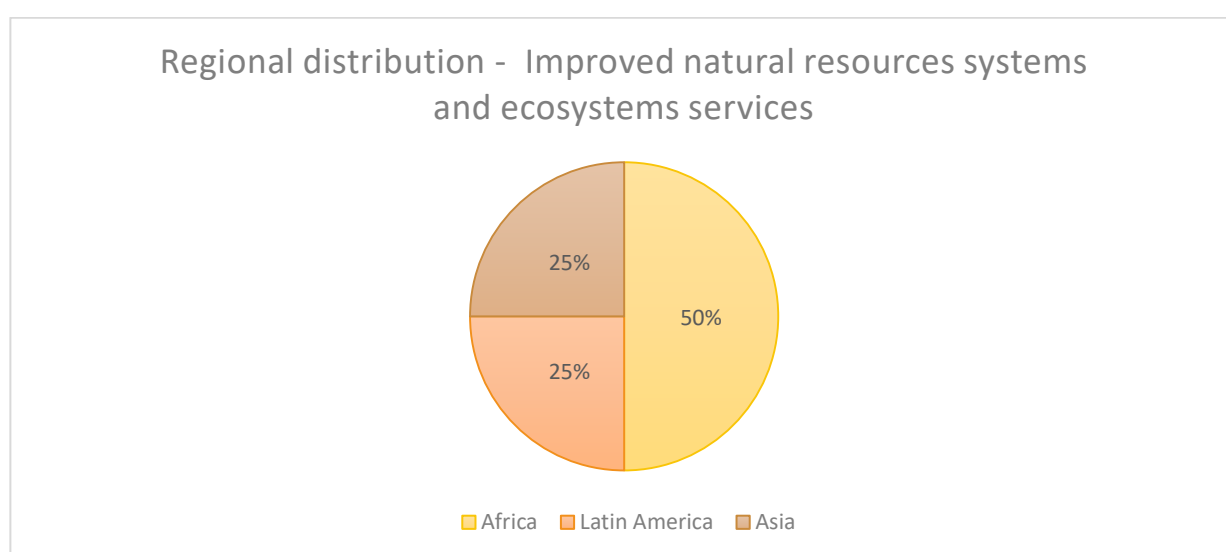


Figure 20: Regional distribution - Improved natural resources systems and ecosystems services

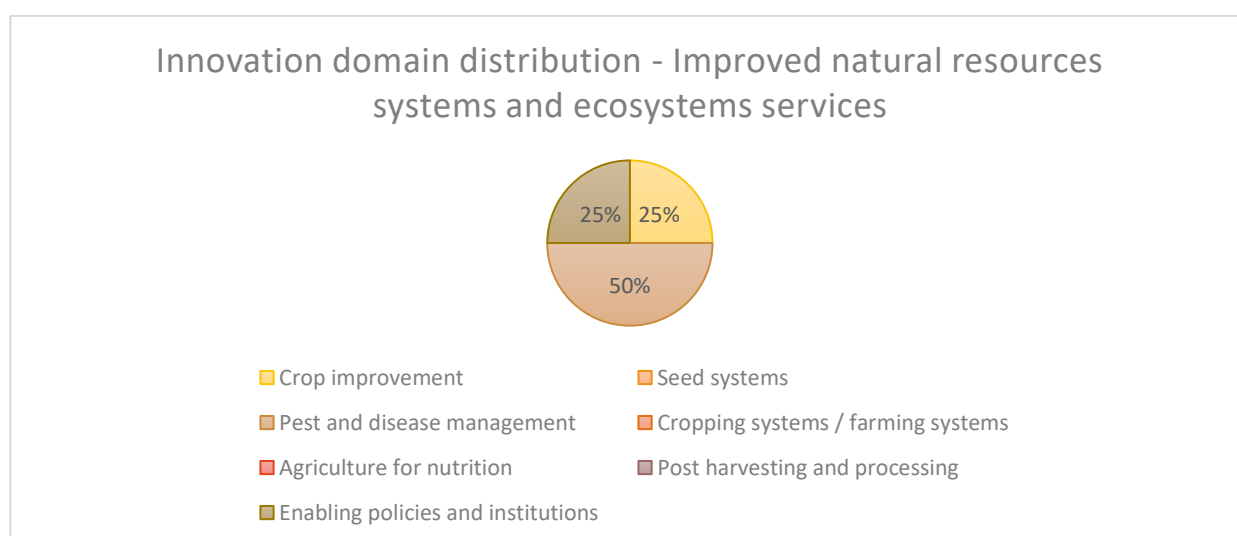


Figure 21: Innovation domain distribution - Improved natural resources systems and ecosystems services

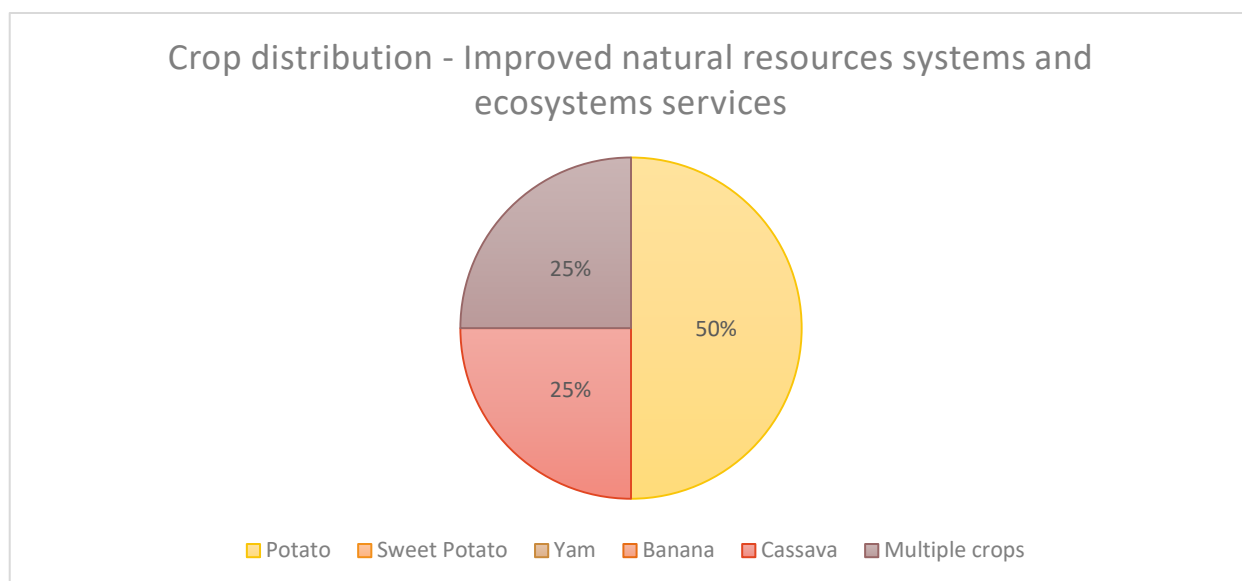


Figure 22: Crop distribution - Improved natural resources systems and ecosystems services

CROSS-CUTTING

One study has been directly mapped to cross-cutting outcomes through the IDO *Equity and inclusion achieved* (Figure 23). This IDO is achieved through the Sub IDO *Gender-equitable control of productive assets and resources*, and the FP5 outcome *Youth and women influence individual and collective resource management and decision-making processes at household, community, farm, and landscape level*. The study took place in Uganda, the innovation domain is Pest and disease management, and the crop studied is Banana.

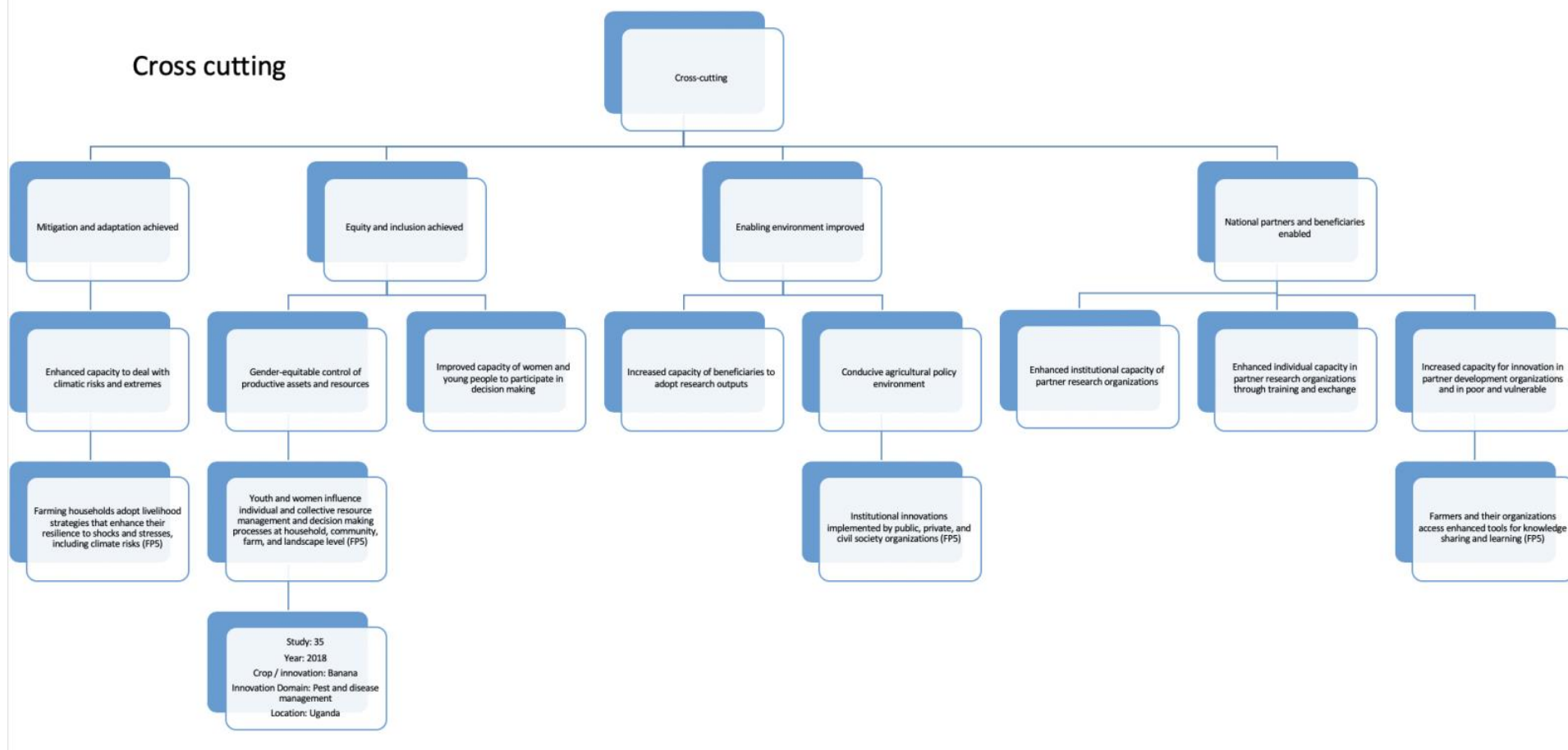


Figure 23: Impact pathway mapping of cross-cutting issues

CONCLUSION

In conclusion, 71 percent of ex-post evaluations are related to SLO 1, as opposed to 17 percent for SLO 2, ten percent for SLO 3, and two percent for cross cutting impacts. 71 percent of evaluations are performed in Africa with Asia and Latin America following far behind at 17 and ten percent respectively. One study has a global perspective. More than 50 percent of studies are focused on the innovation domain of crop improvement, far ahead of other innovation domains, and cassava, comprising 39 percent of evaluations, dominates other crops in terms of ex-posts performed. Banana is the least studied crop, with 2 studies, representing 5 percent of all studies performed.

Of those studies focusing on SLO 1, nearly twice as many (19 compared to 10) are mapped to the IDO *increased productivity* as opposed to the IDO *increased incomes and employment*. Within the *Reduced poverty* impact pathway, there are a total of 13 studies that focus on *Enhanced genetic gains*, thus making this Sub IDO 70 percent of ex-post studies conducted in relation to *increased productivity*, nearly 50 percent of studies focused on SLO 1, and almost 30 percent of all ex-post evaluations performed.

In terms of the IDO *increased productivity*, the main focus is on the Sub IDO *Enhanced genetic gains*. The other Sub IDOs - *Increased conservation and use of genetic resources*, and *Reduced pre- and -post production losses, including those caused by climate change* - have only one study mapped to them.

The impact pathway of SLO 1 also has no ex-post evaluations reflecting the work being done on FP2 outcome *Male and female farmers have equitable access to sufficient quantities of guaranteed high-quality RTB seed at affordable price through local, national, and regional delivery systems*. Additionally, there is a study mapped to the Sub IDO *More efficient use of inputs*, however, the study itself does not have an obvious link with any of the outputs in FP4, which is mapped to that Sub IDO.

The ex-post studies related to SLO 2 are skewed towards the Sub IDO *Optimized consumption of diverse nutrient-rich foods* (five studies) as compared to the Sub IDO *Increased availability of diverse nutrient-rich foods* (two studies). No ex-posts are linked to the FP2 outcome *Consumers, and in particular young children and women of child-bearing age have equitable access to nutritious RTB varieties*.

SLO 3 has received the least attention from ex-post evaluations with only four studies. However, of the four Sub IDOs, only *Agricultural systems diversified and intensified in ways that protect soils and water* has no studies mapped to it. There are several FP outcomes that do not have studies mapped to them. They are:

- *Farm HH able to identify and test SID options to bridge dietary gaps while minimizing trade-offs to income and ecosystem service resilience (FP5);*
- *Farming HH participate in devising mechanisms for improving their rights on land, access to credit, access to knowledge (FP5), and;*
- *Farm HH avoid RTB losses from devastating invasive and emerging biotic threats due to timely policies and actions for their exclusion and containment (FP3).*

Cross-cutting impacts have only one study directly mapped to them.

POTENTIAL FOR FUTURE OUTCOME / IMPACT DOCUMENTATION

Participants in the stock-taking exercise suggested 38 potential studies to pursue.

Table 1: Suggestions for future evaluation studies

Innovation domain	Focus	Details	Crop	Geography
1. Crop improvement;	Adoption of potato improved varieties and their impact on crop yield, income	Good funding and gap in impact assessment	Potato	Sub-Sahara Africa
	Adoption of banana resistant varieties and their impact on crop yield, income	New varieties "Narita" 7 hybrids, resistant. Gates Foundation	Banana	East Africa
	Adoption of cassava resistant varieties and their impact on crop yield, income	New technologies entering into dissemination process (CBSD + cassava mosaic disease resistant)	Cassava	Eastern and Central Africa
	Assessment of effectiveness and economic viability of RTB seed rapid multiplication techniques (Potato)	New propagation system using rooted cuttings	Potato	Africa
	Adoption of metabolomics - molecular markers in breeding programs and impact of efficiency and effectiveness	Knowledge to drive information on new seeds.	All RTB crops	Various
1. Crop improvement; 3. Pest and disease management	Ex-ante assessment of the impact of the adoption transgenic variety on crop yield (?)	Measure the impact of investments in transgenics	All RTB crops	Various
	Adoption of banana resistant varieties and their impact on crop yield, income	New variety of banana, and assessing adoption and economic impact	Banana	India
		Status: pest resistant varieties have been distributed	Banana	Nigeria, Cameroon
	Adoption of cassava resistant varieties and their impact on crop yield, income	Determine impact of new varieties that are resistant against Cassava Mosaic Disease	Cassava	Uganda, DRC, Malawi
	Ex-ante assessment of the impact of the adoption transgenic variety on crop yield (Potato)	Laid-blight resistance variety will be ready for release in Uganda	Potato	Uganda
1. Crop improvement; 4. Cropping systems / Farming systems	Impact of in-situ conservation on farmers' livelihood (?), on agrobiodiversity (?)	Measure impact of preserving and promoting genetic diversity in farmers field	All RTB crops	Various

Innovation domain	Focus	Details	Crop	Geography
1. Crop improvement; 5. Agriculture for nutrition	Adoption and nutritional impact of diversified diets and best feeding practices	Have interventions changed HH and individual's behaviour especially towards resilient and nutritious foods	Potato, sweet potato	Mozambique, Rwanda (done) Kenya and Malawi
	Adoption and nutritional/health impact of biofortified varieties	Adoption / non-adoption and why: due to vitamin A? Do people like new varieties for other reasons such as shape? Understand best way to promote the varietal if it's really going to be beneficial for them. Work also done in relation to biosecurity plans in Latin America	Banana	Congo, Burundi, also SEA
		Biofortified potatoes with more iron and zinc – health and nutrition and combat anaemia.	Potato	Various
		OFSP and potato	Sweet potato and potato	Sub-Sahara Africa, Malawi
2. Seed systems;	Assessment of effectiveness and economic viability of RTB seed rapid multiplication techniques (Yam)	Produce planting material under RTB and widely distributed by other institutions. Impact is being measured, but not necessarily under RTB	Yam	Nigeria, Cameroon
	Assessment of effectiveness and sustainability of RTB seed system models	Ongoing with idea Investigating also sustainable seed system – different business models for commercializing planting material in cassava in Vietnam. Baseline data collected through value chain study and is coming to an end. Second phase to in 2020 and last 3 years on clean seeds. Will use experimental economic frameworks.	Cassava	Vietnam
3. Pest and disease management;	Adoption of BXW management practices and their impact on crop yield, income	SDSR single disease single removal	Banana	Uganda
	Impact of ICT tool on early detection and disease management	Disease identification tool to report and eradicate bunchy top. Benin was reported and eradicated. Impact: if had not done that – how would disease have spread and what would have economic impact been? Perhaps only 100% successful eradication scheme.	Banana	Benin

Innovation domain	Focus	Details	Crop	Geography
		Mobile phone app - Nuru: uses AI to recognize cassava diseases and pests	Cassava	Tanzania, but increasingly global
	Adoption of management practices to control nematodes and their impact on crop yield, income	Nematode control through planting in paper	Potato	Kenya
	Adoption of biorationals to control potato tuber moth and their impact on crop yield, income	Product to control potato tuber moth was registered in Peru in 2018. Shows strong promise	Potato	Peru, Bolivia, Ecuador
	Adoption of management practices to control cassava mosaic disease and their impact on crop yield, income	Pest and diseases management techniques show promise based on having developed strategies for Cassava mosaic disease in the region.	Cassava	Vietnam, Cambodia
	Pest risk assessment under changing climates	Impact of climate change on the damage of insects on a number of crops. Increasing temperatures economic and quality damage	Cassava, sweet potato	Various
3. Pest and disease management; 7. Enabling policies and institutions	Impact of awareness raising initiative related to fusarium wilt on disease management and containment strategies developed by National stakeholders (NPPOs)	Banana community is more aware of the threat. Increasing preparedness especially in neighbouring countries including rapid response plans. Plant protection authorities, governments, fao. And plans to combat it	Banana	Africa (Mozambique), SEA
	Impact of knowledge sharing initiative related to cassava mosaic virus on disease management and containment strategies developed by National stakeholders (NPPOs)	Sharing knowledge of how to manage Cassava mosaic virus disease in Africa with partners in Asia. Knowledge transfer outcome. Institutions and extensionists, farmers, plant protection, 3.6 + 3.5 collaboration	Cassava	Africa, India, Sri Lanka, Cambodia, Vietnam, southern China, Laos, Thailand
	Impact of awareness raising, capacity development and policy advice initiatives on P&D management and containment strategies developed and implemented by National stakeholders (NPPOs)	Pest risk assessment being used to develop PRA for Ecuador - Peru, Bolivia, Colombia are at high risk. Impact could be policy changes in the future.	Potato	Andean region
	Impact of delivery modalities on the adoption of virus detection kits	CIP produced virus detection kits were free since 1970s. 15 years ago starting charging for them, and now charging full price. What is the impact of this? Long term component of narrative.	Sweet potato	Global

Innovation domain	Focus	Details	Crop	Geography
	Dashboards for policy makers (focus?)	Pest and disease tracking at national level. Citizen scientists and crowd sourced information. Identify incidents of disease and also management tools. With accumulated data, policy makers can make better decisions and use resources most optimally.	Banana	Rwanda
4. Cropping systems / Farming systems;	Adoption of soil conservation management practices and their impact on farm productivity and farmer livelihoods	Study in Thailand soil fertility and erosion control 1994-2004 Nippon Foundation preliminary studies done. Decided to go back in 2017 to visit farmers that were exposed to the projects and well as those not involved in projects. To view long term adoption of soil erosion... Adoption and impact study – productivity and livelihoods indicators.	Cassava	Thailand
	Influence of decision support tools on the adoption of best agronomic practices	Guidance to farmers to improve RTB crops. Been done for cassava.	Cassava	Various
7. Enabling policies and institutions;	Impact of International Transit Centre on performance of breeding programs (?)	Measure impact of ITC and the multilateral treaty on the use of materials by end-user. How does this influence the deposit of new materials in the ITC. What is incentive to deposit materials into the gene bank. Role of international collections. Futureproofing, and as a resource that countries can rely on to access genetic material to tackle problems	Banana	(blank)
	Impact on next-users' and end-users' capacities (?) of Promusa as knowledge sharing platform	Impact of knowledge sharing next users, subsequent users, to the end users. Study done, but stopped at next user important work that bioversity is doing that provides information and links for banana people. Evaluate to show value and should be recognized.	Banana	(blank)
	Adoption of best agronomic practices and their impact on, soil quality, farm productivity and farmer livelihoods	What are the effects of the various types of partnerships on HH impacts – socioeconomic and health?	Cross-cutting	Various
	Decision support tools (which ones?)	Gates foundation, lots of good data	Cross-cutting	Tanzania and Nigeria and other central African states
	Scaling up impacts (focus?)	Better understand the effectiveness of scaling up initiatives	Cross-cutting	Various
5. Agriculture for nutrition; 7. Enabling	Adoption and nutritional impact of biofortified varieties	Gates foundation - building a nutritious food basket (ended 2018) - biofortification	Cassava	(blank)

Innovation domain	Focus	Details	Crop	Geography
policies and institutions				
7. Enabling policies and institutions; 3. Pest and disease management	Impact of awareness raising, capacity development and policy advice initiatives on P&D management and containment strategies developed and implemented by National stakeholders (NPPOs)	<p>How influences and policy advocacy on pest and diseases is going to generate impacts through the interventions of the government.</p> <p>Pest risk analysis used by plant protection agencies national authorities.</p>	Cassava	Various

POTENTIAL EX-POST EVALUATION ANALYSIS

The regional distribution of potential ex-post evaluations (Figure 24) continues to be dominated by studies based in Africa, as compared to evaluations that have already been completed, but the percentage has decreased from 71 percent to 46 percent. The biggest change is increasing focus on global, or inter-regional studies, which increases from 2 percent of completed studies to 37 percent of potential studies. Focus on Asia and Latin America has also been reduced from 17 percent to 11 percent, and 10 percent to 6 percent respectively.

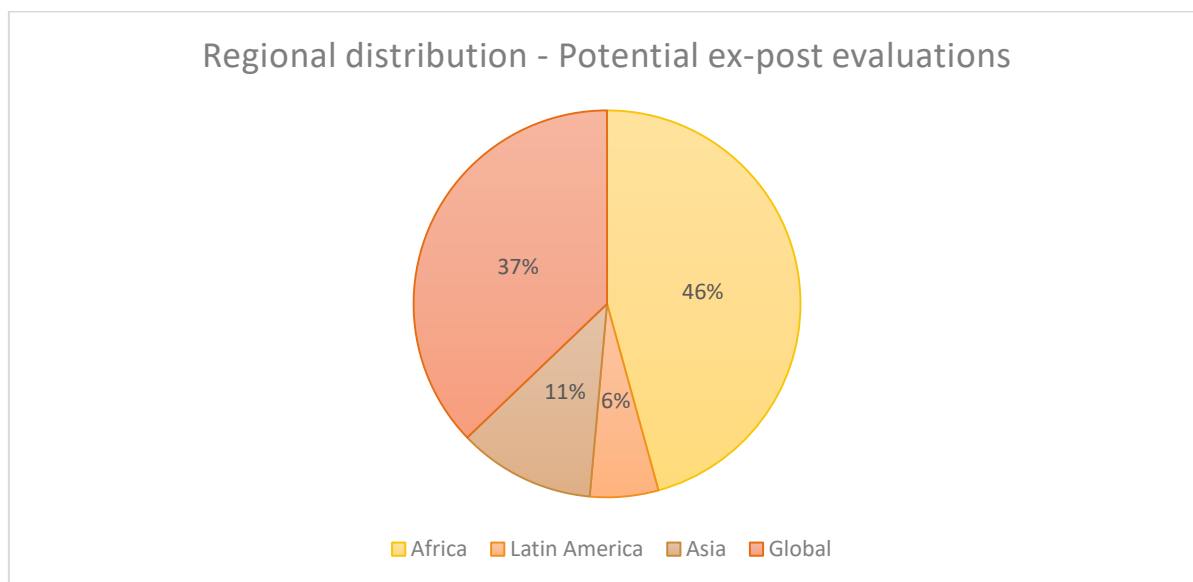


Figure 24: Regional distribution - Potential ex-post evaluations

In terms of innovation domains (Figure 25), the most striking difference between completed and potential ex-post evaluations is a new importance placed on pest and disease management, which represents 35 percent of potential studies as compared to nine percent of completed studies. Crop improvement continues to be a dominant focus but has reduced from 52 percent of completed studies to 31 percent of potential studies. Enabling policies and institutions remains relatively stable, but there has been a reduction in terms of proposed studies in post harvesting and processing, from 9 percent of completed studies to no potential studies. Agriculture for nutrition, cropping systems / farming systems, and seed systems remain relatively stable.

Innovation domain distribution - Potential ex-post evaluations

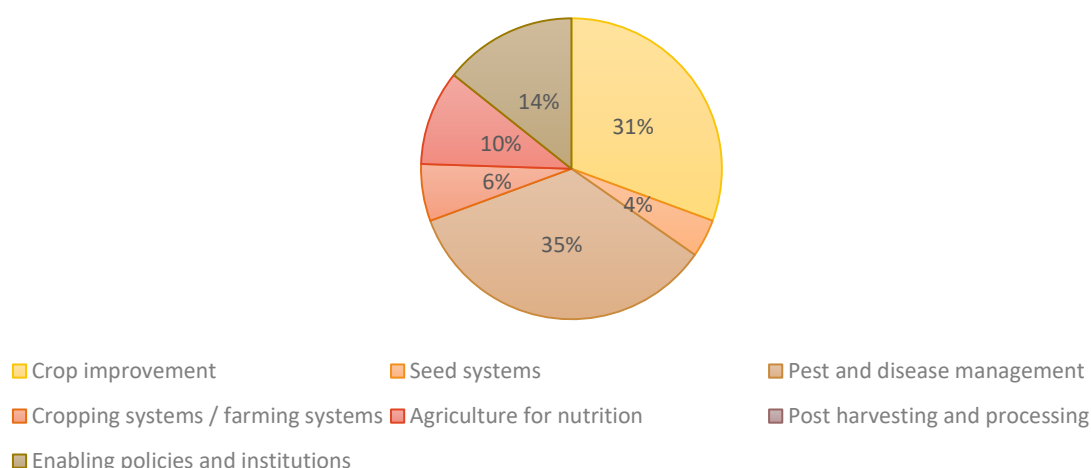


Figure 25: Innovation domain distribution - Potential ex-post evaluations

In terms of crops to be studied (Figure 26), cassava remains the one with the higher number of proposed studies but has been reduced from 39 percent to 28 percent. Banana sees the largest increase from only five percent of studies completed to 26 percent of potential studies proposed. A relative reduction in the number of sweet potato related studies is noticed.

Crop distribution - Potential ex-post evaluations

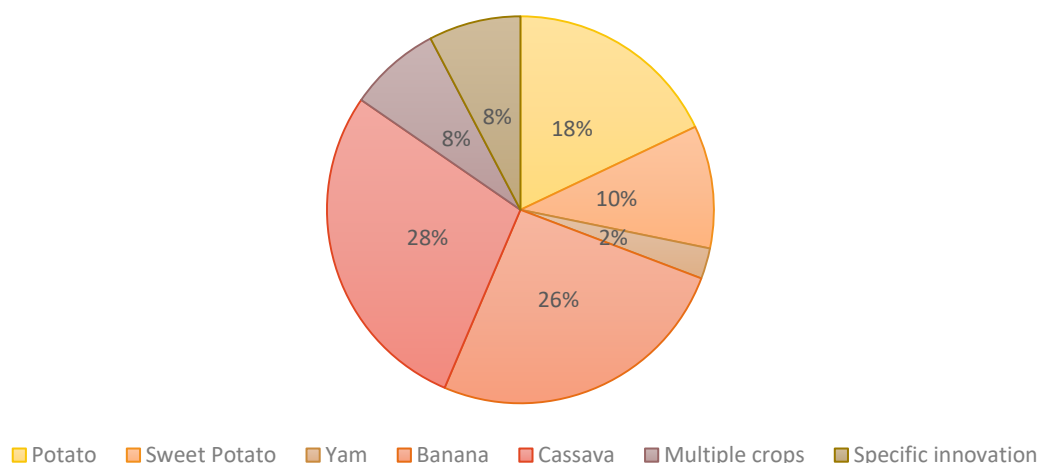


Figure 26: Crop distribution - Potential ex-post evaluations

INSIGHTS FROM INTERVIEWS

Ex-post assessments reflect the larger development discourse that is emerging from RTB-linked work. This narrative has been dominated by the story of adoption of new varieties and crop improvements. Interviewees suggested expanding from a more narrowly defined technological-focused perspective of impact to a more holistic perspective that attempts to understand innovation in all its facets including capturing influence or

capacity development for next users, like business and government, that may then have a large impact on end users.

These interviewees suggest a stronger focus on markets; not only at the production level, but also on the remaining value chain, and in particular on what influences and informs market demand in terms of RTB technologies. In a similar vein, some interviewees also suggested increasing focus on individual-level analysis and especially women and youth, given that household benefits are not equally shared.

CONCLUSION

It is clear from the analysis that there is a greater interest in diversifying the focus of ex-post evaluations. There is a renewed interest in including ex-post assessment work on SLO 3, Improved natural resource systems and ecosystems services. This demonstrates a desire to measure RTB crops and their resilience and adaptive capacity. There is however, not much change in interest towards SLO 2, Improved food and nutrition security and health, which should in any case, be increasingly addressed by future studies, given that only 17 percent of completed ex-posts focus on SLO 2.

ASSESSMENT CHOICES AND OPPORTUNITIES TO STRENGTHEN REPORTING

Being more strategic

Due to the decentralized nature of earmarked funding for 5.1, individual centres allocate money based on their own policies and priorities, which may be less in line with RTB priorities and impact pathways. Further, various reasons were put forward for the choice of ex-post assessments. These include limited budgets, choosing studies that have less restrictions for their performance, such as having field-based resources; opportunities to derive value for investment; and the availability of relevant data, such as the lack of baseline data. Additionally, relationships play a role in choosing studies, whether choices are mandated by senior management for reasons related to fundraising, or by potential conflicts with other program participants. These reasons, together with the opinions expressed by interviewees, stress the importance of making strategic choices for ex-post impact studies, rather than what is most efficacious.

Communication

Communication is also important in the selection of ex-post assessments. The feedback about communication within cluster 5.1 is laudatory, with a strong sense of satisfaction reported by cluster members. However, there are indications that communications with other flagships, clusters, and research teams could be strengthened. Two-way communication could improve other flagships' and clusters' knowledge of 5.1 activities and learnings that are generated, and 5.1 could have a greater overview of important developments as well as better understanding the demand from flagships and clusters for assessments. Strengthening communication could improve 5.1's role as a learning lab for RTB.

Mixed methodologies

One of the stronger themes to come out of the stocktaking exercise is the need for greater meshing of the biological and social sciences and this was particularly evident in discussions about ex-post assessment methodologies. Impact assessments are generally oriented to quantitative measurement. However, there is value in pursuing more multidisciplinary research, and mixed-methodologies, to better include qualitative perspectives. Adoption-based studies, for example, can delimit results, but scientists want to know why the results are occurring; what are the processes behind the results?

High-quality quantitative and qualitative research can provide this information, though it is admittedly more challenging than a more straightforward quantitative approach. However, given the myriad changes (in gender, youth, and generally in traditional norms) that are occurring, it is increasingly important to understand the socioeconomic realities informing choices. Additionally, more technologically focused methodologies should also be considered for their many positive attributes. These methodologies include algorithms that search documents for key terms, thus playing a part in attributive arguments, while other algorithms can monitor social

media and other online for a for debates and discussion relating to key topics. Newer methodologies, especially those that can be automated, also have cost-cutting and efficiency values and can be utilized across different contexts and geographies.

There are also possibilities for using M&E information to improve ex-post assessments, which would follow larger movements in the impact assessment world that is increasingly paying attention to routine day to day project-level M&E. Interviewees suggest that M&E at the CRP level is excellent, but there is a disconnect between what is being collected in MEL and what is transpiring in 5.1. This information, if prepared properly, could be valuable to strengthen ex-post assessments.

IDENTIFICATION OF THE USE OF 5.1 CLUSTER RESEARCH PROJECTS AND KNOWLEDGE GENERATED

Understanding the impact of ex-post assessments is challenging for a number of reasons. To begin with, impact data derived from ex-post assessments are not systematically collected, so that most evidence that is collected is anecdotal. Impacts, therefore, are difficult to document, attribute, and measure.

Nonetheless, respondents did report that ex-post assessments have led to policy changes. For example, in Uganda, a respondent asserts that information derived from an ex-post assessment was used by legislators to develop policy to control the disease at a large scale. Practices for managing the disease were implemented as a result of the policy decisions which led to reduced rates of incidence in 2015-2016. Now, however, given BXW is endemic to Uganda, there are signs it is increasing again, which raises the question of whether an ex-post assessment can impact long term policies and management strategies.

Several respondents suggested that clusters should report on policy advocacy efforts and adoption, which would allow 5.1 to study the impacts of the implementation of the policy. However, it is acknowledged that meagre funding levels present a challenge as does the interest of donors.

RECOMMENDATIONS FOR SHAPING THE 5.1 AGENDA FOR 2019-2021.

Impact pathways

Based on the gaps identified in the mapping exercise of ex-post evaluations conducted, there is considerable space to focus studies on SLO 2, SLO 3, and cross-cutting impacts, which represent only seventeen, ten, and two percent of evaluations performed. The strategic choice of studies should be strengthened.

Clearly, representing almost 30 percent of all ex-post studies performed, there appear to be enough studies supporting the sub IDO *Enhanced genetic gains* (SLO 1). Another sub IDO that is well supported is *Diversified enterprise opportunities* (SLO 1), that counts nine studies. Less well supported Sub IDOs in SLO 1 include:

- More efficient use of outputs (one study);
- Reduced pre- and -post production losses, including those caused by climate change (one study); and,
- Increased conservation and use of genetic resources (one study).

The impact pathway of SLO 1 also has no ex-post evaluations reflecting the work being done on FP2 outcome *Male and female farmers have equitable access to sufficient quantities of guaranteed high-quality RTB seed at affordable price through local, national, and regional delivery systems*. Additionally, although there is a study mapped to the Sub IDO *More efficient use of inputs*, the study itself does not have an obvious link with any of the outputs in FP4, which is mapped to that Sub IDO.

There are supporting studies for all Sub IDOs in SLO 2, although these are skewed towards *Optimized consumption of diverse nutrient-rich foods* rather than *Increased availability of diverse nutrient-rich foods*. No studies exist supporting the FP2 outcome *Consumers, and in particular young children and women of child-bearing age have equitable access to nutritious RTB varieties*.

SLO 3 has received the least attention from ex-post evaluations with only four studies. However, of the four Sub IDOs, only *Agricultural systems diversified and intensified in ways that protect soils and water* has no studies mapped to it. There are several FP outcomes that do not have studies mapped to them. They are:

- *Farm HH able to identify and test SID options to bridge dietary gaps while minimizing trade-offs to income and ecosystem service resilience* (FP5);
- *Farming HH participate in devising mechanisms for improving their rights on land, access to credit, access to knowledge* (FP5), and;
- *Farm HH avoid RTB losses from devastating invasive and emerging biotic threats due to timely policies and actions for their exclusion and containment* (FP3).

Together with the mapping of potential ex-post assessments, it is suggested to focus on SLO 3 in particular as well as SLO 2, to address both the existing gaps and the interest communicated by scientists through the interviews. It is recommended that 5.1.3 develop a framework for analysis to assess the impact of RTB pest and disease techniques to understand what RTB has done on pest and disease and what the impact has been. Nutrition should also be addressed in a more comprehensive manner, and perhaps there is the potential to work more closely with the CRP on Agriculture for Nutrition and Health.

Methodologies

It is recommended to engage in mixed methodologies incorporating biological and social sciences. It is also recommended to engage with newer methodologies that made possible through more intensive use of ICT, and it may serve the CGIAR to work with universities that are on the cutting edge of developing such methods. In addition to such universities, cultivating relationships with the private sector may also yield important results.

Communications

In order to ensure that Cluster 5.1 ex-post assessments are meeting the demand of the CRP, and that flagships and clusters can truly benefit from the work of 5.1, it is important to improve communications and coherence between the program participants. Flagships could provide 5.1 with ToRs for prospective ex-post assessments, or perhaps M&E results can be structured to alert 5.1 at opportune moments. Concurrently, 5.1 should develop communications strategies that inform program participants of the opportunities for learning inherent in the cluster and work together with program participants to ensure that key developments are addressed in a timely and effective manner.

IDENTIFICATION OF POSSIBLE SYNERGIES AMONG PROGRAM PARTICIPANTS TO ORIENT FUTURE PLANNING

Potential synergies between program participants are mitigated by a number of factors including the funding environment, which encourages competition for limited opportunities, political difference between centres, priorities associated with specific crops, and the priorities of specific centres. Interviewees suggested there is a lot of emphasis on increasing synergies in RTB, and for the most part these efforts are well received. For those that would like to pursue more synergies, there is the belief that there should be greater emphasis on synergies between similar sciences and scientists such as food scientists, breeders, and geneticists, which is otherwise limited because of the centre-specific way of organization. For other interviewees, however, there is too much emphasis on creating synergies. Some interviewees expressed doubts that all synergies add value, while others feel collaborations may be more fruitful with organizations outside RTB. Additionally, some believe there is too much emphasis on cross-cutting initiatives, and that it is more important to focus on one crop.

Suggestions for synergies centred around the biological and social sciences, shared geographies, data collection and management, tools development, gender tools and analysis, and program partnerships.

Creating synergies between the biological and social sciences were the most frequent suggestion in the interviews. Synergies between biological and social sciences are not often clear, due to divergent approaches and methodologies, which can present challenges to finding common ground. However, several respondents felt that a better understanding between the two sciences promises rewards, and that opportunities for more collaboration would be beneficial. For example, in relation to the domain of small holders, for the most part the focus is on the biology (e.g. varieties, productivity, agronomic management). What receives less focus is the social component, which drives the adoption of innovations. Efforts should, in an explicit manner, investigate actual adoption practices and not solely technical qualities. This, it is suggested, is perhaps the greatest value to incorporating social science into ex-post evaluations. The main drivers for innovations are not technical, but relate to human, sociological, and emotional needs and values, and these must be better understood in order to attain maximal impacts.

There were several suggestions for increasing synergies relating to data. In terms of data collected, it is suggested that the big data agronomy trials in Cluster 3.2, which includes data collected on weather, soil, and modelling, may fruitfully be applied to other crops. Also, increased homogeneity between data bases, developing common database platforms, as well as database-sharing should be encouraged, all of which can increase potential synergies and facilitate cross-cutting work. Additionally, data collection tools, built on ODK and other platforms, could be used more broadly, and common protocols for performing surveys would improve the interoperability of data in terms of aggregation and analysis.

There are suggestions to increase synergies around gender, and in broad terms to incorporate gender research more thoroughly into research. Tools developed for gender data collection and analysis should be more widely shared. Also, gender-based research cells within the CGIAR could provide tools and findings to incorporate gender perspective more broadly. There was a suggestion to incorporate gender tools in product profile processes, which would also have importance for other CRPs.

The subject of program partnerships was often brought up in the interviews and discussions centred around flagship and cluster relationships, synergies between RTB and centres, and strategic synergies with organizations outside CGIAR.

Several interviewees identified incongruencies between centre-based initiatives and priorities, and RTB priorities, which can limit the effectiveness of ex-post evaluations. As such, synergies between RTB and centres could be strengthened. Centre-based initiatives are guided by their own impact pathways and these, in and of themselves, may not capture the full RTB pathway from discovery to farmers, to consumers, households, livelihoods, and nutrition. Greater congruity between studies performed in various flagships and clusters would strengthen a more comprehensive approach to the RTB pathway and thus also strengthen impacts and their evaluation.

Finally, some respondents suggested that synergies should be exploited with actors outside the CGIAR to advance strategic goals. Synergies could be fostered especially with governments and the private sector, the two partners that can achieve scaling in the area of livelihoods, even more so than with development partners. Synergies with private sector actors was suggested specifically, in relation to improving and differentiating value chain elaboration. Work would be primarily demand-driven, which facilitates buy-in and adoption.

ANNEX A: INTERVIEW SCHEDULE

Date of interview	Name of interviewee	Role in RTB	Centre
February 1, 2019	Graham Thiele	Director of RTB	CIP
Multiple	Claudio Proietti	Program Management Officer	CIP
Multiple	Elisabetta Gotor	Cluster Leader 5.1	Bioversity
February 7, 2019	Enoch Kikulwe	Cluster 5.1 scientist	Bioversity
February 4, 2019	Feleke, Shiferaw	Cluster 5.1 scientist	IITA
January 30, 2019	Marta Kozicka	Cluster 5.1 scientist	Bioversity
February 6, 2019	Roberto Labarta	Cluster 5.1 scientist	CIAT
February 7, 2019	Guy Hareau	Cluster 5.1 scientist	CIP
February 5, 2019	Dan McGonigle	BVI manager	Bioversity
February 5, 2019	Inge van den Bergh	Centre Focal Point	Bioversity
February 11, 2019	Luis Augusto Becerra	FP1 Leader, Centre Focal Point	CIAT
February 26, 2019	James Legg	FP3 Leader, Centre Focal Point	IITA
February 8, 2019	Tawanda Muzhingi	FP4 Leader	CIP
February 6, 2019	Marc Schut	FP5 Leader	IITA
March 1, 2019	Jan Kreuze	Cluster leader CC3.1	CIP
February 26, 2019	Conny Almekinders	Scientist	WUR
March 4, 2019	Victor Manyong	Director R4D	IITA
March 4, 2019	Hugo Campos	DDG-R	CIP
March 1, 2019	Julius Okello	Cluster 5.1 scientist	CIP
March 1, 2019	Vivian Polar	Gender Coordinator	CIP
February 26, 2019	Vanya Slavchevska	Gender Focal Point	CIAT
February 11, 2019	Dominique Dufour	Centre Focal Point	CIRAD
March 14, 2019	Bettina Heider	Centre Focal Point	CIP

ANNEX B: EX-POST ASSESSMENTS PERFORMED

ID	Year	Citation and link	Summary	Crop / Innovation	SLO	Innovation Domain	Center	Country / Region
1	2010	Loechl, C.; Lubowa, A.; Cole, C.; Prain, G.; Low, J. 2010. School-based nutrition education and promotion of orange-fleshed sweet potato 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 Sweet potato 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 sweet potatoes 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).	Sweet potato	2	5. Agriculture for nutrition	CIP	Uganda
2	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 program in the Ecuadorian Sierra. Multiple evaluation methods are employed to ensure identification of program impact. The findings suggest that the program 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 secondary health or environmental effects were found. Overall, the program provides clear evidence that combining production support with facilitating market access can be successful.	Platforms	1	7. Enabling policies and institutions;	CIP	Ecuador

3	2011	Developing capacity for agricultural market chain innovation: Experience with the 'PMCA' in Uganda. <i>Journal of International Development</i> , 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.	Potato	1	7. Enabling policies and institutions;	CIP	Uganda
4	2011	Tenkouano, A., Pillay, M. & Coulibaly, O. (2011). Hybrid distribution to farmers: adoption and challenges. In M. Pillay and A. Tenkouano, <i>Banana breeding: progress and challenges</i> (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.	Banana	1	2. Seed systems; 1. Crop improvement	IITA	Cameroon; Ghana; Malawi; Mozambique ; Nigeria; Rwanda; Tanzania; Uganda
5	2012	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. <i>African Journal of Agricultural Research</i> . 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 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 program 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.	Sweet potato	2	1. Crop improvement;	CIP	Kenya

6	2012	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.	Cassava	1	7. Enabling policies and institutions;	IITA	Sub-Saharan Africa
7	2012	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 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	Cassava	2	3. Pest and disease management;	IITA	DRC

			who grew the crop mainly for food. These findings are useful for informing agricultural and food policy debates in Africa.					
8	2013	Ayedun, B., Okuneye, P.A., Dipeolu, A. & Abdoulaye, T. (2013). Socioeconomic assessment of adoption of production and processing technologies on farming households in Nigeria. <i>Journal of Agricultural Management and Rural Development</i> 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.	Cassava	1	1. Crop improvement; 6. Post-harvesting and processing	IITA	Nigeria
9	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. <i>Journal of Root Crops</i> 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).	Yam	1	2. Seed systems;	IITA	Nigeria
10	2013	Pradel, W.; Hareau, G.; Quintanilla, L.; Suarez, V. 2017. Adopción e impacto de variedades		Potato	1	1. Crop improvement;	CIP	Peru

		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						
11	2013	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	<ul style="list-style-type: none"> - 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 program 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. 	Multi RTB	1	1. Crop improvement;	SPIA	Thailand, China

12	2013	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.	Cassava	1	1. Crop improvement; 6. Post-harvesting and processing	IITA	Nigeria
13	2014	Awotide, B., Abdoulaye, T., Alene, A. & Manyong, V. (2014). Assessing the extent and determinants of adoption of improved cassava varieties in south-western Nigeria. <i>Journal of Development and Agricultural Economics</i> , 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.	Cassava	1	1. Crop improvement;	IITA	Nigeria
14	2015	Alan de Brauw, Patrick Eozenou & Mourad Moursi (2015) Program Participation Intensity and Children's Nutritional Status: Evidence from a Randomised Control Trial in Mozambique, <i>The Journal of Development Studies</i> , 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 program s 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 program and then examine impacts of the program 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.	Sweet potato	2	5. Agriculture for nutrition;	IFPRI	Mozambique
15	2015	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. <i>World</i>	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	Multi RTB	3	7. Enabling policies and institutions;	Bioversity	South America

		Development 70 p. 162-170 ISSN: 0305-750X http://hdl.handle.net/10568/68400	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.					
16	2015	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	<ul style="list-style-type: none"> - 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. <p>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 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.</p>	Multi RTB	1	1. Crop improvement;	CIP	Sub-Saharan Africa
17	2015	Impact of agricultural technology adoption on asset ownership: the case of improved cassava varieties in Nigeria. Awotide, B.A., Alene, A.D.,	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	Cassava	1	1. Crop improvement;	IITA	Nigeria

		Abdoulaye, T. et al. Food Sec. (2015) 7: 1239. https://doi.org/10.1007/s12571-015-0500-7	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.					
18	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.	Sweet potato	2	5. Agriculture for nutrition;	IFPRI	Mozambique
19	2015	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 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	Yam	1	7. Enabling policies and institutions;	IITA	Nigeria, Ghana

			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.					
20	2016	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. <i>Tropicultura</i> , 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	Cassava	1	1. Crop improvement;	IITA	Congo

			even when they are working for the promotion of purely agricultural activities.					
21	2016	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.	Cassava	2	1. Crop improvement;	IITA	Nigeria
22	2017	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.	Cassava	1	1. Crop improvement;	IITA	Columbia
23	2017	Jeffrey Alwang, Elisabetta Gotor, Graham Thiele, Guy Hareau, Moti Jaleta, Jordan Chamberlin, Pathways from research on improved staple crop germplasm to poverty reduction for smallholder farmers, Agricultural Systems, Volume 172, 2019, Pages 16-27, ISSN 0308-521X, https://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	Multi RTB	1	1. Crop improvement;	Bioversity	Ethiopia, Uganda

			framework to model the adoption/area planted joint decision for maize farmers in Ethiopia and sweet potato 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 \$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.					
24	2017	JOTE, A., FELEKE, S., TUFA, A., MANYONG, V., & LEMMA, T. (2018). ASSESSING THE EFFICIENCY OF SWEET POTATO PRODUCERS IN THE SOUTHERN REGION OF ETHIOPIA. <i>Experimental Agriculture</i> , 54(4), 491-506. doi:10.1017/S0014479717000199	Applying stochastic frontier Cobb–Douglas production function, the study assessed the efficiency of sweet potato (<i>Ipomoea batatas</i>) producers in the Southern region of Ethiopia. The study revealed the existence of fairly large technical inefficiency in sweet potato production. 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	Sweet potato	1	4. Cropping systems / Farming systems;	IITA	Ethiopia

			nearly 30% output gains. The analysis of allocative efficiency also revealed that sweet potato producers were producing sweet potato 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 sweet potato production by reconfiguring their current utilization of production inputs in favor of more land and manure but less seed rate. Furthermore, age and education are important determinants of the efficiency of sweet potato production. In view of these findings, it is advisable to put in place appropriate extension intervention programs that enable sweet potato producers to exploit the potential gains in sweet potato output through technical and allocative efficiency improvement.					
25	2017	Labarta, R., Wossen, Tesfamichael, Phuong Le, D. (2017). The adoption of Improved Cassava Varieties in South and Southeast Asia. In: The 9th ASAE International Conference: Transformation in agricultural and food economy in Asia. 11 – 13 January 2017. https://www.cabdirect.org/cabdirect/abstract/20183342281 ; https://ageconsearch.umn.edu/record/284824/files/Ricardo%20Labarta.pdf	Adoption of cassava varieties has been estimated in nine countries in South and Southeast Asia based on contributions of cassava experts working in different disciplines (i.e. breeding, seed production, extension, economics and plant protection). Adoption estimates indicate that out of 4.1 million of hectares of cassava production targeted in the nine countries, 82.7% are planted with improved varieties and 2.7 million hectares (65% of total area) are grown using CIAT related varieties.	Cassava	1	1. Crop improvement;	CIAT	South and Southeast Asia
26	2017	Mignouna DB., Abdoulaye T., Akinola AA., Alene A., Oparinde A., Manyong VM., Maroya N., Asiedu R. — A Two-stage Empirical Analysis of Market Participation in Yam-growing Areas of West Africa, p. 262-274.	http://www.tropicultura.org/text/v35n4/262.pdf	Yam	1	7. Enabling policies and institutions;	IITA	West Africa
27	2017	Oparinde, A., Abdoulaye, T., Mignouna, D. B. & Bamire, A. S. (2017). Will farmers intend to	Analysis of market segments within a population remains critical to agricultural systems and policy processes for targeting new innovations.	Cassava	2	1. Crop improvement;	IITA	Nigeria

		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	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.					
28	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.	Cooperatives	1	7. Enabling policies and institutions;	IITA	Nigeria
29	2018	Ainembabazi, J.H., Abdoulaye, T., Feleke, S., Alene, A., Dontsop-Nguezet, P.M., Ndayisaba, P.C., ... & Manyong, V. (2018). Who benefits from which agricultural research-for-development technologies? Evidence from farm household poverty analysis in Central Africa. World Development, 108, 28-46. https://hdl.handle.net/10568/92931	CIALCA developed and disseminated over 30 agricultural R4D technologies. A survey of 596 adopters and 360 non-adopters, using econometric analysis showed adoption of AR4D technologies reduced the probability of being poor by 13%. A large share of poverty reduction is causally attributable to adoption of improved crop varieties (32%) followed by post-harvest technologies (28%) and crop and natural resource management (26%). Findings indicate that relatively poor farm households benefit from adopting improved crop varieties more than better-off households.	R4D technologies	1	1. Crop improvement; 6. Post-harvesting and processing	IITA	Central Africa
30	2018	Feleke, S., Manyong, V., Abdoulaye, T., Alene, A., Wossen, T. and Dontsop, P., (2018). "Are agricultural technologies pro-poor? The case of improved cassava varieties in sub-Saharan Africa", Selected Paper presented at the 30th International Conference of Agricultural Economists (ICAE), July	Using data coming from household surveys conducted in Tanzania, DR Congo, Sierra Leone and Zambia through multinational-CGIAR support to agricultural research for development projects in Africa, this study shows that adoption of improved cassava varieties decreased the rate, depth and severity of food insecurity. Results show that these effects are more favorable towards the food insecure (pro-poor) as measured by the share	Cassava	2	1. Crop improvement;	IITA	Sub-Saharan Africa

		28 - August 5, Vancouver, Canada. https://ageconsearch.umn.edu/record/277196?ln=en	of overall benefits and thus present important evidence on the effectiveness of the adoption of cassava technology for reducing the rate and depth of food insecurity in sub-Saharan Africa.					
31	2018	Gatto, M.; Hareau, G.; Pradel, W.; Suarez, V.; Qin, J. 2018. Release and adoption of improved potato varieties in Southeast and South Asia. International Potato Center (CIP) Lima, Peru. ISBN 978-92-9060-501-0. 42p. Social Sciences Working Paper No. 2018-2 https://hdl.handle.net/10568/97694	Release and adoption of potato improved varieties was studied in Bangladesh, China, India, Indonesia, Nepal, Pakistan, and Vietnam. In 2015, the potato area in our study region was 7.6M ha. About 97% of the area is planted to improved varieties (IVs). In terms of area, CIP-related varieties are planted to about 1.4M ha which is about 19% of the total area. China accounts for most (87%) of total area cultivated to CIP-related varieties. About 3M households are using CIP-related material, particularly in China (2.5M), India (0.2M) and Nepal (0.1M).	Potato	1	1. Crop improvement;	CIP	South and Southeast Asia
32	2018	Gatto, M.; Hareau, G.; Pradel, W.; Suarez, V.; Qin, J. 2018. Release and adoption of improved sweetpotato varieties in Southeast and South Asia. International Potato Center (CIP) Lima, Peru. ISBN 978-92-9060-503-4. 42p. Social Sciences Working Paper No. 2018-3. https://hdl.handle.net/10568/98395	Release and adoption of sweetpotato improved varieties was studied in Bangladesh, China, India, Indonesia, Nepal, Papua New Guinea, Philippines, and Vietnam. In 2015, the sweetpotato area in our study region was 3.6M ha. About 88% of the area is planted to improved varieties (IVs). There are major regional differences. Whereas in China 100% of the area is under IVs, in Bangladesh this is only 6%. In terms of area, CIP-related varieties are planted to about 164,000 ha which is about 5% of the total area. China accounts for most (71%) of total area cultivated to CIP-related varieties. However, this only represents 4% of total area in China. The country with the highest figure is Vietnam, where 20% of the total area is planted to CIP-related varieties.	Sweet potato	1	1. Crop improvement;	CIP	South and Southeast Asia
33	2018	ISPC. (2018). Adoption and Impact of Cooperation-88 Potato in China, Brief N. 66. Rome: Independent Science and Partnership Council.	https://ispc.cgiar.org/publications/adoption-and-impact-cooperation-88-potato-china	Potato	1	1. Crop improvement;	CIP	China
34	2018	Kikulwe, E.M.; Okurut, S.; Ajambo, S.; Gotor, E.; Ssali, R.T.; Kubiriba, J.; Karamura, E. (2018). Does gender matter in effective management of plant	This study utilizes sex-disaggregated data from 341 households in Uganda to analyze: gender-related drivers and constraints for the adoption of BXW control technologies in targeted banana-farming communities. Results	Banana	3	3. Pest and disease management;	IITA	Uganda

		disease epidemics? Insights from a survey among rural banana farming households in Uganda. <i>Journal of Development and Agricultural Economics</i> 10(3) p. 87-98. ISSN: 2006-9774.; http://hdl.handle.net/10568/91294	show that female and male have different access to and control on agricultural assets and this influence the adoption of management practices. Also, the study finds both gender and farmer perceptions on BXW control to significantly affect adoption of BXW control practices and household food security.					
35	2018	Ojiako, I.A., Tarawali, G., Okechukwu, R.U., Chianu, J., Ezedinma, C. & Edet, M. (2018). Profitability of cassava production: comparing the actual and potential returns on investment among smallholders in southern Nigeria. <i>Journal of Biology, Agriculture and Healthcare</i> , 8(16), 51-65. https://hdl.handle.net/10568/97563	An analysis was conducted of the gross margin and the returns on investment of smallholder farmers enrolled into an out-growers' scheme to supply cassava to commercial starch processors under the Nestlé-IITA cassava starch value chain project implemented from 2011-2015. The project, which sought to build clusters of smallholder cassava farmers under out-growers' scheme around two major private sector-managed commercial starch processing factories, Matna Foods and Nigerian Starch Mills Limited, was implemented in eight cassava farming states of Nigeria. The results show that there is a yawning gap (more than 100%) in profitability and returns on investment between the actual and potential for the cassava enterprises. While price instability remains an unresolved issue due to the uniqueness of the cassava crop, inability of farmers to achieve optimal yields is the major contributor to poor performance of the cassava industry.	Cassava	1	4. Cropping systems / Farming systems;	IITA	Nigeria
36	2018	Shiferaw Tafesse, E. Damtew, B. van Mierlo, R. Lie, B. Lemaga, K. Sharma, C. Leeuwis, P.C. Struik, Farmers' knowledge and practices of potato disease management in Ethiopia, <i>NJAS - Wageningen Journal of Life Sciences</i> , Volumes 86–87, 2018, Pages 25-38, ISSN 1573-5214, https://doi.org/10.1016/j.njas.2018.03.004	The study is representative of the two major potato growing regions of Ethiopia located in the central highlands of the country. Three categories of potato farmers were considered: producers of quality declared seed (QDS), producers of normal seed and producers of ware potatoes. Knowledge and practices about disease management were assessed. Results show that the practice and the farmer category matter for the declared use of the disease management practices. Handling infected/damaged seed and ware potatoes at harvest is mentioned by 97% of the farmers, crop rotation by 95%, fungicide application by 87%, roguing plants with symptoms of bacterial wilt by 80%, using late blight resistant potato	Potato	3	3. Pest and disease management;	CIP	Ethiopia

			varieties by 65%, planting bacterial wilt free seed by 26%, seed renewal by 13%. Results show incongruences between scientific explanations and farmers' understanding of the diseases. Farmers' knowledge, which informs their practices, needs to be enhanced in a learning approach that integrates generic and local knowledge.					
37	2018	Willy Pradel, Marcel Gatto, Guy Hareau, S.K. Pandey, Vinay Bhardway, Adoption of potato varieties and their role for climate change adaptation in India, Climate Risk Management, Volume 23, 2019, Pages 114-123, ISSN 2212-0963, https://doi.org/10.1016/j.crm.2019.01.001 .	Adoption of improved varieties is an important strategy to adapt to the negative implication associated with climate change and variability. However, incomplete data on varietal release and adoption is often the reality in many countries hindering informed decision-making on breeding and varietal dissemination strategies to effectively adapt to climate change. In taking the example of potatoes in India, we analyze the extent to which the potato sector is resilient to climate change. We do so by comparing state-level climate change projections with adoption of high resistant and tolerant potato varieties to major abiotic and biotic stresses. Release and adoption data was collected in 2016 in six expert elicitation workshops conducted with 130 experts from the potato value chain in Bihar, Gujarat, Karnataka, Punjab, Uttar Pradesh, and West Bengal. We found that from the total of 81 releases, 45 improved varieties are adopted in India and that in each state high resistant and tolerant varieties are cultivated providing some degree of varietal resilience. Early maturity has been the most important and heat tolerance is the least important trait. Comparing climate projections with adoption rates of high resistant and tolerant varieties, we found that Gujarat is relatively most resilient. In other states we found some mismatches between climate projections and adopted specific varietal traits. Our results allow policy-makers and breeders to better prioritize investments into breeding for specific traits and dissemination strategies.	Potato	3	1. Crop improvement;	CIP	India
38	2018	Wossen, T., Alene, A., Abdoulaye, T., Feleke, S., Rabbi, I.Y. & Manyong, V. (2018). Poverty	Adoption of cassava varieties tracked using data from DNA-fingerprinting in 2015-16 showed that two thirds of cassava growers in Nigeria were	Cassava	1	1. Crop improvement;	IITA	Nigeria

		reduction effects of agricultural technology adoption: the case of improved cassava varieties in Nigeria. <i>Journal of Agricultural Economics</i> , 1-16. https://hdl.handle.net/10568/97927	using improved varieties. Economic analysis demonstrated that adoption of improved varieties has allowed about 1.6 million individuals to escape poverty (using a poverty line of USD 1.9 per person per day).					
39	2018	Wossen, T., Gatiso, T.T. & Kassie, M. (2018). Estimating returns to fertilizer adoption with unobserved heterogeneity: evidence from Ethiopia. <i>Food and Energy Security</i> , 1-9. https://hdl.handle.net/10568/97860	This paper uses the World Bank's Living Standards Measurement Study-Integrated Surveys of Agriculture (LSMS-ISA) data from Ethiopia to estimate the relationship between fertilizer adoption and agricultural productivity. The 2015/16 survey round was used for main analysis. Results suggest that adoption of fertilizer increases gross return by about 35%.	Fertilizers	1	4. Cropping systems / Farming systems;	IITA	Ethiopia
40	2018	Wyckhuys, Kris; Zhang, W.; Prager, Steven D.; Kramer, D.B.; Delaquis, E.; Gonzalez, C.E.; van der Werf, W. (2018). Biological control of an invasive pest eases pressures on global commodity markets. <i>Environmental Research Letters</i> , 13(94005). https://hdl.handle.net/10568/97455	Thailand is a vital exporter of cassava-derived commodities to China and supplies 36% of the world's internationally-traded starch. The spread of cassava mealybug (<i>Phenacoccus manihoti</i>) in Thailand (2008-2011) caused a 26% reduction of the cassava yield countrywide and triggered price surges and structural changes in global starch trade. Study shows how the adoption of biological control measures (i.e. the introduction of a host-specific parasitoid, <i>Anagyrus lopezi</i>) has contributed in restoring (2011-2013) the cassava yield and in easing shocks on export volumes and pricing for cassava starch globally. Biological control provides direct economic benefits of US\$200–704 per ha annually at farm-gate prices in Thailand which mostly benefited small holders.	Cassava	1	3. Pest and disease management;	CIAT	Thailand
41	2018	Kennedy, Gina; Raneri, Jessica E.; Stoian, Dietmar; Attwood, Simon; Burgos, Gabriela; Ceballos, Hernán; Ekesa, Beatrice; Johnson, Vincent; Low, Jan W.; Talsma, Elise F. (2018). <i>Roots, Tubers and Bananas Contributions to Food Security</i> . Reference Module in Food Science, 1-26. https://hdl.handle.net/10568/97427	This study reviews the role RTB play for food and nutrition security in terms of their contribution to food availability, access, and utilization, as well as sustainability factors that may influence their utilization in the future.	Multi RTB	2	5. Agriculture for nutrition;	Bioversity	Global



RESEARCH
PROGRAM ON
Roots, Tubers
and Bananas

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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