Final Report

Expanding Utilisation of RTB and Reducing Their Postharvest Losses

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by

International Potato Center (CIP) on behalf of the

CGIAR Research Program on Roots, Tubers and Bananas (RTB)

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Programme Partners:

Other RTB members:

- Bioversity International
- International Institute of Tropical Agriculture
- International Centre for Tropical Agriculture
- French Agricultural Research Centre for International Development

In collaboration with a number of AR&D partners:

- International Livestock Research Institute
- National Agricultural Research Organisation
- Makerere University
- Uganda Martyrs University
- Gulu University
- Iowa State University – Uganda Program
- Self Help Africa
- CHAIN Uganda
- Volunteer Efforts for Development Concerns
- International Institute of Rural Reconstruction

And private sector entities:

- KAIKA InvestCo
- Uganda Fruits and Vegetables Exporters and Producers Association
- The Ssemwanga Centre for Agriculture & Food Ltd
- Mbarara District Farmers Association
- Kapchorwa Commercial Farmers Association
- Wanale Seed and Ware Potato Association
- Mbale Potato Dealers Association
- Pig Production and Marketing Uganda Ltd
- Brica Investments Ltd

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TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

BugiZARDI	Buginyanya Agricultural Research and Development Institute
CHAIN Uganda	Coalition for Health, Agriculture and Income Networks
CIAT	International Centre for Tropical Agriculture
CIP	International Potato Center
CIRAD	French Agricultural Research Centre for International Development
CRP-RTB	CGIAR Research Program on Roots, Tubers and Banana
DSIP	Agricultural Sector Development Strategy & Investment Plan
EC	European Commission
ENDURE	Expanding Utilisation of RTB and Reducing Their Postharvest Losses
FCR	Feed conversion rate
IFAD	International Fund for Agricultural Development
IFDC	International Fertilizer Development Center
IIRR	International Institute of Rural Reconstruction
IITA	International Institute for Tropical Agriculture
ILRI	International Livestock Research Institute
KCCA	Kampala City Council Authority
LoU	Letter of understanding
NaCRRI	National Crop Resources Research Institute
NaLiRRI	National Livestock Resources Research Institute
NARL	National Agriculture Research Laboratories
NARO	National agricultural research organisation
NARS	National agricultural research systems
NGO	Non-governmental organisation
PHL	Postharvest losses
PIM	CGIAR Research Program on Policies, Institutions, and Markets
PMCA	Participatory Market Chain Approach
PPD	Postharvest physiological deterioration
R&D	Research and development
RH	Relative humidity storage
RTB	Roots, tubers, and bananas
	CGIAR Research Program on Roots, Tubers and Bananas
SP	Sweetpotato
SSA	Sub-Saharan Africa

t	Tonne
ToT	Training of trainers
UFVEPA	Uganda Fruits and Vegetable Exporters and Producers Association
UGX	Ugandan Shillings
VC	Value chain
VEDCO	Volunteer Efforts for Development Concerns
WCRTC	World Congress of Root and Tuber Crops

SUMMARY

1. PROGRAMME GOALS AND OBJECTIVES

In sub-Saharan Africa (SSA), root, tuber, and banana (RTB) crops are major contributors to food and income security. However, they are characterised by high postharvest losses (PHL), short marketing channels, and limited added value due to their bulkiness and high perishability, poor postharvest management, and lack of storage and processing facilities.

Project goal: Contribute to improved food security for RTB-producing communities in Eastern and Central Africa

Project objectives: Improve food availability and income generation through better postharvest management and expanded use of RTB, based on (1) postharvest and processing technologies; (2) value chain (VC) assessment and development; and (3) capacity development.

Specific objectives

- Decreased RTB storage losses by 15% in pilot sites
- 20% increased shelf-life of fresh RTB in pilot sites
- 10% increased processing of RTB for on-farm use in pilot sites
- 10% increased income from RTB and their products, including livestock where relevant, for rural producers in pilot sites
- Increased participation of women in higher and more profitable levels of the VC and more equitable distribution of benefits between men and women in the community
- National agricultural research systems (NARS), development organisations, and private sector players engaged in a continuous collaborative innovation process to tackle different constraints in RTB VCs.

2. PROGRAMME COMPONENTS

The *Expanding Utilisation of RTB and Reducing Their Postharvest Losses* (ENDURE) project has tested and validated innovations for improved postharvest management, expanded processing, and targeting changing needs of emerging urban markets. In particular, it has assessed the innovations' technical feasibility, economic viability, and social acceptability for male and female VC actors. Furthermore, considerable effort has been put into developing market linkages, enhancing the provision of VC development services and strengthening the capacities of relevant stakeholders in order to promote early adoption of the most promising innovations.

The project consists of four subprojects that have been defined following a preparatory phase that entailed the establishment of crop-specific, multi-agency teams, a preliminary identification and analysis of the postharvest innovations to work on, and capacity-building activities to strengthen the required capacities of the different teams to successfully contribute to achieve the overall project objectives. The scoping activities and the development of the business cases enabled validation (or otherwise) of some of their preliminary assumptions and strengthened the teams' cohesion and capacity to conduct research in partnership.

The four subprojects are:

- Reducing PHL and promoting product differentiation in cooking banana VC.
- Improving the utilisation of sweetpotato (SP) and other root and tuber crops residues for pig feed.
- Postharvest innovations for better access to specialised ware potato markets.
- Extending the shelf-life of fresh cassava roots for increased incomes and reduced PHL.

3. MAIN DELIVERABLES AGAINST TARGETS OUTPUTS

Output 1.1: Current main RTB postharvest challenges and priorities for improvement identified with key RTB production communities (women and men) and value chain actors

Four crop-specific, multi-agency teams were established to jointly identify the main RTB postharvest challenges, opportunities, and priorities. The teams developed seven preliminary business cases for research. Scoping studies were conducted to validate initial hypotheses and assumptions as well as provide initial estimates of PHL. Final business cases for research funding were produced to address the identified postharvest challenges and market opportunities.

Output 1.2: RTB technologies and their application for reducing PHL and expanding utilisation prioritised and gaps for research identified

The scoping studies conducted by the four teams entailed a review of relevant literature and collection of primary data. The seven business cases presented options for funding research around a number of technologies and other innovations. Eventually, four were prioritised and selected for funding (the subprojects).

Output 1.3: RTB varieties with improved postharvest characteristics identified, tested, and validated with target communities (women and men) and value chain actors across a range of production, marketing, and storage environments

Banana. Four varieties were identified and promoted as being in high demand by markets. Access to planting material was improved and the split corm method was found the most viable multiplication technique. *Sweetpotato.* One variety producing a good balance of food (roots) and feed (vines) was identified as the most suitable dual-purpose variety. It is currently being actively promoted and the planting material sold by the established silage business centres. *Potato.* Eighteen varieties/clones were evaluated for agronomic and postharvest characteristics. One clone performed the best overall and should be considered for official registration and release. *Cassava.* Out of 16 tested, 1 improved and 2 local varieties showed the best potential for shelf-life extension using the proposed technologies.

Output 1.4: RTB on-farm storage and processing systems trialled and validated

Sweetpotato. Options for on-farm silage-making for pig feed using SP vines and non-commercial roots tested and validated, and ideal level of supplementation determined. *Potato*. Two storage options were tested with promising results: collective ambient stores and improved traditional individual stores. *Cassava*. Two postharvest shelf-life extension technologies were tested: root waxing technology and high relative humidity (RH) storage. Results are promising, but additional research is required to prove the economic viability.

Output 1.5: Other RTB technologies to reduce PHL and expand utilisation validated

Banana. The following innovations were tested: optimal harvest time; sucker staggering; cold storage; introduction of convenient presentation forms; weight-based pricing mechanism; and cushioning. Optimal harvest time and convenient presentation forms were validated. Sucker staggering, cold storage, and weight-based pricing look promising, but additional research is required for final validation. *Sweetpotato.* Silage-making as a business (off-farm) and provision of related services are emerging and sales are picking up. *Potato.* Storability experiments were conducted also on potatoes stored by the local trader association. Besides, three new harvesting methods were assessed and outperformed the traditional hand hoe in reducing physical and quality losses at harvest. *Cassava*. Shelf-life extension technologies were introduced to and operationalised also by a sole enterprise. Furthermore, research was conducted to validate a pruning technology.

Output 2.1: Current RTB value chains and food access situation assessed and priorities for improvement and enhanced gender equity identified with key chain actors/stakeholders

Market and VC studies were conducted for each target crop to (1) map the VC; (2) assess margins; (3) validate priorities for improving postharvest management; (4) further refine the estimation of the demand for the proposed innovations and end products; and (5) deepen the analyses of PHL. The main findings of the studies were shared with partners, collaborators, and relevant stakeholders to validate and refine the priorities of the interventions. A comparative analysis of PHL along fresh cassava, banana, and potato VCs in Uganda was also conducted to inform policy prioritisation and future interventions.

Output 2.2: New market opportunities to expand use of RTB assessed and prioritised with stakeholder participation

During the preparatory phase, the different teams identified and analysed new market opportunities, and the most promising innovations that culminated in the four subprojects that have been implemented.

Output 2.3: RTB producer/processor groups strengthened for equitable participation and innovation in value chains

Banana. Training on agronomic and postharvest practices targeted 818 farmers (425 M, 393 F). Training on entrepreneurial skills and business planning targeted 206 farmers (100 M, 106 F). The project supported the development of four gender-responsive business plans. *Sweetpotato.* Training on silage-making and use and pig management targeted 585 farmers (254 M, 331 F). Training on entrepreneurial skills and marketing 129 farmers (92 M, 37 F). The project has also supported the development of 14 gender-responsive business plans: 11 for silage business entrepreneurs (either individuals or groups) and 3 for expanding the operations of the silage business centres established by the project. *Potato.* Training on pre- and postharvest management targeted 98 farmers (51 M, 47 F) and 15 traders (11 M, 4 F). Training on entrepreneurial and business skills targeted 643 farmers (342 M, 301 F). Furthermore, the project supported the associations hosting the three collective stores to develop store management plans and business plans. *Cassava.* Training on agronomic and postharvest practices targeted 91 farmers (39 M, 52 F). Training on entrepreneurial skills and marketing targeted 261 farmers (111 M, 150 F). Furthermore, the project supported the development of business plans for each of the two pack-houses established with project support.

Output 2.4: Sustainable multistakeholder platforms for further RTB value chain innovation created with public/private sector and participation by non-governmental organisations (NGOs) and community-based organisations

*Banana***.** The Western Region Banana Innovation Platform was established, formalised, and registered. One sub-county platform was also created. *Sweetpotato*. The project built on existing pig platforms and facilitated the meetings of the Central and Eastern region platforms. As a sustainability strategy, 202 executive members of the national and regional platforms' committees were trained in good governance. *Potato*. The Eastern Regional Potato Multistakeholder Innovation Platform was established from scratch and is being facilitated by one national agricultural research organisation (NARO) partner. *Cassava*. Two idle, existing district platforms were revamped and strengthened through a number of meetings held and facilitated by the project.

Output 3.1: Project's website containing documented methods, technologies, and knowledge products suited to target audiences (researchers, extension services, communities, NGOs, etc.)

A functional project website has been developed and is currently up and running. Project documents, reports, and publications are available online, and the website's content was regularly updated as the project progressed.

Output 3.2: Capacity built in key national partners for reducing PHL and increasing use of RTB

At least nine major training events have been held for national partners. Cross-crop learning within the Ugandan scientific community has been facilitated through workshops, science days, and official launches of project innovations. NARO researchers have been involved in the research design and implementation for all crops. Ten MSc students have been identified, granted fellowships, supervised, and coached for undertaking studies to complement project research activities.

Output 3.3: Outputs of research disseminated throughout agricultural knowledge and information systems

The project generated a number of knowledge products to disseminate key research findings (see International Public Goods section). Communication and dissemination of project outputs have been guided by a purposively designed communication and visibility plan.

4. INNOVATIONS, ADOPTION, AND SCALING UP

The project introduced, tested, and promoted a number of technological, commercial, and institutional innovations for enhanced postharvest management, taking into account their technical feasibility, economic viability, and social acceptability for male and female VC actors. Some of the innovations are extremely promising, are already being adopted, and offer immediate opportunities for scaling. A non-exhaustive list of such innovations includes cassava pruning for shelf-life extension, SP silage, macro-propagation of market-demanded banana varieties, potato dehaulming, and optimum harvest time for banana and potato (Table 1).

Table 1: Examples of Major Innovations

	Technological	Commercial	Institutional
Banana	Varieties with long shelf-life Seed macro-propagation techniques	Potted and labelled plantlets for sale High-quality banana clusters for export	Seed sharing models: recovery and business
SP	Dual purpose variety for food and feed (Naspot 11)	SP silage for sale	Silage chopping service entrepreneurship model Silage centres
Potato	Modified ambient and traditional stores Genotypes with storable attributes (Rwangume)	Stored ware potato for sale on the local and regional markets	Store management plans to minimise free riding
Cassava	Cassava pack-house facilities Varieties amenable to RH and waxing Pruning	Waxed cassava	Farmer-processor arrangements for supply of quality cassava roots

For some other innovations that require larger capital investments and, sometimes entailed the launch of a new product on the market (e.g. cassava shelf-life extension technologies, potato storage, and mechanical harvest of potato), further studies on adoption and economic viability should be conducted before large-scale scaling. In fact, the short duration of the project and the emerging nature of these enterprises have not allowed a systematic capture of the data required for reaching conclusive recommendations. Nevertheless, these also seem extremely promising as witnessed by the benefits that accrued to farmers and processors as a result of the profitable—although still limited—sale of new (e.g. waxed cassava) or improved products (e.g. quality stored potatoes).

5. INTERNATIONAL PUBLIC GOODS

The project produced and disseminated a number of research outputs and knowledge products. These include the following: 1 article published and 4 submitted in peer-reviewed journals, 18 presentations and posters given at fora and symposia, and 41 project publications (22 technical reports, 8 manuals, 1 protocol, 2 brochures, and 8 leaflets). Additional articles are being finalised for submission to peer-reviewed journals.

6. GENDER

Gender has received high priority. To ensure that gender issues were considered at all stages of implementation, a gender team was established, led by the CIP-SSA gender specialist. At the beginning of the project, a gender action plan was developed and featured landscape studies, capacity development, gender mainstreaming in VC and business development, and technical backstopping to the four teams. Gender situational analyses were conducted for all subprojects to identify constraints that could hinder the uptake of the proposed technologies and innovations by both men and women, and establish the existing gender-related empowerment levels in a number of relevant domains. Based on the findings, context-specific strategies (either gender responsive or transformative) were drawn for each subproject to address the identified constraints and identify the most suitable options for women and men. Ad hoc trainings were conducted for sensitising and equipping the implementing partners with tools for gender mainstreaming, including for the development of gender-responsive business plans.

7. PARTNERSHIPS

The Participatory Market Chain Approach (PMCA) adopted by the project contributed to establishing strong partnerships within and between the four commodity teams. All CRP-RTB international members (CIP, IITA, CIAT, Bioversity, and CIRAD) were part of at least one research team. Another CGIAR center, ILRI, was instrumental for the successful implementation of the SP subproject. Gender tools developed by the CGIAR Research Programme on Policies, Institutions, and Markets were tested and validated under this project. These represent noticeable examples of the value of cross-CRP collaborations to ensure required synergies and complementarities.

Researchers from NARO were also involved in all subprojects; four of them contributed to project implementation. In addition, three national universities, five NGOs, and a number of private sector players contributed to project activities and achievements. The private sector played a crucial role in enhancing farmers' market access, spearheading the innovations, and providing invaluable feedback to ensure that the teams were actually responding to market needs and opportunities.

The project also built collaborations with local authorities that played a key role in facilitating the implementation of activities and disseminating the innovations. Notable examples are extension staff promoting SP silage and local government supporting women farmers' groups willing to engage in banana macro-propagation through financial assistance and purchase of plantlets for distribution outside the project area. CIP expects that these partnerships can be consolidated and made sustainable through the multistakeholder platforms that have been either established or strengthened by the project.

In terms of collaboration among the four subproject teams, the project has fostered cross-crop learning among researchers, development practitioners, and private sector players by building on the clear (but often ignored) similarities among RTB crops and promoting the adoption of shared methodologies. Furthermore, the organisation of cross-subprojects events allowed implementing partners to be exposed to the work conducted by others, thus contributing to broadening their research horizons.

The success of the project in this regard is shown by the fact that its partnership approach is being used as a model to develop the strategic research framework's strategy of the CRP-RTB work on nutrition, postharvest, and value addition. Furthermore, the final report

of the RTB evaluation conducted in 2015 by the CGIAR Independent Evaluation Arrangement highlighted this project as an excellent example of the collegial research that the programme aims at promoting and facilitating.

8. EC / IFAD VISIBILITY ACTIVITIES

The project was given high visibility. Guided by the communication and visibility plan, communication material, including brochures, leaflets, and flyers, were produced and distributed during project implementation. Engagement with national journalists and television reporters resulted in extensive media coverage of the project; over 20 articles were published in national newspapers and online. Researchers and project beneficiaries had opportunities to radio broadcast their achievements and stories. Some were also featured on local TV. To ensure broader outreach, over 15 blogs were prepared to share selected project stories and important events through social media. The project has also benefitted from extensive visibility through CRP-RTB, with highlights in the annual reports 2015 and 2016.

The EC's role in providing funding for the project and the technical support of IFAD were duly acknowledged and made visible in reports and other publications, presentations, brochures, posters, banners, stickers, and placards.

9. CONCLUSIONS

The project has provided evidence that, in most cases, a single innovation is not sufficient to address the multidimensional nature of RTB postharvest challenges. Accordingly, the project tested, validated, refined, and promoted a number of technological, commercial, and institutional innovations that span along the full spectrum of the VC. They include identification and improved access to suitable varieties with enhanced postharvest traits; improved agronomic and harvesting techniques; and postharvest handling, storage, processing, and marketing practices and technologies. To ensure the suitability and promote early uptake of the proposed innovations, research activities have been accompanied by major endeavours to strengthen the technical, entrepreneurial, and collective action capacities of project beneficiaries, as well as to ensure stronger market linkages, primarily through the direct involvement of the private sector.

Some of the innovations are extremely promising, and are already being adopted and offer immediate opportunities for scaling. For others, particularly the ones that require larger capital investments, further studies on adoption and economic viability are recommended before large-scale scaling.

As a way forward, the fact that there are several pending research questions, and that new ones have emerged as a result of the project, should be taken as a seed for future research initiatives to further enhance the quality of life and income of smallholders growing RTB crops in Uganda and elsewhere. Furthermore, the example of budding businesses where people have pooled their own resources to start on their own (e.g. for SP silage and banana multiplication business), the interest of other players to promote and scale the innovations (e.g. local governments, extension service, and the International Fertilizer Development Center), the strong partnerships that have been built and the multistakeholder platforms that have been established or strengthened by the project, signal a path to sustainability beyond the life cycle of the project. Moreover, the development of several business plans is expected to facilitate future engagement with VC stakeholders and other research and development initiatives.

The systems perspective, maturity, experience, and insights gained by the research team would only increase the likelihood of delivery and achieving high impact of projects/ interventions building on the success of the current one.

The results and lessons from this project have provided evidence of the effectiveness of multistakeholder approaches, that bring together research and development-oriented organisations as well as private sector players and local authorities, in developing market-

driven innovations and fast-tracking their adoption. The end of the project should be regarded as a new beginning for more research, development interventions, and stronger private-public partnerships that can be successfully built on the project's achievements in a bid to expand the utilisation and reduce the PHL of RTB. The ultimate goal of such post RTB-ENDURE projects/interventions would be to unleash the potential of these crops to contribute to enhanced food and nutrition security, income generation, gender equality, and job creation in Uganda and in the region at large.

1. BACKGROUND

In sub-Saharan Africa (SSA), root, tuber, and banana (RTB) crops are major contributors to food and income security. However, they are characterised by high postharvest losses (PHL), short marketing channels, and limited added value due to their bulkiness and high perishability, poor postharvest management, and lack of storage and processing facilities (Collison et al. 2003; Ngambeki et al. 2010; Bonabana et al. 2003).

The *Expanding Utilisation of RTB and Reducing Their Postharvest Losses* (RTB-ENDURE) project has addressed these constraints by testing and validating technological, commercial, and institutional innovations for improved postharvest management, expanded processing, and targeting changing needs of emerging urban markets in a bid to reposition RTB crops as added-value cash crops. In particular, the project has assessed the innovations' technical feasibility, economic viability, and social acceptability for male and female value chain (VC) actors. Furthermore, considerable effort has been put into developing market linkages, enhancing the provision of VC development services and strengthening the capacities of relevant stakeholders in order to promote early adoption of the most promising innovations. The project has been implemented in Uganda by the CIP-led CGIAR Research Program on Roots, Tubers and Bananas (CRP-RTB), with funding from the EU and technical support of IFAD.

Project goal: Contribute to improved food security for RTB-producing communities in Eastern and Central Africa

Project objectives: Improve food availability and income generation through better postharvest management and expanded use of RTB, based on (1) postharvest and processing technologies, (2) VC assessment and development, and (3) capacity development.

Specific objectives:

- To decrease RTB storage losses by 15% in pilot sites
- To increase shelf-life of fresh RTB by 20% in pilot sites
- To increase processing of RTB for on-farm use by 10% in pilot sites
- To increase income from RTB and their products, including livestock where relevant, for rural producers in pilot sites by 10%
- To increase participation of women in higher and more profitable levels of the VC and promote more equitable distribution of benefits between men and women in the community
- To strengthen the capacity of national agricultural research systems (NARS), development organisation and private sector players to engage in continuous collaborative innovation processes to tackle different constraints in RTB VCs.

1.1 PROJECT APPROACH

It is possible to identify two main phases of the project: a "preparatory phase" and a "research and VC development implementation phase". The first year of the project can be referred to as a preparatory phase.

The preparatory phase has mainly entailed the establishment of crop-specific research teams, a preliminary identification and analysis of the postharvest innovations to work on, and the selection of the most promising ones to be tested and validated during the second phase. Furthermore, training and capacity-building activities have been conducted to strengthen the required capacities of the different teams in order to successfully contribute to the achievement of the overall project objectives.

During the inception workshop in March 2014, participants were facilitated to form four crop-specific research teams (potato, banana, sweetpotato, and cassava) for jointly identifying some postharvest innovations with high potential to contribute to the project

objectives. The different teams included representatives of various CGIAR (CIP, IITA, CIAT, Bioversity International, and ILRI) and non-CGIAR potential partners: CIRAD, national agricultural research organisation (NARO), MAIF, Makerere University, non-governmental organisations (NGOs), private sector, and others. Each team, taking also into account the outcomes of a planning workshop held in mid-2012, selected one to two options and developed short proposals for undertaking scoping studies for exploring the feasibility, likely adoption, and potential impact of the proposed interventions (Annex CC2). Following ad hoc facilitation (e.g. training sessions on gender-responsive market studies and analysis, see Annex CC3) and based on the results of the scoping studies, the four teams developed and submitted seven business cases for research funding.

Even though continuous support has been provided to the different teams in order to help them strengthen their proposals, during the preparatory phase the project has adopted a rather competitive approach and the teams were aware that only the most robust and convincing options would have been funded. The business cases went through rounds of internal (by the project management and the project's Steering Committee) and external reviews (by leading experts in the area of RTB postharvest and VCs). Finally, four research options were selected for funding, one for each crop. They are outlined in the next section, whereas the reports of the funded business cases can be found in Annexes B1, S1, P1, and C1, respectively.

The selection of the four research options to be funded officially closed the preparatory phase and marked the beginning of the research and VC development implementation phase (a meeting-cum-training workshop was organised in December 2014, to officially launch the new phase; see Annex CC4). The different team members had worked together for a number of months for jointly identifying and analysing new market opportunities and the most promising innovations. The scoping activities and the development of the business cases had contributed to validate (or otherwise) some of their preliminary assumptions and strengthen the teams' cohesion and capacity to conduct research in partnership. By the end of the first year, all research teams had been brought up to speed about the expected project outputs and outcomes and their capacities to implement the Participatory Market Chain Approach (PMCA) methodology and mainstream gender in their research activities had been strengthened (Bernet et al. 2006).[1] The four teams could now confidently move into the research and VC development implementation phase and conduct on-the-ground testing to provide evidence of their proof of concepts.

The overall project approach recognizes that research is often confused with innovation; but there are important differences between them. Whereas research focuses on generating new knowledge, innovation refers to the practical use and successful application of research results. Accordingly, the second phase of the project has been built around three main pillars: research, capacity building, and VC development.

Research has been conducted primarily to assess the technical feasibility, economic viability, and social acceptability of the proposed innovations. Key research findings were disseminated through technical reports, knowledge products (e.g. manuals, brochures, guidelines, protocols, etc.), scientific papers, and participation in scientific conferences and symposia.

The capacities of the implementing teams and relevant VC actors have been strengthened for ensuring sound science and fast-tracking the uptake of the innovations.

[1] The PMCA is a methodology developed by CIP to help small farmers link up with profitable markets by stimulating innovation process and long-term partnerships among farmers, market agents, and service providers. It requires improving communication, building trust, and facilitating collaboration among participants so that they can jointly identify, analyse, and exploit new market opportunities.

The VC actors involved in the piloting of the innovations have been supported, including through provision of necessary facilities and equipment, development of business plans, and establishment of new market linkages.

To address the challenges of the target crops, such as their high perishability, the project has worked from the production to the consumption ends of the VCs, and strived to intervene at a number of key nodes, including access to suitable varieties, enhanced harvesting techniques, postharvest and processing technologies, and enhanced market chain organisation. Gender practices and norms were analysed to develop suitable strategies for equitable benefit sharing. Finally, strong involvement of the private sector has been ensured and multi-stakeholder dialogue promoted primarily through the establishment or strengthening of innovation platforms and ad hoc events, to reinforce innovation brokerage, better connect innovators with users, and facilitate the emergence of an RTB community of practice in Uganda. Accordingly, in the second phase, the project switched from a competitive to a collaborative approach in its endeavour to promote cross-crop and cross-team learning. Figure 1 provides a schematic representation of the overall project approach.

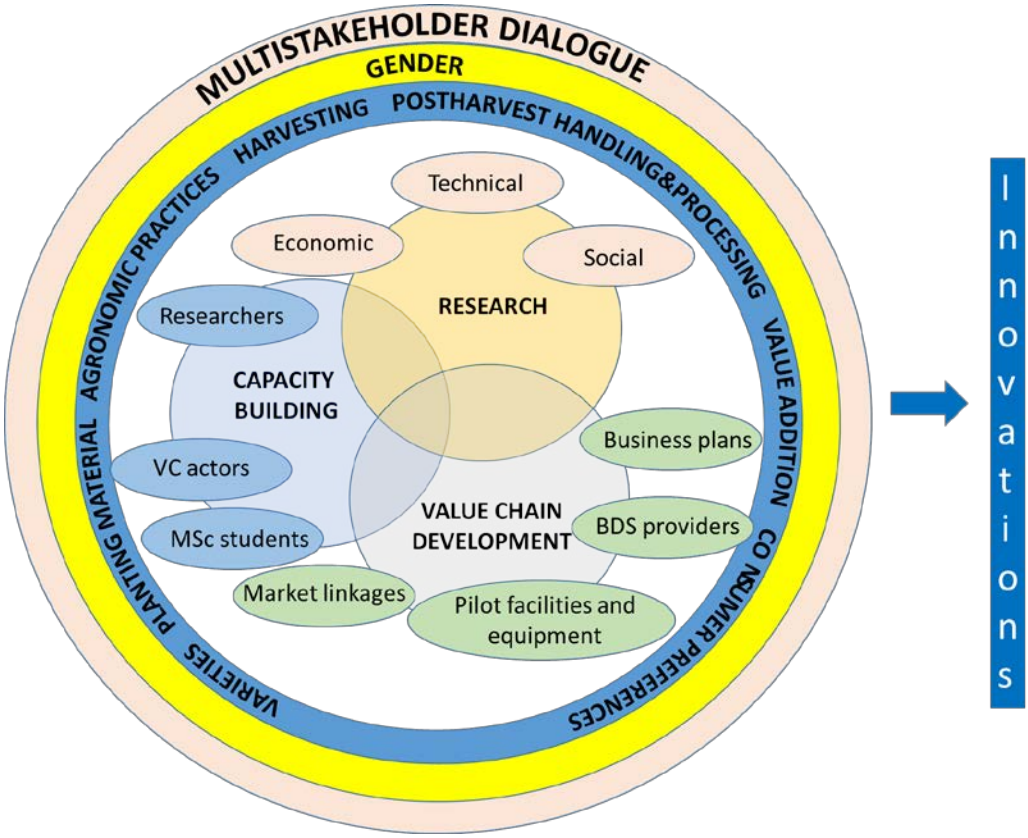

Figure 1. Schematic representation of the overall project approach.

1.2 PROJECT COMPONENTS

The project consists of four subprojects that have been defined in the course of the first year (preparatory phase), as previously described. Although each research subproject is unique in design, substantial complementarities exist in approach and participatory methodologies for VC development, thus offering opportunities for cross-crop learning and integration. The four subprojects are briefly outlined below:

- Reducing PHL and promoting product differentiation in the cooking banana VC

  The cooking banana VC is characterised by high PHL due to banana's short shelf-life, highly seasonal production, and poor postharvest handling. Furthermore, there are opportunities to promote product differentiation through different presentation forms of bananas and new marketing approaches. This subproject (1) explored ways to

reduce PHL and reduce fluctuations in annual supplies through use of diverse varieties and agronomic practices; (2) investigated options for upgrading storage, transport, and marketing in response to changing consumers' preferences; (3) studied the feasibility of introducing a weight-based pricing mechanism; and (4) strengthened the capacities of VC actors to respond effectively to emerging market opportunities.

The research team was led by Bioversity International and comprised IITA, CIRAD, NARO, the Ssemwanga Centre for Agriculture and Food Ltd, Kaika InvestCo, Uganda Fruits and Vegetable Exporters and Producers Association (UFVEPA), and other VC actors in Isingiro, Rakai, and Kampala districts.

- Improving the utilisation of sweetpotato (SP) and other root and tuber crops residues for pig feed

  Feeding is one of the main production constraints for smallholder pig farmers due to the seasonality, high cost, and poor quality of feeds; coupled with limited knowledge of supplementation strategies. As a coping strategy, farmers extensively use crop residues, grasses, weeds, and kitchen leftovers to feed their animals. SP vines are the most commonly used fodder, although they are highly seasonal and perishable. Simple silage-making for feed conservation, combined with strategic supplementation, is an easy, effective, and affordable option for pig-feeding during periods of feed scarcity and can help to reduce wastage of SP residues. This subproject (1) investigated options for silage-making and supplementation; (2) identified models for proper organisation of VC actors for production, conservation, and marketing of SP-based feeds; (3) strengthened the existing linkages between pig farmers and SP traders; and (4) built technical and entrepreneurial capacities and established business development services for profitable silage-making and pig-rearing.

  The research team was led by CIP and comprised ILRI, NARO, Volunteer Efforts for Development Concerns (VEDCO), CHAIN-Uganda, Iowa State University, Makerere University, Uganda Martyrs University, Pig Production and Marketing Ltd, and other VC actors in Masaka and Kamuli districts.

- Postharvest innovations for better access to specialised ware potato markets

  In eastern Uganda, there are two potato cropping seasons. The market supply is highly seasonal, with periods of gluts and scarcity and, therefore, high price fluctuations and PHL. The team explored the opportunity to take advantage of the higher price during the off-season by expanding the cropping period and introducing storage technologies. This will ensure higher and more stable income for small-scale farmers and consistent market supplies. In particular, this subproject (1) assessed the effect of variety, local climatic conditions, pre-harvest, and harvest practiced on storability of ware potatoes; (2) exploited varietal differences in maturity and dormancy to prolong harvest and marketing periods; and (3) strengthened business skills and collective marketing of pilot VC actors.

  The research team was led by CIP and comprised NARO, Self Help Africa, Makerere University, and other VC actors in Kapchorwa, Mbale, and Kampala districts.

- Extending the shelf-life of fresh cassava roots for increased incomes and reduced PHL

  Cassava roots are characterised by very short shelf-life due to rapid postharvest physiological deterioration (PPD). This results in substantial level of price discount during marketing. Innovations that prolong the shelf-life of fresh roots are demanded by farmers and traders to reduce PHL, relieve marketing pressures, and target new markets. Building on lessons learnt from West Africa and Latin America, the project assessed the feasibility of introducing two shelf-life extension technologies, namely high relative humidity storage (RH) and waxing of the fresh roots. Waxing is a simple technology in which clean cassava roots are briefly dipped in melted wax to create a coating which preserves the roots. This subproject (1) assessed PPD of different varieties and studied the effectiveness of the shelf-life extension technologies and

other agronomic practices; (2) investigated the effect of the treatments on eating quality and safety; (3) identified the most promising market segments for fresh cassava with extended shelf-life; and (4) promoted South-South cross-continent collaboration and knowledge-sharing for capacity strengthening.

The research team was led by IITA and comprised CIAT, NARO, CIRAD, International Institute of Rural Reconstruction (IIRR), Makerere University, Kyambogo University, and VC actors in Masindi, Kabarole, and Kampala districts.

Details about how each project component contributed towards the project's broader objectives can be found in the project logframe (see Appendix 1) and are visually represented in Appendix 2. Project sites are shown in Appendix 3.

2. IMPLEMENTATION PROGRESS

2.1 PROJECT EXPENDITURE BY YEAR

Total Project Budget	Year 1	Year 2	Year 3	Year 4	Total Expenditure
Funds received	0	816,000	0	988,000	1,804,000
Expenditure	529,828	610,662	1,615,932	243578	3,000,000
Balance	-529,828	205,338	-1,615,932	744,422	-1,196,000

2.2. BRIEF COMMENTS ON EXPENDITURE

The total budget of the project was €3m. According to the project's operational plan, the funds were allocated year by year as follows:

Year 1 (2014)	Year 2 (2015)	Year 3 (2016)	TOTAL
1,020,000	980,000	1,000,000	3,000,000

The implementation rate for the first year was 52%. This low level of expenditures was substantially due to the fact that the first year was a preparatory phase basically for the establishment of crop-specific research teams, a preliminary identification and analysis of the postharvest innovations to work on, and the selection of the most promising ones to be tested and validated during the second phase.

Budget categories	Budget Year 1	Expenses Year 1	Balance Year 1	Burn rate
Consultancy	-	-	-	-
Equipment & Materials	36,538	36,205	333	99%
Goods, Services & Inputs	486,396	110,941	375,455	23%
Operating Costs	147,678	101,261	46,417	69%
Salary& Allowances	256,492	219,880	36,612	86%
Workshops	-	-	-	-
Training	36,537	39,658	(3,121)	109%
Travel & Allowances	56,359	21,883	34,476	39%
TOTAL	**1,020,000**	**529,828**	**490,172**	**52%**

Regarding the project staff the execution during the first year, it was 86% of the approved budget. Only three positions were pending recruitment in this preliminary phase, including the gender specialist, who began her involvement in the project in the second year for ensuring successful implementation of the gender action plan.

During this first phase, workshops and meetings were held to define the action plans with the project partners in preparation of the second year. Two training events were held in this year to build the capacities of commodity teams in market research and gender mainstreaming (implementation rate training category: 109%).

At the end of 2014, the research and VC development implementation phase began.

The implementation rate for the second year was 62%, as follows:

Budget categories	Budget Year 2	Expenses Year 2	Balance Year 2	Burn rate
Consultancy	-	-	-	-
Equipment & Materials	-	-	-	-
Goods, Services & Inputs	465,925	127,975	337,950	27%
Operating Costs	149,044	129,334	19,710	87%
Salary& Allowances	269,317	255,314	14,003	95%
Workshops	-	-	-	-
Training	36,537	52,746	(16,209)	144%
Travel & Allowances	59,177	45,292	13,885	77%
TOTAL	**980,000**	**610,661**	**369,339**	**62%**

By the end of the second year, all the staff had been hired and were actively working for the project (percentage of execution: 95%). The trainings, meetings, and workshops continued to be carried out during this year. Between 2015 and 2016, two 4-day trainings in gender-responsible business planning were held to further strengthen partners' capacities in undertaking gender-responsive postharvest and marketing research. (percentage of execution: 144%).

The Goods, Services, & Inputs category includes research, publications, and partner expenses. Although many activities were carried out by CIP and partners during 2015, most expenses were reported in 2016 (percentage of execution: 27%).

The budget for the third year consisted of funds initially budgeted for this year plus a carry-over from years 1 and 2, totalling €859,511.

Budget categories	Carry over Year 1	Carry over Year 2	Total Balance for Year 3
Consultancy	-	-	-
Equipment & Materials	333	-	333
Goods, Services & Inputs	375,455	337,950	713,405
Operating Costs	46,417	19,710	66,127
Salary& Allowances	36,612	14,003	50,615
Workshops	-	-	-
Training	(3,121)	(16,209)	(19,330)
Travel & Allowances	34,476	13,885	48,361
TOTAL	**490,172**	**369,339**	**859,511**

To reflect the actual pace of implementation, the delay of partners in submitting financial reports, and the emerging need for experts' inputs, CIP proposed a reformulation of the budget approved for year 3, including adding funds to the consultancy category. The new budget was approved as:

Budget categories	Budget Year 1	Budget Year 2	Budget Year 3	Total
Consultancy	-	-	44,582	44,582
Equipment & Materials	36,205	-	-	36,205
Goods, Services & Inputs	486,396	465,925	367,975	1,320,296
Operating Costs	147,678	149,044	178,232	474,954
Salary& Allowances	256,492	269,317	337,272	863,081
Workshops	-	-	-	-
Training	36,537	36,537	78,745	151,819
Travel & Allowances	56,359	59,177	(6,473)	109,063
TOTAL	**1,019,667**	**980,000**	**1,000,333**	**3,000,000**

During the third year of the project, another challenge was faced. Although we had enough budget to carry out the activities, during the whole year funds from the donor were not received, generating a cash break by the end of 2016 of €1,956,820. Regardless, the activities were executed at 87% of the budget approved for 2016.

Budget categories	Total Budget for Year 3	Total Expenses Year 3	Balance Year 3
Consultancy	44,582	28,414	64%
Equipment & Materials	-	-	-
Goods, Services & Inputs	1,081,380	925,842	86%
Operating Costs	244,358	178,097	73%
Salary& Allowances	387,887	346,741	89%
Workshops	-	-	-
Training	59,415	103,925	175%
Travel & Allowances	41,888	32,913	79%
TOTAL	**1,859,510**	**1,615,932**	**87%**

All staff worked to ensure achievement of project's objectives (percentage of execution: 89%).

The excess of expenditure in training is due to the strengthening of capacities at both institutional and beneficiary level. During 2016, a second SP training of trainers (ToT) was organised to provide updated recommendation on silage-making and use based on the research findings. Furthermore, the project organised field visits, innovations launches, and the final project workshop. The event was attended by more than 100 participants and was held back to back with a public exhibition to showcase the innovations and technologies generated during project implementation. These events, despite not qualifying for conventional training, allowed the participants from key national partners to increase their awareness about postharvest challenges and opportunities of RTB crops and appreciate technologies and other innovations to address them (implementation rate: 175%).

In Goods, Services, & Inputs category, the implementation rate was 86%. In terms of total budget for partners, 94% of the approved budget was used. On the other hand, some publications and consultancies related to sustainability activities of the project were still pending.

Partners	Total Budget	Total Expenses	Final Balance	Burn rate
BIOVERSITY	394,787	394,787	0	100%
IITA	391,021	366,432	24,589	94%
SHA	49,166	39,000	10,166	79%
VEDCO	39,950	30,652	9,298	77%
CHAIN	39,280	36,544	2,736	93%
BUGIZARDI	80,275	62,603	17,672	78%
ILRI	89,611	89,527	84	100%
MUZARDI	18,155	17,793	362	98%
Total	**1,102,245**	**1,037,338**	**64,907**	**94%**

Note that delayed disbursement of funds from the donor led to cash flow problems that required implementation to slow down, so at the end of year 3 a four-months extension was requested and approved by the donor to allow for proper wrap-up of the activities and finalise reports and knowledge outputs. During the no-cost extension period (Jan.–Apr. 2017), the previous year's activities were completed.

The total execution of the project was 100% of the budget approved.

Budget categories	Total Budget	Total Expenses	Final Balance	Burn rate
Consultancy	44,582	40,754	3,828	91%
Equipment & Materials	36,205	36,205	0	100%
Goods, Services & Inputs	1,320,296	1,274,854	45,442	97%
Operating Costs	474,954	454,487	20,467	96%
Salary& Allowances	863,081	888,473	-25,392	103%
Workshops	-	-		-
Training	151,819	198,084	-46,265	130%
Travel & Allowances	109,063	107,143	1,920	98%
TOTAL	**3,000,000**	**3,000,000**	**(0)**	**100%**

2.3 PHYSICAL ACHIEVEMENTS BY OUTPUT AGAINST TARGET

The project consists of 12 outputs. To keep the main report short, only an indicator of the achievements against the original targets is presented in this section. A short description of achievements is presented in Appendix 4. More details are available in the following section and in Appendix 5.

No.	Output	Target	Achieved
1.1	Current main RTB postharvest challenges and priorities for improvement identified with key RTB production communities and VC actors	• Main postharvest constraints and causes of PHL identified • Relevant PHL estimated according to specific criteria for all crops • Marketing opportunity and constraints understood	100%
1.2	RTB technologies and their application for reducing PHL and expanding utilisation prioritised and gaps for research identified	At least 2 technologies for each crop group inventoried and product development/pilot experiences reviewed, including via online sources and literature review, and gaps identified	100%
1.3	RTB varieties with improved postharvest characteristics identified, tested, and validated with target communities (women and men) and VC actors across a range of production, marketing and storage environments	At least 10 RTB varieties tested and validated for improved postharvest characteristics, including where relevant nutritional factors, with stakeholder platforms	100%
1.4	RTB on-farm storage and processing systems trialled and validated	At least 4 on-farm storing and processing technologies selected for dissemination with stakeholder platform	95%
1.5	Other RTB technologies to reduce PHL and expand utilisation validated	At least 6 other RTB technologies to reduce losses tested and validated with stakeholder platforms	100%
2.1	Current RTB VC and food access situation assessed and priorities for improvement and enhanced gender equity identified with key VC actors/ stakeholders	Priorities for improvement shared and agreed with stakeholders in 4 VCs	100%
2.2	New market opportunities to expand use of RTB assessed and prioritised with stakeholder participation	1 new market opportunity identified per RTB crop	100%

No.	Output	Target	Achieved
2.3	RTB producer/processor groups strengthened for equitable participation and innovation in VCs	At least 20 producers, traders, and processors strengthened per crop	100%
2.4	Sustainable multistakeholder platforms for further RTB VC innovation created	4 platforms created and operational (1/crop)	70%
3.1	Project's website containing documented methods, technologies, and knowledge products	• 1 functional project's website • Series of project publications (e.g. scientific articles, manuals, guidelines, MSc theses, technical reports, and protocols) available online	100%
3.2	Capacity built in key national partners for reducing PHL and increasing use of RTB	• At least 3 training events held per RTB crop • Researchers from NARO involved in the design and implementation of the research for all crops • At least 5 MSc students supported and supervised	100%
3.3	Outputs of research disseminated throughout agricultural knowledge and information systems	• Communications plan developed • At least 2 articles published • At least 3–5 presentations and posters given at fora and symposia • At least 5 project publications (e.g. manuals, guidelines, technical reports) produced and disseminated for each crop	95%

2.4 ACHIEVEMENTS BY OUTPUTS

Output 1.1: Current main RTB postharvest challenges and priorities for improvement identified with key RTB production communities (women and men) and value chain actors

Narrative. During the inception workshop in March 2014, four crop-specific multi-agency teams were established to jointly identify the main RTB postharvest challenges, opportunities, and priorities (Annex CC2). Taking into account the outcomes of the planning meeting held in mid-2012 as well, seven preliminary business cases for research were developed by the teams. Following training to equip the teams in adopting the PMCA approach and tools (Annex CC3), scoping studies were conducted to validate initial hypotheses and assumptions as well as provide initial estimates of PHL. Based on the findings of the scoping studies, final business cases for research funding were produced to address identified postharvest challenges and market opportunities.

Output 1.2: RTB technologies and their application for reducing PHL and expanding utilisation prioritised and gaps for research identified

Narrative. The scoping studies conducted by the four teams entailed a review of relevant literature and collection of primary data to address identified gaps. The seven business cases presented options for funding research around a number of technologies and other innovations. Eventually, following the feedback received by lead experts during a specific poster session organised during the 2014 CRP-RTB Annual Review and Planning meeting, as well as transparent internal and external reviews of the business cases, four were selected for funding in October 2014 (the subprojects).

Output 1.3: RTB varieties with improved postharvest characteristics identified, tested, and validated with target communities (women and men) and value chain actors across a range of production, marketing and storage environments

Narrative. *Banana.* Four varieties were identified and promoted by the project either because they were highly preferred by consumers (Nakitembe, Musakala, and Mbwazirume) or because of the longer intrinsic shelf-life and potential for export (Kibuzi). To enhance farmers' access to planting material of these varieties, 10 mother gardens have been established (40% managed by women) each serving 2–3 nearby farmers groups for macro-propagation. Three multiplication techniques have been trialled (split corm, decapitation, and enhanced nutrition), and cost-benefit analyses indicated (Annex B7) the split corm method as the most viable technique. Properly labelled and packaged clean planting material of these varieties are being sold to nearby farmers; sales to buyers outside the project area have commenced. Leaflets (including agronomic, culinary, and other attributes of the varieties as well as contacts of multipliers) were produced in three languages (see Annex B9 for the English version) and distributed to farmers and traders.

Sweetpotato. On-farm and on-station trials were conducted to identify the most suitable dual-purpose variety and the response to pruning (partial vine removal). Results show that NASPOT 11, a variety released by the national sweetpotato program is the most suitable variety producing a good balance of food (roots) and feed (vines), as reflected by its root–vine ratio. It performed well in both target districts, in terms of yield and disease resistance, and it was the only variety in which pruning stimulated vine production without affecting root yield. NASPOT 11 is currently being actively promoted and the planting material sold by the silage business centres established by the project (see 1.5).

Potato. Ten varieties already registered in Uganda and commonly grown in western Uganda (with potential to perform well in eastern Uganda) and 8 clones from CIP breeding program were evaluated. Clones 392797.22 and 398208.704 are the most adapted for the Mt Elgon region because they are high yielding and the most resistant to diseases, in particular late blight (Annex P6). The varieties/clones were also assessed for their postharvest attributes, in particular storability, consumers' acceptability, and processing characteristics. With the exception of Shangi, they were all suitable for storage having a dormancy periods of 2 months or greater (Annex P4). Clones 398208.704 and 393385.4 are adapted for processing, while varieties Rwanshaka and Victoria are more suitable for table use. Clone 392797.22 is the most overall acceptable, followed by Rwangume, Kinigi, and Rwanshaka. Considering agronomic and postharvest performance, clone 392797.22 performed the best overall and should be considered for official release. Rwangume, a local landrace, has recently been released as NAROPOT 4.

Cassava. Sixteen varieties were collected from the three main fresh-root trading routes to Kampala (incl. target districts of Masindi and Kyenjojo) and analysed to determine varietal differences in PPD and, in turn, how PPD affects biochemical composition and eating quality of the roots as well as suitability to the two proposed shelf-life extension technologies (see 1.4). TME14 and two popular local varieties (Bukalasa and Nyaraboke) showed the best potential for shelf-life extension (Annex C5).

Output 1.4: RTB on-farm storage and processing systems trialled and validated

Narrative. *Sweetpotato*. The project tested options for on-farm silage-making for pig feed using SP vines and non-commercial roots. Results show that SP vines and roots can produce silage of acceptable quality, and that addition of maize bran helps absorb the effluent and limit spoilage. The nutritional properties of silage would meet the requirements for raising pigs, except for poor balance of essential amino acids and low dry matter, although they cannot support young pigs (Annex S5). Four diets with increasing levels of SP silage were tested on-station and on-farm in order to determine the effect of SP silage diets on performance of growing pigs. Results revealed that a diet composed solely of SP silage would result in poor growth and feed conversion rate (FCR). Daily feed intake and daily weight gain improved as the level of supplement increased (Annex S6). An economic analysis showed that supplementing SP silage with maize bran at 40%

inclusion is only marginally less efficient than fully commercial diets—often out of reach of smallholders—but outperforms the conventional farmers' feeding practices, ensuring a 32% reduction in feeding costs (Annex S7). The 60:40 ratio method was promoted among pig farmers in the target sites (see 2.3). Two options for making SP silage were refined and validated. The original tube silo method (Annex S15) was refined to improve effluent management and shelf-life of the silage (Annex S16) and is suitable for smallholders, while the stack silo is more suitable for semi- and commercial farmers.

Potato. Two ware potato on-farm storage options were tested: collective ambient stores (capacity of 40–50 t) and improved traditional individual stores (capacity of 4–8 t). Four collective stores and 12 individual stores were constructed at different altitudes in order to determine how external climatic conditions may affect the storability of the tubers. Results show that, based on the difference in temperature and RH within the stores, together with the genetic makeup of the potato varieties, the potatoes in the stores located at lower altitude (Mbale town, 1,200 masl) should be kept for a maximum of 6 weeks. Those located at higher altitude (Kapchorwa and Bennet, 1,800–2,300 masl) can be stored for up to 9 weeks (Annex P4). Storing suitable varieties of potato (see 1.3), even for just a few weeks, would allow the marketing window to be significantly extended, thus evening out the supplies and benefitting from the price increases after the bumper harvest. An economic analysis (Annex P5) showed that storing potatoes can be highly profitable. Unsurprisingly, the highest profitability is achieved with lower construction costs and longer storage period—that is, 9 weeks (IRR: 109%; ROI: 668% and payback period of less than a year). However, storage remains a viable business even in the least favourable scenario characterised by extremely high (and unlikely) construction cost and a short storage period of just 3 weeks (IRR: 14%; ROI: 64% and payback period of less than 4 years). The cost of storage losses, and in particular economic losses due to quality degradation, may be high; but this is outweighed by the high market price that stored potatoes would reach. The key enabling factors for on-farm storage are mostly related to engineering aspects to keep the storage construction cost low and an enhanced capacity of small-scale farmers to work together to ensure that the stored utilisation is optimised. Therefore, store management plans were developed for the farmers' associations hosting the collective stores in order to ensure proper management of the stores and minimise free-riding (see one example in Annex P12).

Cassava. The project tested two postharvest shelf-life extension technologies: root waxing technology and high RH storage. The results of on-station trials suggest that there are no negative effects on the physical and chemical properties of the treated roots over 21–28 day storage period, depending on the variety. However, sensory evaluation showed that waxing or RH storage (combined with pruning, see 1.5) maintains the eating qualities of the stored roots for up to 14 days, depending on the variety (Annex C6). This is a step-change improvement over the typical 3-day shelf-life of fresh roots. Consumer evaluation of the preserved roots revealed that the taste qualities of waxed roots are highest (probably related to increased sweetness due to conversion of starch into sugars), followed by RH-stored roots compared with untreated cassava roots. Two Ugandan MSc students were involved in the on-station research on root waxing and RH storage (see 3.2). Waxing technology might be particularly suitable for high-end outlets, such as supermarkets, whereas RH storage is a cheaper technology that may be more suitable for large-scale distribution. Market testing was conducted to promote the shelf-life extended roots and receive feedback from retailers, caterers, and consumers. However, additional research is required to comprehensively assess the economic viability before mass scaling can be recommended. Two pack-houses have been established, one managed by a farmers' association based on the capacities that have been built during the visit of the research team to CIAT–Colombia (see 3.2). Manuals for setting up and managing a pack-house have been produced and disseminated (Annexes C7 and C8). Linkages with a number of potential buyers have been established and sales are slowly picking up.

Output 1.5: Other RTB technologies to reduce PHL and expand utilisation validated

Narrative. *Banana.* Optimal harvest time for bananas, ensuring both better postharvest properties and optimum taste qualities, was determined in the two target districts at 133–142 and 133–150 days after flowering, respectively (Annex B4). A Ugandan MSc student supported the initial set up of the field experiments (see 3.2). Fifty-six pilot farmers (23 F) hosted demonstration sites for sucker staggering (i.e. de-suckering in a planned manner so as to even out production and regulate sales), but prolonged drought prevented reaching conclusive results on its effectiveness in evening out supplies and reducing PHL. However, 8 farmers (5 F, 3 M) have successfully implemented sucker staggering, and the first staggered suckers flowered around December. Storage temperature experiments indicated that the best temperature range for preserving bananas is 12–18^{0}C which increases shelf-life to over 12 days, compared with 5 days at room temperature. Peeled and untreated banana at 18^{0}C keeps for 4 days compared with a few hours at room temperatures (Annex B6). Therefore, a simple charcoal cooler would be sufficient to substantially extend the shelf-life and reduce PHL; it has been successfully piloted in one retail market. The project has registered over 10 orders for charcoal coolers from banana retailers. Additional research is required to assess the economic viability of banana cold storage. Convenient presentation forms of cooking bananas (including clusters, unpeeled, and peeled fingers that are sorted, graded, and labelled by cultivar) were piloted. They respond to new demographic trends, offer opportunities to increase retail margins, and can contribute to reduced wastage. The banana team provided business training to two women who recently moved into wholesale—an activity normally dominated by men—and helped them gain access to credit, markets in Kampala, and banana exporters as part of a strategy to promote women's participation in market-chain links with higher margins. These women are also acting as role models for other women and households in their communities, while some participants in the trainings (see 2.3) have started supplying banana that meet the quality standards of more demanding markets (e.g. for export). A weight-based pricing mechanism has been introduced with some initial success with the export market and some high-end retail markets. A study revealed that banana VC actors are willing to adopt these mechanisms. However, all actors need to be brought on board (Annex B3). The project trialled the introduction of cushioning during transport to minimise bruises and PHL, though retailers were reluctant to pay a premium for protected bunches, which discouraged the wholesaler.

Sweetpotato. The project promoted silage making as a business (off-farm) and the provision of related services. Eleven potential silage entrepreneurs were identified and supported with training in entrepreneurial skills and business planning to help them starting their enterprises and ease access to financial services (see 2.3). The project established and launched three silage business centres managed by NGOs and one farmers' association to sell silage, provide technical services (e.g. machine rentals), and offer fee-based training in silage-making and improved feeding practices. Those centres trained youth and farmer groups that purchased their own shredders, and linked farmers to markets through Pig Production and Marketing Ltd, which is also promoting silage use.

Potato. Storability experiments (see 1.4) were conducted also on potatoes kept in a collective store hosted by the local potato trader association. Furthermore, based on the result of the VC study (see 2.1) that identified damage during harvesting as the main cause of PHL, a new experiment was designed to assess different harvesting methods. The tested lifters substantially reduced the amount of potatoes left unharvested on the ground (38% when hand hoe is used). Furthermore, the proportion of harvested tubers presenting cuts and bruises, and therefore unmarketable, dropped from 19% to 7–9%. Farmers showed great interest in the local ox-drawn lifter modified according to their recommendations (Annex P7).

Cassava. Options for adopting shelf-life extension technologies at trader level (off-farm) were explored. Brica Investments has operationalised the second pack-house, and several batches of waxed cassava have been tested on the market. Furthermore, during capacity-

building activities in Colombia (see 3.2), the research team has appreciated how the pruning of cassava (defoliation of the plants 6 days before harvest) can slow down PPD. Research findings showed that pruning is a potential, valuable low-cost technology for extending cassava roots' shelf-life (for 4–7 days) and reducing PHL along the VC (Annex C5). In some varieties, pruning considerably increased the acceptability of stored roots. Preliminary results indicate that varieties such as Nyaraboke, Njule, TME14, and Hoima respond better to pruning. Pruning is a recommended practice for roots meant for waxing and RH storage.

Output 2.1: Current RTB value chains and food access situation assessed and priorities for improvement and enhanced gender equity identified with key chain actors/stakeholders

Narrative. Market and VC studies were conducted by all teams in order to (1) map the VC; (2) assess margins; (3) validate priorities for improving postharvest management; (4) further refine the estimation of the demand for the proposed innovations and end products; and (5) deepen the analyses of PHL. The main findings of the studies were shared with partners, collaborators, and relevant stakeholders to validate and refine the priorities of the interventions.

Banana. The main findings of the study (Annex B3) are (1) The most demanded varieties in the market are not widely grown in the project sites—for instance, only 2% of farmers grow Musakala in project sites. (2) At retail level, 47% of banana is sold in bunches and only 10% as peeled bananas; however, 32% of the retailers report an increase in demand for the latter. (3) About 55% and 58% of consumers are dissatisfied with the quality of bunches and peeled bananas, respectively. (4) About 98% of the producers, 40% retailers, 75% supermarkets, and 50% consumers are willing to embrace the weight-based pricing system. (5) PHL were estimated at each node of the VC. Overall, 30% of traded and 13% of harvested bananas (corresponding to over 1m t/year) incur either physical or economic losses.

Sweetpotato. Several studies have been conducted. Current pig-feeding practices were studied. Findings revealed that SP vines are the main fodder during the wet season, whereas during the dry season, farmers face feed scarcity and have to resort to expensive—and often low-quality—purchased feed and home-made mixes. Owing to lack of affordable feed, many farmers experience poor pig growth performance and had to sell off their young piglets (Annex S3). The study validated the results of previous work that indicated a potential for better use of SP and other RTB crop residues as pig feed in the smallholder pig-farming systems. But the major constraint is the poor access to technologies for preserving these resources, such as silage. The findings were presented in a paper published in a peer-reviewed journal (Dione et al. 2015) (Annex S9). Since the viability of the silage technology is dependent on availability of SP residues, a baseline survey estimated root and vine wastage at the various nodes of the SP VC. It revealed that current wastes have the potential of generating 67,838 t of silage per year (equivalent to 27,135bn UGX) if sold at price charged by a few entrepreneurs who had already started making silage for sale. A paper has been produced and submitted for publication (ibid.). A willingness-to-pay study showed that pig farmers are willing to pay an average of 668 UGX/kg of supplemented SP silage (40% maize bran inclusion), which is higher than the break-even price of 545 UGX/kg. One Ugandan MSc student was enrolled for conducting research in this area (see 3.2).

Potato. A market study showed that various actors store ware potato under poor conditions and for short times. About half of farmers store up to one third of harvested potatoes for no more than 4 weeks; while traders and processors store for just a few days. About 96% of farmers incur PHL. PHL were estimated at each node of the VC. Overall, 36% of harvested potatoes (corresponding to about 60,000 t/year) incur either physical or economic losses. One MSc student supported this research component (3.2). Since mechanical damages during harvesting and premature harvesting were identified among the major causes of PHL, two additional studies were conducted. The first was to

evaluate the efficiency of different harvesting methods (see 1.5); the second to understand the reasons for and implications of harvesting the tubers prematurely. Premature harvesting was found to significantly reduce ($p \leq 0.05$) the yield and, despite the higher price fetched, the gross income of farmers. It also affects the quality of potato, preventing the possibility to store and obtain better return at a later stage. An additional research also found that potato-marketing along the entire VC was greatly influenced by periodic supply and demand from neighbouring countries, primarily Kenya and South Sudan.

Cassava. A study revealed that all respondents purchase cassava in fresh form, whereas 75% purchase it in dried form (chips and flour) as well. On average, about 50% and 30% of cassava produced by farmers in target areas is sold or consumed in fresh form, respectively. An average of 16 t of fresh cassava is supplied by each wholesaler to major markets in Kampala weekly, whereas each retailer procures and sells about 1,200 kg of fresh cassava roots weekly. Annual market demand of fresh root was estimated to be about 300,000 t and projected to increase. Unlike other actors in the fresh cassava VC, retailers—the vast majority of whom are women—incur high level of losses due to the rapid postharvest deterioration of the roots. In fact, they are the VC actors who keep the cassava for longer, awaiting buyers. Although the amount of roots that have to be thrown away (physical losses) is rather limited, almost half of them are sold at discounted prices due to PPD, particularly when the demand is low. The annual overall financial loss due to PPD in Uganda is estimated at over US $30m (Annex C3). One MSc student has assessed the willingness-to-pay for roots with extended shelf-life (see section 3.2).

Cross-cutting. A comparative analysis of PHL along fresh cassava, banana, and potato VCs in Uganda showed that relative losses (% of harvest crop) are particularly high in potatoes, but the banana VC is the most affected in absolute terms (volume of losses). The findings were presented at an international conference, and can contribute to policy prioritisation as they show that a diverse set of interventions is required to tackle PHL.

Output 2.2: New market opportunities to expand use of RTB assessed and prioritised with stakeholder participation

Narrative. During the project's preparatory phase, the different teams identified and analysed new market opportunities and the most promising innovations that culminated into the four subprojects that were implemented.

Output 2.3: RTB producer/processor groups strengthened for equitable participation and innovation in value chains

Narrative. The project provided training and technical assistance to build the capacities of VC actors in a number of domains—for example, technological aspects (both pre- and postharvest), entrepreneurship, agribusiness, collective actions, and so on. In some cases, specific assessment of training needs have been carried out with project beneficiaries (e.g. potato subproject).

Banana. Training on agronomic and postharvest practices targeted 818 farmers (425 M, 393 F). Training on entrepreneurial skills and business planning targeted 206 farmers (100 M, 106 F). The project supported the development of four gender-responsive business plans (two for seed multiplication and two for differentiated banana products).

Sweetpotato. Training on silage-making and use and pig management targeted 585 farmers (254 M, 331 F). Training on entrepreneurial skills and marketing targeted 129 farmers (92 M, 37 F). The project has also supported the development of 14 gender-responsive business plans: 11 for silage business entrepreneurs (either individuals or groups) and 3 for expanding the operations of the silage business centres established by the project.

Potato. Training on pre- and postharvest management targeted 98 farmers (51 M, 47 F), members of the associations hosting the stores. Postharvest training was also provided to 15 members (11 M, 4 F) of the partner traders association. Training on entrepreneurial and business skills targeted 643 farmers (342 M, 301 F). Furthermore, the project

supported the associations hosting the collective stores to develop store management plans and business plans.

Cassava. Training on agronomic and postharvest practices targeted 91 farmers (39 M, 52 F). Training on entrepreneurial skills and marketing targeted 261 farmers (111 M, 150 F). Furthermore, the project supported the development of business plans for each of the two pack-houses established with project support.

Details of the training content and training material developed by implementing partners can be found in Appendix 5 and in the annexes. A summary of farmers' direct involvement in training as well as other project activities can be found in Appendix 6.

Output 2.4: Sustainable multistakeholder platforms for further RTB value chain innovation created with public/private sector and NGO and CBO participation

Narrative. Simple exploratory analyses were conducted to map the current relevant platforms in Uganda and the on-going interventions for supporting their establishment and development. Most of these platforms do not function well and are mostly project based, raising concerns about their long-term sustainability. Therefore, in most cases, it was deemed appropriate to work towards their strengthening rather than establishing new platforms from scratch which, due to the short duration of the project, are likely to collapse at the end of the intervention. The project supported representatives of implementing partners to join and actively engage in local, regional, and national platforms.

Banana. The project supported the effort to form the Western Region Banana Innovation Platform that was eventually established, formalised, and registered. The project also facilitated the formation of one sub-county banana platform in a target district; one member of the subproject team was elected as interim executive leader. Members of the team are also contributing to the establishment of the national platform.

Sweetpotato. To further its work on SP silage for pig-feeding, the team opted to facilitate some of the existing pig platforms (national, Central region, and Eastern region platforms) that had previously received financial support from ILRI. Therefore, the project facilitated the meetings of the Central region and Eastern region platforms. As a sustainability strategy, 202 executive members of the national and regional platforms' committees were trained in good governance.

Potato. Since no potato platforms existed, other than a national Steering Committee supported by the International Fertilizer Development Center (IFDC) and focussing on potato seed distribution and new varieties for processing, the project supported the establishment of the Eastern Regional Potato Multistakeholder Innovation Platform that was officially launched in early 2016. Three meetings were held throughout the year, during which a nine-member executive committee was selected and work plans refined. The Buginyanya Agricultural Research and Development Institute (BugiZARDI) is expected to keep on facilitating the regional platform and identify alternative sources of funding for ensuring its sustainability.

Cassava. The project focussed on revamping and strengthening the existing local platforms in target districts that had lost momentum and were weak with poor representation and no resources. A number of meetings were facilitated by the project with the participation of key actors, local district staff, and the private sector in a bid to broaden the memberships and building more sustainable, inclusive, and effective private sector-led platforms in both districts.

Because of the support provided by the project, most of the platforms that existed prior to the intervention are likely to have reached a sufficient level of maturity to autonomously continue their operations or be able to seek additional support. However, the completely new ones that have been established by the project (e.g. potato regional and the banana sub-county platforms), or were found idle (e.g. the cassava district platforms), may not

survive if members are not sufficiently active to successfully identify sources of funding, including through fee-based mechanisms.

Output 3.1: Project's website containing documented methods, technologies, and knowledge products suited to target audiences (researchers, extension services, communities, NGOs, etc.)

Narrative. A functional project website has been developed and is currently up and running (http://www.rtb.cgiar.org/endure/). Project documents, reports, and publications are available online, and the website's content was regularly updated as the project progressed. The most recent project report and publications are being migrated to CGSpace (https://cgspace.cgiar.org/handle/10568/82596) to ease management of and access to the repository. Furthermore, photos can be found in specific Flickr albums that can be accessed by following the link: https://www.flickr.com/photos/106872707@N03/albums/with/72157677770602186.

Output 3.2: Capacity built in key national partners for reducing PHL and increasing use of RTB

Narrative. Two training events were held in 2014 to build the capacities of the commodity teams in market research and gender mainstreaming (Annex CC3 and Annex CC4). *Banana*: In 2015, 3-day training for strengthening partners' capacities in PMCA and Phase 2 tools (Annex B10). *Sweetpotato:* 2-day training in PMCA tools and two ToT events to build partners' capacities in (1) biosecurity measures, data collection, and calibration of feeding equipment and (2) silage-making (Annex S17). The 1st sweetpotato silage-making manual developed by the project was used during this training (Annex S10). A second sweetpotato ToT was held in 2016, to provide updated recommendation on silage-making and use based on the research findings (Annex S20). *Cassava*: Six members of the cassava team participated in a 9-day training organised by CIAT–Colombia to strengthen their capacities in PPD assessment and shelf-life extension, since these technologies are completely new in Uganda. The capacities of the cassava team were strengthened in the following areas: (1) varietal selection for waxing and RH storage; (2) PPD evaluation; (3) root waxing and RH storage; (4) pre- and postharvest factors affecting the effectiveness of shelf-life extension technologies; and (5) options for developing marketing channels and business models (Annex C9).

Between the end 2015 and early 2016, two 4-day trainings in gender-responsive business planning were held to further strengthen partners' capacities in undertaking gender-responsive postharvest and marketing research and for validating the subprojects' gender strategies. Additional details are provided in Section 5. The workshop reports can be found in Annex CC5 and Annex CC6.

In line with the PMCA approach, the innovations were officially presented in final events with the participation of interested stakeholders, including market chain actors, research and development (R&D) organisations, local authorities, and development practitioners. Each subproject organised a specific 2-day event, and key representatives of the other project teams attended as well. On the first day (science day), the relevant research team presented the key findings of their research and discussed the interventions to develop the VC (in some cases other R&D organisations presented their work in the RTB postharvest research arena). On the second day, field visits were held to officially launch and showcase the innovations to the participants in colourful events. Other relevant organisations and private sector players were invited to present products and services in dedicated booths. Each event was attended by well over 100 participants.

Finally, the project culminated with an end-of-project workshop (101 participants) which was held back to back with a public exhibition at the Entebbe Botanical Gardens. It showcased the innovations and technologies generated during the project implementation. A poster session was also held, and the four best posters (one from each subproject) were awarded (Annex CC7).

These events, despite not qualifying for conventional training, allowed the participants from key national partners to increase their awareness about postharvest challenges and opportunities of RTB crops and appreciate technologies and other innovations to address them. Furthermore, representatives of the other subprojects, including from NARO, could appreciate the work done by other colleagues in the RTB arena. This set the stage for facilitating the establishment of a community of practice in the postharvest area of these crops in Uganda.

Researchers from NARO (five different institutes) have been involved in the research design and implementation of all subprojects. Two were supported to present in important international congresses (South Africa and China).

Ten postgraduate students (MSc level) have been identified, granted fellowships, supervised, and coached for undertaking studies to complement project research activities. Three of them presented their research findings at an important event in Ethiopia; one has already graduated.

Output 3.3: Outputs of research disseminated throughout agricultural knowledge and information systems

Narrative. A communications and visibility plan, initially drafted by the CIP-SSA communication specialist, was reviewed and validated during a 2-day workshop (Annex CC8). Based on this, each subproject team developed and implemented its own sub-plan.

The project knowledge outputs include 5 papers in peer-reviewed journals (1 accepted, 4 submitted); 18 presentations and posters given at fora and symposia; and 41 project publications, including technical reports, manual, protocols, and brochures (see Appendix 7). Project publications are available online (see 3.1), and several have been disseminated through communication and social media platforms of CIP and CRP-RTB, as well as partners. In several occasions, manuals, protocols, brochures, and leaflets have been distributed to partners and beneficiaries. Additional papers are expected to be submitted to peer-reviewed journals over the next months.

2.5. DIFFICULTIES ENCOUNTERED AND MEASURES TAKEN TO RESOLVE PROBLEMS

Crosscutting issues: As agreed with implementing partners, the major challenges were related to time and financial constraints.

Delays in starting the project and hiring the project leader, the multi-crop/multi-agency nature of the initiative, and the approach adopted that required the establishment of research teams and initial validation of the different options for improved postharvest management (despite the advantages described in Section 1) have implied that the whole first year was spent on identifying the most promising research options to work on over the next 2 years. Additional time had to be devoted in early 2015 for clearly defining the responsibilities, work plans, and deliverables of each of the over 20 implementing partners. Furthermore, delayed disbursement of funds from the donor led to cash flow problems that required project implementation to slow down. As a result, the project had little time left for conducting all activities and delivering the numerous research outputs it was committed to. To deal with this, the partners' work plans and the letters of understanding (LoUs) had to be revised several times. A 4-month extension was requested and approved to allow the proper wrap-up of the activities and finalise reports and knowledge outputs.

The weakening of the Euro has represented an additional financial challenge as the LoUs with partners were in USD. Therefore, the financial loss has been fully absorbed by CIP, and a number of crosscutting activities as well as the possibility of proving top-up funds for supporting the innovations showing the most promising results had to be trimmed. Some activities, such as the production of quality videos, were completely dropped.

An additional challenge came from the closure of Makerere University for about 3 months (Nov. 2016–Feb. 2017) following a series of strikes by students and lecturers. This caused

delays in the courses and eventually in the completion of the degree of most of the MSc students supported by the project.

Banana: In the trials to determine the optimal harvest age, data loggers for measuring the temperature were lost. The CIRAD team had to modify the methodology of the experiment whose results are location specific and cannot be extrapolated at country or regional level, as originally envisioned. This experiment was also affected when the MSc student who had set-up the trials dropped out of the program.

Most farmers abandoned the sucker-staggering trials as a result of the prolonged drought that hit western Uganda in 2016, and inhibited the emergence of new suckers. While the few farmers who have stayed in the experiment have appreciated the innovation, no conclusive results about its efficiency in evening out the production and reducing PHL could be obtained.

Finally, attempts to sale cushioned banana bunches were not successful due to reluctance of some traders to cover the additional costs.

Sweetpotato: In the first year an outbreak of African Swine Fever hit the area where the pig-feeding trials were being established. Therefore, trials had to be relocated to another NARO research station.

Another major challenge was the delayed release of the micro-silos laboratory analyses from Makerere University, whose results were planned to guide the design of the pig-feeding trials. Therefore, only partial lab results were used for selecting the best treatments for the trials. Moreover, some of the pigs that had been selected for the trials were no longer suitable. They had to be replaced and the trials were conducted on a phased basis in order to deal with the resulting heterogeneity in piglets' age.

Other challenges were related to the drought that destroyed the first on-farm SP trials (that had to be replanted) and the excessive excitement of some farmers that stealthily opened the silage containers before reaching the ideal maturity for conducting the feeding trials. Additional silage had to be produced to cope with this challenge.

Finally, no proper motorised choppers were available in the market, and hammer mills had to be adapted. While these may be suitable for research purposes, they may need to be down-sized for wider adoption. Choppers could also represent a safety threat if not properly managed. Following feedback by users, they were refurbished in order to offer additional protection against incidents.

Potato: Construction of collective stores was delayed, primarily due to bad weather and inconsistency of bales' quality. Despite the effort to speed up the construction, one season of storage trials was lost. Furthermore, due to unforeseen structural problems, one ambient store partially collapsed and two others experienced some structural anomalies. An engineer was recruited to identify the problem and solutions. He found that the wood used for roofing of the stores was too weak to withstand the weight exerted by the straw and plastered mortar, and could not also withstand termite damage. CIP followed his recommendations, and the partially collapsed stored was completely rebuilt following a new design that also allowed for substantial savings over the previous one. All other stores were reinforced with metal supports that will ensure a life-span of at least 8–10 years. The associations hosting the collective stores showed some management weaknesses that the project addressed by strengthening the required management and business skills, establishing associations' committees, and jointly developing store management plans.

The construction of the individual stores was also seriously delayed, mainly due to lengthy procumbent procedures in NARO. This prevented reaching conclusive results about their effectiveness in extending the shelf-life of tubers.

Severe drought spells affected the project in several ways. It slowed the multiplication of tubers and, coupled with bacterial wilt that decimated several CIP clones, led to limited quantities of potatoes for variety evaluation and storage trials. CIP had to adjust the experiments accordingly. Moreover, owing to lack to potatoes in western Uganda, many traders travelled throughout the whole country to purchase potato and export to Rwanda. This led to unusual high market prices during the harvest time that discouraged many farmers to store their product in the main 2016 season. As a consequence, the stores could not be completely filled. This may have increased the level of storage losses.

Cassava: The team was not familiar with the state-of-art methodology for PPD assessment and the two technologies for shelf-life extension. Therefore, it was deemed necessary to strengthen the required capacities by training sessions organised by CIAT–Colombia. This resulted in practical skills and knowledge that the team used to improve the research design. However, this delayed the start of the trials and other research activities, and led to amendment of the work plans.

Some misunderstanding emerged between the staff of the National Agriculture Research Laboratory (NARL) and the National Crop Resources Research Institute (NaCCRI) due to some overlaps in their official mandate and insufficient demarcation of the respective roles. However, this issue has been sorted out by successfully promoting a constructing dialogue for smoothing sometimes conflicting views and approaches.

The project has also experienced delays in setting up the pack-houses due to delays in procurement by NARO and the need to establish a water source at the farmer-led pack-house. Once these obstacles were overcome, partners had to work hard to run the trials. And though this did not affect the overall research results, limited time was left for market testing and to consistently capture consumers' feedback as required for any new product that is launched in the market.

Finally, one of the three MSc students who started their studies with the cassava subproject found a job and decided not to complete her studies. The NARO team took over her tasks in order to not affect the experiments.

3. INNOVATIONS

The project introduced, tested and promoted a number of technological, commercial and institutional innovations for enhanced postharvest management taking into account their technical feasibility, economic viability and social acceptability for male and female value chain actors. Some examples of the key innovations are presented Table 1.

Table 1: Examples of Major Innovations

	Technological	**Commercial**	**Institutional**
Banana	Varieties with long shelf-life Seed macro-propagation techniques	Potted and labelled plantlets for sale High-quality banana clusters for export	Seed sharing models: (1) recovery and (2) business
Sweetpotato	Dual-purpose variety for food and feed (Naspot 11)	SP silage for sale	Silage chopping service entrepreneurship model Silage centres
Potato	Modified ambient and traditional stores Genotypes with storable attributes (Rwangume)	Stored ware potato for sale on the local and regional markets	Store management plans to minimise free riding
Cassava	Cassava pack-house facilities	Waxed cassava	Farmer-processor arrangements for

	Technological	Commercial	Institutional
	Varieties amenable to RH and waxing Pruning		supply of quality cassava roots

Details of the major innovations are given below:

- Technological innovations (such as a new production or postharvest practice). These include varieties with suitable postharvest attributes (for all target crops) and improved access to their planting material (such as through banana macro-propagation); agronomic practices (such as cassava planting techniques and pruning, potato dehaulming, optimum harvest time for banana and potato, potato, and SP vines harvesting techniques, etc.); postharvest handling, storage, and processing (such as sorting and grading of banana and potato, ware potato and banana storage, cassava treatments for extended shelf-life, etc.).
- Commercial innovations (such as a new or improved product). They include SP silage, waxed cassava, potted and labelled clean banana plantlets, packaged high-quality banana clusters for export, chilled peeled banana, and others.
- Institutional innovations (such as a new way for smallholder farmers to work with other VC actors for improved market access and strengthened negotiating power). These include SP-pig VCs integration, chopping service-based model for SP silage, banana weight-based pricing mechanism, community-based banana plantlets sharing models (*recovery model* and *business model*), arrangements to ensure supply of suitable cassava roots to the pack-houses and minimise rejects, etc.

Some of these innovations require very low investments in terms of both initial capital and additional labour (e.g. cassava pruning and harvesting at optimum time). Others, though not demanding large investments, entail additional labour (e.g. improved cassava planting/ harvesting techniques and regular inspections of cassava fields, sorting and grading, on-farm production of SP silage with manual chopping, etc.). Finally, some may be quite demanding in terms of both initial investment and, often, labour. These range from medium (e.g. banana macro-propagation and silage by motorised chopper) to relatively larger investments (e.g. US $5,000–10,000 for a potato collective ambient store or a cassava pack-house). Besides research validation of the proposed innovations, the required investment has played a key role in initial adoption and scaling of the proposed innovations.

Some low-cost innovations are already being adopted by target beneficiaries and, in some cases, spreading outside the project sites. For example, cassava pruning is being highly appreciated because it increases sweetness and shelf-life of the root at almost no cost. Similarly, dehaulming of potato is being practiced by most farmers in the project sites while collection, sorting, grading, cleaning, and packaging of market-demanded presentation forms and varieties of banana in western Uganda has proved to be highly promising and offers opportunities for scaling (see Box 1).

Box 1: Extract from interview to Annet Nabigaga, Rakai district

I do not just grow any banana variety but the market-preferred ones […]. Working as a group has been key in my success. I do not work as an individual and I am sure that if did, I would not succeed. We work as a group to multiply planting materials […]. Being part of a group also helped me to mobilise my fellow farmers to start buying bananas from them […]. The business is growing: I now supply 150 boxes (10 kg each) every week to two traders who export bananas to Canada. I also supply 40 bags and 200 bunches every week to eight retail outlets around Kampala and Entebbe […]. I am also happy that I have set a good example not only for my children but also to the women in my community. They come to me for advice unlike before. I also buy their bananas by kilogram and at a higher price compared to that offered by other traders. I buy a kilogram of bananas at UGX 700 yet the other traders who buy in kilograms buy it at between UGX 500 and UGX 600. I feel I should give back to the community since I had the opportunity to benefit from this project.

Source: Banana case story.

Some innovations requiring medium-scale investments have also been successfully tested for adoption and scaling. For instance, seven farmer groups are currently involved in macro-propagation of banana plantlets in project sites. Two of them (1 youth, 1 woman) were started by farmers themselves as commercial enterprises pooling their own resources and, for the women's group, supported with $2,000 from the district gender fund. More than 5,100 plantlets have been sold to 66 farmers within the community in just 6 months. In addition, the technology has spread to other districts and three more enterprises have been established in Mityana, Mayuge, and Mbarara districts. Over the same period, sales of over 4,400 plantlets to 134 farmers outside the project area were recorded. The production volumes are expected to rapidly increase. For instance, one group has established its own mother garden of recommended varieties, and the district local government and World Vision have begun to scale out the technology to other parts of Rakai District. The enterprise in Mayuge is expected to produce and sell 1,500 plantlets monthly when fully operational.

Commercialisation of SP silage is also picking up. Several silage makers trained at the silage business centres have manufactured and sold 77 t of silage during the second half of 2016 alone. In addition, 72 farmers have bought silage directly from these centres. Silage is currently sold at $0.12/kg, already offering a good profit, and studies indicate that farmers are prepared to pay up to $0.18/kg. At least one group and a sole entrepreneur have purchased their own motorised choppers ($700) to move into commercial production. A youth silage-making group is expanding its operations and disseminating the technology to several parts of the country.

Both the banana macro-propagation and the SP silage technologies have been selected and presented in March 2016, at the CRP-RTB World Cafe in Tanzania as promising innovations for further scaling.

Some of the innovations requiring large capital investments have also shown promising in terms of commercialisation; not surprisingly, no additional enterprises have yet emerged. For instance, potato ambient stores have showed that the quality of mature and disease-free tubers of selected varieties can be kept for up to 9 weeks. Farmers who embarked in this venture have sold the stored tubers at up to thrice the price offered by the market at harvesting time. This created an incentive for farmers to invest in upgrading the facilities such as by building sorting tables and internal partitions for enhanced space allocation to members. Two large-scale traders are exploring agreements with farmers' associations to ensure consistent potato supplies throughout the year to a major local fast-food operator (Café Javas). One bank, Centenary Bank, has been involved in the project since the onset and showed interest in providing loans for stores construction. IFDC is introducing and promoting this technology to other part of the country and one bank.

Another example is the cassava-waxing technology. About 120 outlets have been contacted in a bid to create a distribution network, and negotiation for supply of waxed roots with two supermarkets, three hotels, two restaurants, and two food vendors are at advanced stage. To date, the farmers' association alone has processed and sold over 5 t of waxed cassava. Despite limited volumes, this is a very promising result, taking into account that commercial operations have started only at the end of 2016, and waxed cassava has never been sold before in Uganda.

Apart from the crop-specific innovations, the project design can be seen as innovative itself. By adopting the PMCA methodology, different research teams made of researchers, development practitioners, and VC actors, including farmers' organisations and private firms, have worked together from the onset to jointly design the interventions based on their experience and the findings of the scoping studies. While this has been a time-consuming process, the different multidisciplinary teams have gained in terms of social cohesion and deeper understanding of the target VCs. The competitive process that has characterised the first year of implementation has also been an innovative approach for motivating the different teams and discarding less promising options for research. Last but not least, the teams produced a number of business plans for investment for selected

private sector players involved in the research. These aspects represent a valuable building block for private sector investments as well as follow up interventions for promoting innovations uptake.

4. INTERNATIONAL PUBLIC GOODS

The project produced and disseminated a number of research outputs and knowledge products that include:

- 1 article published in peer-reviewed journal and available online
- 4 articles submitted to peer-reviewed journals
- 18 presentations and posters given at fora and symposia
- 41 project publications:
  - 22 technical reports
  - 8 manuals
  - 1 protocol
  - 2 brochures
  - 8 leaflets.

Details are provided in Appendix 7 and references to the relevant annex are given in Appendix 9. Additional project publications and articles are being finalised and submitted.

5. GENDER ISSUES

Gender has received high priority in all areas of implementation of the project. In fact, in Uganda, gender roles in RTB crops' production, processing, and marketing are often complex. Key decisions on potato and banana cultivation and marketing are made by men though women provide labour at various production stages. Men dominate wholesale trade while, in most cases, women are in charge of retailing. Although SP and cassava may largely be seen as "women's crops", there is a concern that as markets improve or better processing technologies become available, men may take over roles previously dominated by women. It has also been noted that men are more likely to adopt new technologies, especially if they are capital intensive.

To ensure that gender issues were considered at all stages of implementation, a gender team was established, led by the CIP-SSA gender specialist, and appropriate level of funding was ensured.

At the beginning of the project, the gender team developed a gender action plan which aimed to (1) sensitise subproject teams on gender mainstreaming in the design and implementation of the interventions; (2) ensure comprehensive understanding of the gender dynamics involved in the project interventions; (3) support the subproject teams to ensure that both men and women benefit from the project; (4) ascertain the impact of the project on men and women; (5) conduct postharvest and VC gender research and disseminate the results; and (6) validate gender-responsive VC tools recently developed or adapted by CRP-RTB and its partners. The plan featured landscape studies, capacity development, gender mainstreaming in VC and business development, and technical backstopping to the four teams.

In 2014, ad hoc trainings were conducted for sensitising and equipping the implementing partners with initial tools for gender mainstreaming (Annex CC3 and Annex CC4).

During the second phase of the project, the gender team adopted and/or adapted tools (including validation of recently developed PMCA engendered tools for which complementary funds have been obtained from the CRP on Policy, Institutions, and Markets [PIM]) for conducting gender situational analyses for all subprojects. These studies explored constraints that could hinder technology and innovation uptake by both men and women in relation to the proposed technologies. The studies also sought to establish the existing

empowerment levels for women and men in five dimensions: agricultural production, access to resources, access to services, leadership, and time. Findings indicated that though both men and women are resource constrained, women are more affected given their limited access to land, agricultural inputs, finance, and reduced mobility. Furthermore, they are often not empowered to make decisions related to technology adoption, market engagement, and innovation development (Annexes B5, S4, P3, and C4).

Based on the findings, context-specific strategies were drawn for each subproject to address the identified constraints. In line with the CRP-RTB/CIP gender strategy, two paradigms were considered in strategy development: (1) gender responsive and (2) gender transformative. The draft strategies were validated with subproject partners and implementers and finalised for operationalisation. The gender strategies aimed at providing options to address the needs of women and men in a bid to integrate gender at all levels of the VC. It was noted that some constraints cut across men and women. However, women may be more affected since they have less access to and control of key resources as well as limited decision-making power. Therefore, the strategies sought to identify the most suitable options for women and men.

The gender team also delivered two 4-day trainings to further review the strategies for mitigating gender-based constraints and to build the participants' capacities in gender-responsive business plan development, which assisted the process of developing business plans in each subproject.

Amongst key lessons learnt is the importance of engaging men to ensure gender equity. For instance, they should be sensitised on gender issues at household level (whole family approach) so that they can appreciate that women can also be involved in planning and budgeting for the success of the different enterprises. Key findings contributed to and were disseminated through three CRP-RTB infographics focusing on gender in marketing and postharvest innovations (http://www.rtb.cgiar.org/gender-publications/).

6. PARTNERSHIPS

The PMCA contributed to establishing strong, lasting partnerships within and between the four commodity teams.

All CRP-RTB international members (CIP, IITA, CIAT, Bioversity, and CIRAD) were part of at least one research team; two of them (CIAT and CIRAD) have contributed without their staff time being charged to the project. Another CGIAR center, ILRI, was instrumental for the successful implementation of the SP subproject. Gender tools developed by the PIM CRP were tested and validated under this project. These represent noticeable examples of the value of cross-CGIAR programmes collaborations to ensure required synergies and complementarities.

Researchers from NARO were also involved in all subprojects, and new collaborations between different NARO institutes have emerged (a remarkable example is the strengthened collaboration between NARL and NaCCRI, the Regional Centre of Excellent for cassava, in the framework of the cassava subproject). Four NARO institutes contributed to project implementation. In addition, three national universities (Makerere, Kyambogo, and Ugandan Martyrs University through which 10 MSc students were engaged and supervised); five NGOs; and a number of private sector players, including farmers/ traders associations, processors, and retailers, contributed to project activities. The private sector played a crucial role in enhancing farmers' market access, spearheading the innovations, and providing invaluable feedback to ensure that the teams were actually responding to market needs and opportunities.

The potato team also established a solid partnership with IFDC that not only stepped in for supporting the recently established regional platform, but also introduced the ambient store technology in western Uganda.

The project built collaborations with local authorities that have been instrumental in facilitating the implementation of activities and disseminating the innovations. Notable examples are the allocations of communal land (e.g. for constructing the potato store in Mbale town and the cassava pack-house in Kyenjojo), the involvement of several district agricultural officers in the process of establishing the multistakeholder platforms and the extensive involvement of Kampala City Council Authority and extension staff in promoting SP silage. The local government is also supporting women farmers' groups willing to engage in banana macro-propagation through financial assistance and purchase of plantlets for distribution outside the project area.

The subproject partnerships' strength was assessed at the beginning of phase 2 and at the end of 2016, through a specific tool (partnership health checklist) that was developed by CIP-SSA and adapted to the specificities of the project. Interestingly, in both occasions and for all six domains, the health of the partnership was never scored lower than 4 on a 1–5 Liekert scale. CIP expects that these partnerships can be consolidated and made sustainable through the multistakeholder platforms that have been either established or strengthened by the project.

In terms of collaboration among the four subproject teams, the project has fostered cross-crop learning among researchers, development practitioners, and private sector players by building on the clear—but often ignored—similarities among RTB crops and promoting the adoption of shared methodologies wherever possible (e.g. for market and VC studies, assessment of PHL, gender mainstreaming, etc.). Furthermore, the organisation of cross-subprojects events allowed implementing partners to be exposed to the work conducted by others, thus contributing to broadening their research horizons.

The success of the project at this regard is shown by the fact that its partnership approach is being used as a model to develop the strategic research framework's strategy of the CRP-RTB work on nutrition, postharvest, and value addition (Cluster CC4.1). Furthermore, the final report of the CRP-RTB evaluation, conducted in 2015 by the CGIAR Independent Evaluation Arrangement, highlighted this project as an excellent example of the collegial research that the programme aims at promoting and facilitating (http://iea.cgiar.org/wp-content/uploads/2016/10/RTB-Evaluation-Final-Report-Volume-I.pdf).

> ....RTB purposefully uses W1/W2 funds to increase integration across discipline, crop and centre. The ENDURE project funded through W3 in Uganda is the only other project to date to similarly address programmatic integration.
>
> Source: Final IEA report (2015)

7. EC VISIBILITY ACTION

The project was given high visibility. Guided by the communication and visibility plan (Annex CC8), communication material, including brochures, leaflets, and flyers, were produced and distributed during the project implementation. The implementing team consistently engaged with national journalists and television reporters who were invited to several key events. This resulted in extensive media coverage of the project with over 20 articles published in national newspapers and online (Appendix 8). Researchers and project's beneficiaries had several opportunities to radio broadcast their achievements and stories. Some were also featured on local TV. To ensure broader outreach, over 15 blogs were prepared to share selected project stories and important events through social media (particularly Facebook and Twitter of CIP, CRP-RTB, and partners). They can be reached at the hashtag #RTB-ENDURE (alternatively the screenshots are available upon request). The project has also benefitted from extensive visibility through CRP-RTB with highlights in the CRP-RTB annual report 2015 and 2016.

In compliance with the "Communication and Visibility Manual for EU External Actions" (2008 and 2010), the EC's role in providing funding for the project and the technical support of IFAD were duly acknowledged and made visible in reports and other

publications, presentations, brochures, posters, banners, stickers, and placards, including by displaying the relevant logos.

8. CONCLUSIONS

The project findings confirmed that high perishability of RTB crops, limited value addition, and PHL incurred by VC actors represent major challenges to VC development and expanded utilisation of these crops. The project tested, validated, refined, and promoted a number of technological, commercial, and institutional innovations to address these challenges. These span along the full spectrum of the VC and include identification and improved access to suitable varieties with enhanced postharvest traits; improved agronomic and harvesting techniques; and postharvest handling, storage, processing, and marketing practices and technologies. The project has provided evidence that, in most cases, a single innovation is not sufficient to address the multidimensional nature of the postharvest challenges. Rather, the range of improved technologies and innovations should be introduced simultaneously and targeted at the right category of farmers who have the capacity to effectively apply them to exploit pre-identified market opportunities. Accordingly, during project implementation, research efforts to test and validate the different proofs of concepts have been accompanied by major endeavours to strengthen the technical, entrepreneurial, and collective action capacities of project beneficiaries as well as to ensure stronger market linkages. This has primarily been through the direct involvement of the private sector since the onset of the project when the different innovations were initially identified.

Some of the innovations are extremely promising, are already being adopted, and offer immediate opportunities for scaling. A non-exhaustive list includes cassava-pruning for shelf-life extension, SP silage, macro-propagation of market-demanded banana varieties, potato dehaulming, and optimum harvest time for banana and potato. For some other innovations that require larger capital investments and, sometimes entail the launch of a new product on the market (e.g. cassava shelf-life extension technologies, potato storage, and mechanical harvest of potato), further studies on adoption and economic viability should be conducted before large-scale scaling. In fact, the short duration of the project and the emerging nature of these enterprises have not allowed for the systematic capture of the data required for reaching conclusive recommendations. Nevertheless, these also seem extremely promising, as witnessed by the benefits that accrued to farmers and processors as a result of the profitable, although still limited, sale of new (e.g. waxed cassava) or improved products (e.g. quality stored potatoes).

To disseminate the project findings, numerous research outputs and knowledge products (e.g. technical reports, manuals, protocols, brochures, and leaflets) have been produced and disseminated, through traditional and social media, to project beneficiaries and other VC stakeholders, researchers, local authorities, development agencies, and practitioners. Furthermore, they have been presented to key international congresses and the innovations showcased to the public in a number of events.

The way the project has been designed and implemented has facilitated the establishment of notable partnerships and collaboration within the commodity teams, among them, and also between the research teams and other organisations and programmes operating in the RTB arena in Uganda. In this regard, the project represents an excellent example of the collegial research that the RTB-CRP aims at promoting and facilitating.

As a way forward, the fact that there are several pending research questions, and that new ones have emerged as a result of the project, should be taken as a seed for future research initiatives. Furthermore, the example of budding businesses where people have pooled their own resources to start on their own (e.g. for SP silage and banana multiplication business), the interest of other players to promote and scale the innovations (e.g. local governments, extension services, and IFDC) and the multistakeholder platforms that have been established or strengthened by the project, signal a path to sustainability.

Moreover, the development of business plans is expected to facilitate future engagement with VC stakeholders and other R&D initiatives.

As reiterated earlier, the project focussed mainly on research; hence the interventions mainly touched pilot farmers, VC actors, and the research teams. The pilot farmers and other VC actors greatly benefitted from the action-research approach which enabled them to work closely with new actors and partners who would ordinarily be out of their sphere of contact. This greatly improved their "soft" skills (e.g. negotiation skills) and ability to innovate within their local contexts. The research team greatly appreciated the phased nature of the project, which gave them a chance to conduct preliminary research (scoping phase) that offered wider insights on how the technologies were likely to perform, the skills required, and the importance of partnerships in delivery of the outcomes.

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APPENDIX 1. LOGICAL FRAMEWORK

	Objectively Verifiable Indicators	Means of Verification	Assumptions
Goal			
Contribute to improved food security for RTB-producing communities in Eastern and Central Africa	Long-term impacts at national and regional level: • Increased and more stable consumption of RTB food (25% increase) • Improved diet quality among consumers (15% of consumers) • Increased crop incomes amongst RTB producers (20% increase)	• National agricultural, household, and food consumption surveys • Ex-post assessments where possible.	• Technical feasibility of the proposed innovation • Proposed innovations economically viable and socially acceptable • VC actors provided with required inputs, information, technical skills, and access to credit • Further donor and technical assistance likely to be needed to scale out most promising innovations • Macro-economic situation conducive to scaling out • Competitive position of RTB not undermined by subsidies to grains
Objectives			
To improve food availability and income generation through better postharvest management and expanded use of RTB, based on: (1) postharvest and processing technologies, (2) VC assessment and development, and (3) capacity development	• Decreased RTB storage losses by 15% in pilot sites • 20% increased shelf-life of fresh RTB in pilot sites • 10% increased processing of RTB for on-farm use (where relevant) in pilot sites • 10% increased income from RTB and their products, including livestock where relevant, for rural producers in pilot sites • Increased participation of women in higher and more profitable levels of the value chain and more equitable distribution of benefits between men and women in the community • NARS, development organisation and private sector players engaged in a continuous collaborative innovation process to tackle different constraints in RTB VCs *Please see details about how each subproject is expected to contribute towards the project's objectives in the Research Outcomes section below*	*Please see details in the Research Outcomes section below*	• Macro-economic situation conducive • Competitive position of RTB not undermined by subsidies to grains *Please see additional details in the Research Outcomes section below*
Research outcomes (intended next-users are pilot farmers, traders and project partners)			
Decreased PHL of RTB crops	**Banana:** • 10% average reduction of on-farm physical losses	• M&E • Project progress and	• Technical feasibility of the proposed innovation

	Objectively Verifiable Indicators	Means of Verification	Assumptions
	(product no longer fit for human consumption or damaged to the point that it is used for other purposes other than human consumption) for male and female pilot farmers in comparison to status quo • 10% average reduction of on-farm economic losses (product sold at discounted price due to quality deterioration) for male and female pilot traders in comparison to status quo • At least 50% of male and female pilot farmers extending sucker selection period to at least 5 months **Potato:** • 15% reduction in the amount of potato incurring quality deterioration, and therefore market price discount, after 3 months from harvest under current on-farm storage practice as a result of improved preharvest and harvest practices **Sweetpotato:** • 50% average reduction of the amount of wasted vines for pilot male and female farmers involved in on-farm trials • Use of at least 20% of non-marketable roots (roots of such a poor quality that cannot be sold or that, if sold, would fetch such a low price that the commercialisation results unattractive) for silage-making by male and female pilot farmers involved in on-farm trials **Cassava:** • 50% average reduction of physical losses (product no longer fit for human consumption) at the pilot packing-houses (between purchase and sale of the fresh roots) in comparison to status quo • 20% average reduction of economic losses during storage (product sold at discounted price due to quality deterioration) at the pilot packing-houses (between purchase and sale of the fresh roots) compared with status quo	final reports	• Farmers/traders willing to adopt recommended improved preharvest, harvest and postharvest practices • Farmers/traders willing to use SP roots for silage making
Increased shelf-life of RTB crops	**Banana:** • Varieties from mother gardens with at least 20% longer	• M&E • Project progress and	• Technical feasibility of the proposed innovation

	Objectively Verifiable Indicators	Means of Verification	Assumptions
	shelf-life (quality characteristics retained) **Potato:** • 3 months average extension of the shelf-life of ware potato **Sweetpotato:** • Utilisation of vines extended from the current 3 days (in fresh form) to at least 1.5 months (as silage) for male and female pilot farmers involved in the on-farm trials **Cassava:** • Quality characteristics of fresh cassava retained for at least 2 weeks (zero economic losses)	final reports	• Farmers/traders willing to postpone the sales of ware potato
Increased processing of RTB crops and their products	**Sweetpotato:** • Male and female pilot farmers involved in on-farm trials able to feed pigs on SP silage for at least 3 months a year	• M&E • Project progress and final reports	• Technical feasibility of the proposed innovation • Farmers willing to use silage for pig feeding
Increased income from sales of RTB crops and their products by adopting innovations for improved postharvest management	**Banana:** • Male and female pilot farmers and traders selling an average of 15% of their bananas in graded form • Male and female pilot farmers and traders selling an average of 15% of their bananas with weight-based pricing mechanism • Pilot traders selling an average of 10% of their bananas in different presentation forms (e.g. clusters, peeled and unpeeled fingers) **Potato:** • Average 20% higher profit margin obtained by male and female pilot farmers and traders because of deferred sales of stored ware potato **Sweetpotato:** • 5% of male and female pilot farmers selling SP silage • At least 20% savings on purchased pig feed cost by male and female pilot farmers • 20% average increase in pigs' weight gain for male and female pilot farmers involved in on-farm trials	• M&E • Project progress and final reports	• Technical feasibility of the proposed innovation • Farmers/traders willing to adopt recommended improved postharvest practices • Consistent market demand for banana value adding as identified during scoping activity • Farmers/traders willing to postpone the sales of ware potato • Farmers willing to use silage for pig feeding

	Objectively Verifiable Indicators	Means of Verification	Assumptions
	Cassava: • Average 10% higher income obtained by traders because of sales of treated roots (traders model) • Average 10% higher revenue obtained by farmers running the pilot packhorse because of sales of treated roots (farmers model)		
Initial adoption of proposed postharvest innovations by next-users	**Banana:** • At least 25% of male and female pilot farmers planting varieties with intrinsic longer shelf-life from mother gardens in their own fields (excl. on-farm trials) • At least 25% of male and female pilot farmers adopting sucker selection in their own fields (excl. on-farm trials) • At least 10 additional farmers/traders (among those not involved in the trial and supported by the project) adopting at least one of the proposed technological and/ or commercial innovations **Potato:** • 30% of male and female pilot farmers adopting at least 1 pre-storage technique in their own fields (not pilot fields) • At least 10 additional farmers/traders (among those not involved in the trial and supported by the project) constructing ambient stores or paying a fee for storage services **Sweetpotato:** • At least 50 additional male and female farmers within a 5-km radius from the demonstration centres feeding pigs with SP silage • At least one farmer/entrepreneur not directly supported by the project in each location (Kamuli and Masaka) starting a silage-making business **Cassava:** • At least 1 private entrepreneur or farmers/traders association with a business plan to establish a packing house and/or a packing-house with a business plan to develop/expand outgrower schemes	• M&E • Project progress and final reports	• Technical feasibility of the proposed innovation • Proposed innovations economically viable and socially acceptable • Consistent market demand for banana value adding as identified during scoping activity • Demand for treated cassava roots large enough to justify investments • Access to credit
Increased participation	• At least 20% of women involved in the pilots are	• M&E	• Local and national partners agree

	Objectively Verifiable Indicators	Means of Verification	Assumptions
of women in higher and more profitable levels of the VC and more equitable distribution of benefits between pilot men and women	involved in more profitable nodes of the RTB chain • At least 30% of women involved in the pilots perceive greater control over RTB crop income	• Case studies • Project final report	about project's positive selection mechanisms for ensuring women participation in the pilots • Local social-cultural context allowing women's participation in higher nodes of the VC and better control over income

Strengthened capacity of NARS, development organisation, and private sector players to innovate through development of knowledge, attitude, skills, and social capital	• At least 50% of NARS, development organisations and private sector players involved in the project implementation perceive that their capacities have been strengthened in each of the following areas:
	  • proposed technical innovations
	  • understanding and responding to market opportunities and constraints
	  • establishing and/or strengthening linkages among VC actors
	  • conducting research in partnership
	  • integrating gender in research activities
		• Initial capacity need assessment
		• Final capacity need assessment
		• M&E
		• Project final report
			• Stable partners committed to capacity development

Outputs			
1.1 Current main RTB postharvest challenges and priorities for improvement identified with key RTB production communities (women and men) and VC actors	• Main postharvest constraints and causes of PHL identified • Relevant PHL estimated according to specific criteria for all crops • Marketing opportunity and constraints understood	• Project inception report • Business cases for funding • M&E plan • PMCA training workshop report	• Partners willing to share their knowledge and conduct scoping activities • Respondents willing to contribute
1.2 RTB technologies and their application for reducing PHL and expanding utilisation prioritised and gaps for research identified	At least 2 technologies for each crop group inventoried and product development/pilot experiences reviewed, including via online sources and literature review, and gaps identified	• Business cases for funding	• Partners willing to share their knowledge, conduct scoping activities, and prepare business cases for funding • Respondents willing to contribute
1.3 RTB varieties with improved postharvest characteristics identified, tested, and validated with target communities (women and men) and VC actors across a range of production, marketing	At least 10 RTB varieties tested and validated for improved postharvest characteristics, including where relevant nutritional factors, with stakeholder platforms	• Project progress and final reports • Website	• Project partners conducting collaborative research • Target farmers, traders, processors and consumers willing to be actively involved in the research • Accessibility of the research sites

	Objectively Verifiable Indicators	Means of Verification	Assumptions
and storage environments			
1.4 RTB on-farm storage and processing systems tested and validated	At least 4 on-farm storing and processing technologies tested and validated with stakeholder platforms	• Project progress and final reports • Website	• Project partners conducting collaborative research • Target farmers, traders, processors, and consumers willing to be actively involved in the research • Accessibility of the research sites
1.5 Other RTB technologies to reduce PHL and expand utilisation tested and validated	At least 6 other RTB technologies to reduce losses tested and validated with stakeholder platforms	• Project progress and final reports • Website	• Project partners conducting collaborative research • Target farmers, traders, processors, and consumers willing to be actively involved in the research • Accessibility of the research sites
2.1. Current RTB VCs analysed and priorities for improvement and enhanced gender equity identified with key VC actors/stakeholders	Priorities for improvement shared and agreed with stakeholders in 4 VCs	• Project inception report • Business cases for funding • Website	• Partners willing to share their knowledge and conduct scoping activities • Respondents willing to contribute
2.2. New market opportunities to expand use of RTB assessed and prioritised with stakeholder participation	1 new market opportunity identified per RTB crop	• Project progress and final reports • Business cases for funding	• Partners willing to share their knowledge and conduct scoping activities • Respondents willing to contribute
2.3. RTB producers, traders and processors strengthened for equitable participation and innovation in VCs	At least 20 producers, traders and processors strengthened per crop	• Project inception report • PMCA training workshop report • Training events reports • Project progress and final reports	• Project partners willing to provide training • Target farmers, traders, processors willing to participate in the training • Accessibility of the research sites
2.4. Sustainable multistakeholder platforms for further RTB VC innovation created or strengthened (when already existing) with participation by public/	4 platforms fully operational (one per crop)	• Project progress and final reports • Minutes of the platforms' meetings	• Platform participants willing and able to attend the meetings • Conducive environment to hold regular meetings

	Objectively Verifiable Indicators	Means of Verification	Assumptions
private sector and NGO and community-based organisations			
3.1. Project's website containing documented methods, technologies, and knowledge products suited to target audiences (researchers, extension services, communities, NGOs, etc.)	• 1 functional project's website • Series of project publications (e.g., scientific articles, manuals, guidelines, MSc theses, technical reports and protocols) available online	• No. of website hits • Series of project publications accessible from the website • No. of downloads of project publications	• Members of the research teams willing to produce publications • MSc students concluding their studies • Journals' T&C not preventing on-line dissemination of published papers
3.2. Capacity built in key national partners for reducing PHL and increasing use of RTB	• At least 3 training events held per RTB crop • Researchers from the National Agricultural Research Organisation (NARO) involved in the design and implementation of the research for all crops • At least 5 MSc students supported and supervised	• Project inception report • PMCA training workshop report • Meeting-cum-training workshop report • Business cases for funding • Project progress and final reports • MSc theses	• Stable partners committed to capacity development
3.3 Outputs of research disseminated throughout agricultural knowledge and information systems	• Communications plan developed to guide project and identify target audiences, needs, and appropriate communication channels for delivery of strategic messages • At least 2 articles published and available in print and online • At least 3–5 presentations and posters given at fora and symposia • At least 5 project publications (e.g., manuals, guidelines, MSc theses, technical reports and protocols) produced and disseminated for each crop	• Project communication and visibility plan • Article's proofs and websites of peer-reviewed journals • Programs, reports and proceedings of fora and symposia • Articles in traditional, online and social media • Project progress and final reports • Website	• Members of the research teams willing to publish and present the project's results • MSc students concluding their studies
Activities			
Preparatory phase (2014)			
Hold a project inception	1 inception workshop	• Project inception report	

	Objectively Verifiable Indicators	Means of Verification	Assumptions
workshop to: (1) analyse RTB VCs and main postharvest challenges; (2) identify priorities for improved postharvest management and enhanced gender equity with key VC actors; and (3) establish multi-agency research teams for each RTB crop (banana, sweetpotato, cassava, and Irish potato)		• Project progress and final reports	
Provide training and build capacity on PMCA methodology and gender mainstreaming in collaborative research design and implementation	• 2 training sessions on gender mainstreaming in the inception workshop • 1 4-day PMCA training workshop • 3 training sessions on PMCA in the meeting-cum-training workshop • 3 training sessions on gender mainstreaming in the meeting-cum-training workshop	• Project inception report • PMCA training workshop report • Meeting-cum-training workshop report • Project progress and final reports	• Project's partners willing to attend and actively contribute
Conduct scoping studies to validate hypotheses and assumptions about the preliminary identified priority innovations for improved postharvest management	Scoping studies conducted for 7 research options (2 for banana, 2 for sweetpotato, 2 for cassava and 1 for Irish potato), including literature review, key informant interviews and collection of primary data	• 7 draft business cases submitted for funding	• Respondents willing to contribute
Organise a poster session during the RTB Annual Review and Planning Meeting to present the draft business cases	1 poster session	• Report of the RTB Annual Review and Planning Meeting 2014	
Review (internally and externally) the submitted draft business cases and preliminary select the most promising for funding, based on agreed	• Feedback from 2 external reviewers based on agreed criteria • Preliminary selection of 4 draft business cases for funding • 1 set of required amendments and recommendations for each preliminary selected draft business case	• External reviewers' feedback • Minutes of the project's Process Committee • Communication about	

	Objectively Verifiable Indicators	Means of Verification	Assumptions
criteria		required amendments and recommendations	
Select best bet research options for improved postharvest management	4 revised business cases selected for funding	• Project progress and final reports • Communication about the outcome of selection process to research teams	
Establish a project's Steering Committee	1 project's Steering Committee established (6 representatives of CRP-RTB and 3 representatives of national and regional agricultural R&D organisations)	• Project progress and final reports • Steering Committee membership	• Interest and availability of non-CGIAR representatives
Organise an event for the official launch of the research implementation phase	1 Meeting-cum-training workshop	• Meeting-cum-training workshop report • Meeting-cum-training workshop concept note • Project progress and final reports	
Develop project's gender action plan for research implementation	1 gender action plan	• Meeting-cum-training workshop report • Project progress and final reports • Gender action plan	• Active participation of research teams' members
Develop draft the M&E system for the research implementation phase	• 1 Draft M&E plan • 1 Performance Monitoring matrix	• Meeting-cum-training workshop report • Project progress and final reports • Draft M&E plan • Performance Monitoring matrix	• Active participation of research teams' members
Research implementation phase (2015-2016)			
1. Crop-specific activities			
Please see Gantt charts presented in the 4 business cases and revised work plans for year 2016 for details of activities carried out by each research team			
2. Overarching activities			
Develop and implement the project M&E	• 1 M&E plan • 1 Performance Monitoring Matrix	• M&E plan • Performance	

	Objectively Verifiable Indicators	Means of Verification	Assumptions
system	• M&E visits	Monitoring Matrix • Reports of the visits of the M&E Specialist • Project progress and final reports	
Develop and implement the project communication and visibility plan	• 1 Communication and visibility plan • 1 functional project's website • Project publications (e.g., scientific articles, manuals, guidelines, MSc theses, technical reports and protocols) available online • Preparation and submissions of papers and posters for presentations in fora and symposia • Articles in traditional, on-line and social media	• Communication and visibility plan • Website • Media coverage • Project progress and final reports	
Hold an annual project review meeting	1 project review meeting	• Project progress and final reports • Report of the project review meeting	
Hold regular meetings with the members of the project's Steering Committee	Meetings with members of the Steering Committee held biannually	• Minutes of the project's Process Committee	
Organise an end-of-project workshop	1 end-of-project workshop	• Report of the end-of-project workshop • Project final report	

APPENDIX 2. CONTRIBUTION OF THE SUBPROJECTS TOWARDS PROJECT'S OBJECTIVES

The four subprojects are, by design, quite different in nature. Nevertheless they all contribute to the overall project's objectives. The following figure provides a graphical representation of how each subproject contributes towards the project's broader objectives.

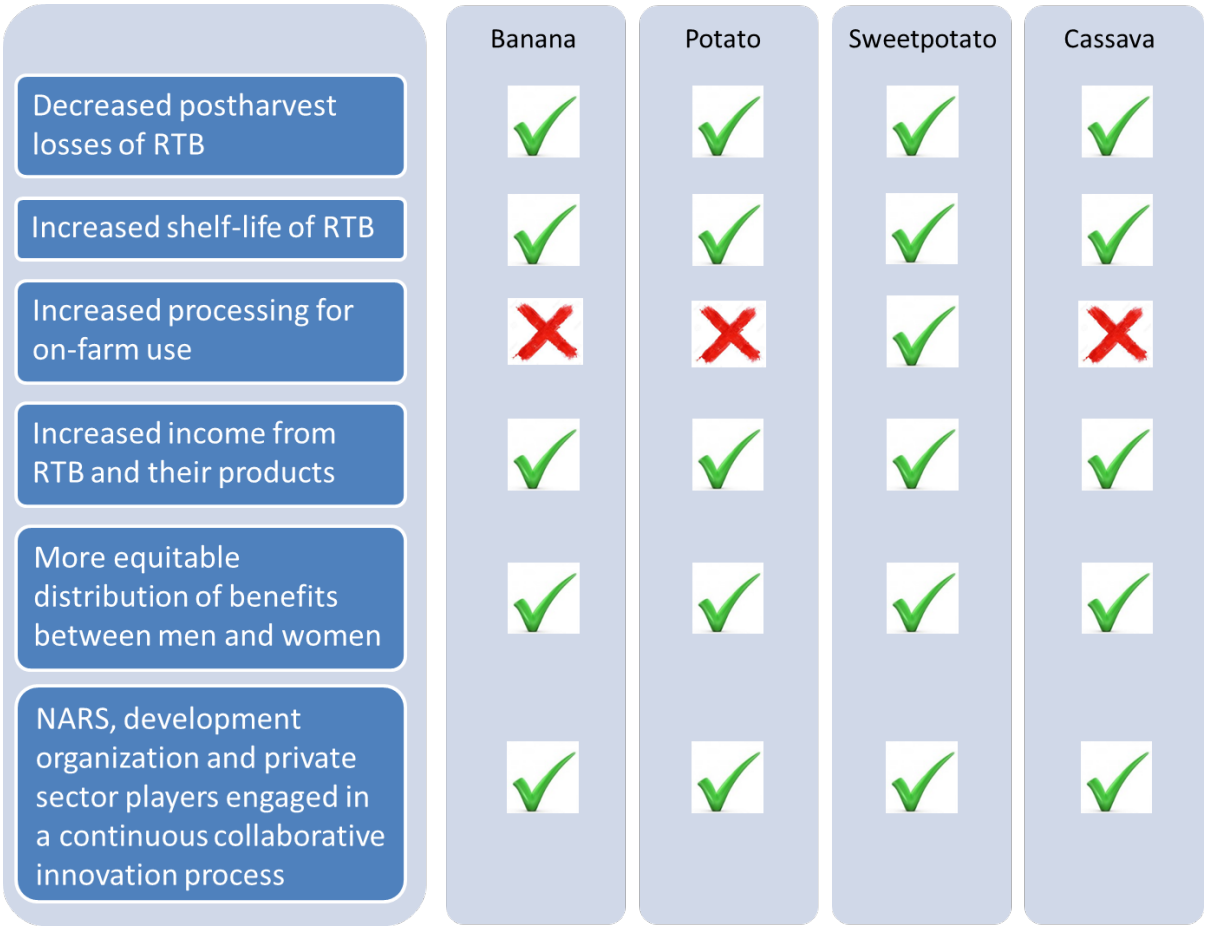

Figure 2: Contribution of each subproject towards project's objectives.

APPENDIX 3. MAIN PROJECT SITES

The project was implemented in a number of different locations spanning across Eastern, Central, and Western Uganda. Figure 3 shows where on-the-ground project activities were implemented and where on-station research was conducted.

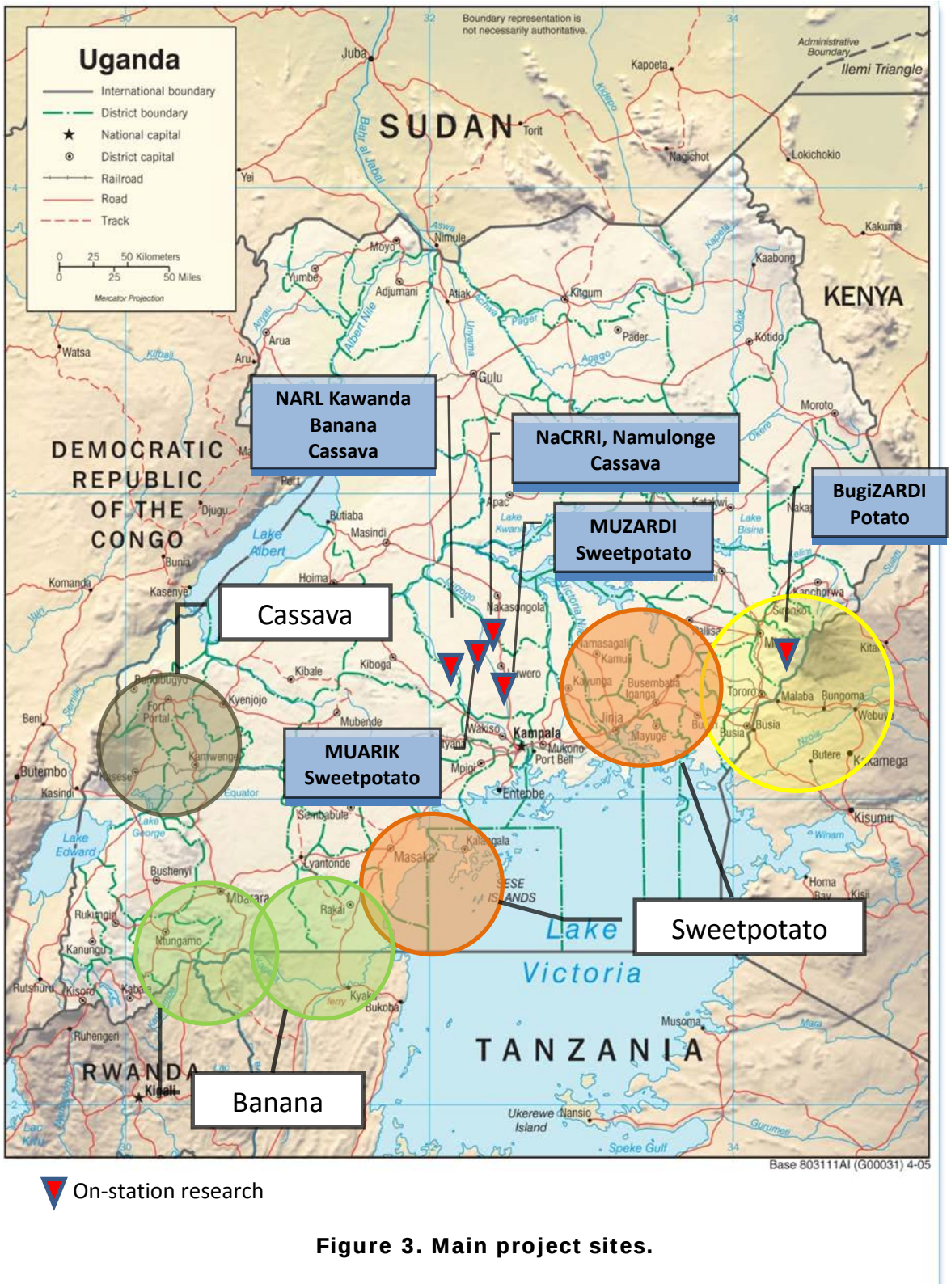

Figure 3. Main project sites.

APPENDIX 4. SUMMARY DESCRIPTION OF ACHIEVEMENTS TOWARDS PROJECT-WIDE OUTPUTS

No.	Output	Target	Achieved	Description
1.1	Current main RTB postharvest challenges and priorities for improvement identified with key RTB production communities and VC actors	• Main postharvest constraints and causes of PHL identified • Relevant PHL estimated according to specific criteria for all crops • Marketing opportunity and constraints understood	100%	Four crop-specific multi-agency teams established to jointly identify the main RTB postharvest challenges, opportunities, and priorities. The teams developed seven preliminary business cases for research. Scoping studies were conducted to validate initial hypotheses and assumptions as well as provide initial estimates of PHL. Final business cases for research funding were produced to address identified postharvest challenges and market opportunities.
1.2	RTB technologies and their application for reducing PHL and expanding utilisation prioritised and gaps for research identified	At least 2 technologies for each crop group inventoried and product development/pilot experiences reviewed, including via online sources and literature review, and gaps identified	100%	The scoping studies conducted by the four teams entailed a review of relevant literature and collection of primary data to address identified gaps. The seven business cases presented options for funding research around a number of technologies and other innovations. Eventually, four were prioritised and selected for funding (the subprojects).
1.3	RTB varieties with improved postharvest characteristics identified, tested, and validated with target communities (women and men) and VC actors across a range of production, marketing, and storage environments	At least 10 RTB varieties tested and validated for improved postharvest characteristics, including where relevant nutritional factors, with stakeholder platforms	100%	*Banana:* 4 varieties were identified and promoted being highly demanded by market. Access to planting material was improved and the split corm method was found the most viable multiplication technique. *Sweetpotato:* Out of 4 tested varieties, NASPOT 11 is the most suitable for dual-purpose producing a good balance of food (roots) and feed (vines). NASPOT 11 is currently being actively promoted and the planting material sold by the silage business centres (see 1.5). *Potato:* 10 registered varieties and 8 CIP clones were evaluated for agronomic and postharvest characteristics; all but 1 were suitable for storage. Clone 392797.22 performed the best overall and should be considered for official release. *Cassava*: 16 varieties were analysed to determine varietal differences in postharvest physiological deterioration and suitability to the two proposed shelf-life extension technologies. TME14 and 2 popular local varieties (Bukalasa and Nyaraboke) showed the best potential for shelf life extension.
1.4	RTB on-farm storage and processing systems trialled and validated	At least 4 on-farm storing and processing technologies selected for dissemination with stakeholder platform	95%	*Sweetpotato:* Options for on-farm silage-making for pig feed using SP vines and non-commercial roots tested and validated, and ideal level of supplementation determined. *Potato*: 2 storage options were tested with promising results: collective ambient stores and improved traditional individual stores. *Cassava:* 2 postharvest shelf-life extension technologies were tested: root waxing technology and high RH storage. Results are promising, but additional research is required to prove the economic viability.
1.5	Other RTB technologies to	At least 6 other RTB technologies	100%	*Banana*: The following innovations were tested: optimal harvest time; sucker staggering; cold

No.	Output	Target	Achieved	Description
	reduce PHL and expand utilisation validated	to reduce losses tested and validated with stakeholder platforms		storage; introduction of convenient presentation forms; weight-based pricing mechanism; and cushioning. Optimal harvest time and convenient presentation forms were validated. Sucker staggering, cold storage, and weight-based pricing look promising but additional research is required for final validation. *Sweetpotato*: As in 1.4 but, in this case, options for silage-making as a business (off-farm) and provision of related services. *Potato*: Storability experiments (see 1.4) conducted also on potatoes stored by the local potato trader association. Three new harvesting methods were assessed and resulted more efficient than the traditional hand hoe in reducing physical and quality losses at harvest. *Cassava*: As in 1.4 but, in this case, the second pack-house has been operationalised by a sole enterprise. Furthermore, research was conducted to validate the pruning technology.
2.1	Current RTB VC and food access situation assessed and priorities for improvement and enhanced gender equity identified with key VC actors/ stakeholders	Priorities for improvement shared and agreed with stakeholders in 4 VCs	100%	Market and VC studies were conducted for each target crop in order to (1) map the VC; (2) assess margins; (3) validate priorities for improving postharvest management; (4) further refine the estimation of the demand for the proposed innovations and end products; and (5) deepen the analyses of PHL. The main findings of the studies were shared with partners, collaborators, and relevant stakeholders to validate and refine the priorities of the interventions. A comparative analysis of PHL along fresh cassava, banana, and potato VCs in Uganda was also conducted to inform policy prioritisation and future interventions.
2.2	New market opportunities to expand use of RTB assessed and prioritised with stakeholder participation	1 new market opportunity identified per RTB crop	100%	During the preparatory phase (year 1), the different teams identified and analysed new market opportunities and the most promising innovations that culminated into the four subprojects that were implemented.
2.3	RTB producer/ processor groups strengthened for equitable participation and innovation in VCs	At least 20 producers, traders, and processors strengthened per crop	100%	*Banana:* Training on agronomic and postharvest practices targeted 818 farmers (425 M, 393 F). Training on entrepreneurial skills and business planning targeted 206 farmers (100 M, 106 F). The project supported the development of four gender-responsive business plans (two for seed multiplication and two for differentiated banana products). *Sweetpotato:* Training on silage-making and use and pig management targeted 585 farmers (254 M, 331 F). Training on entrepreneurial skills and marketing 129 farmers (92 M, 37 F). The project has also supported the development of 14 gender-responsive business plans: 11 for silage business entrepreneurs (either individuals or groups) and 3 for expanding the operations of the silage business centres established by the project. *Potato*: Training on pre- and postharvest management targeted 98 farmers (51 M, 47 F), members of the associations hosting the stores. Postharvest training was provided also to 15 members (11 M, 4 F), of the partner traders

No.	Output	Target	Achieved	Description
				association. Training on entrepreneurial and business skills targeted 643 farmers (342 M, 301 F). Furthermore, the project supported the associations hosting the collective stores to develop store management plans and business plans. *Cassava*: Training on agronomic and postharvest practices targeted 91 farmers (39 M, 52 F). Training on entrepreneurial skills and marketing targeted 261 farmers (111 M, 150 F). Furthermore, the project supported the development of business plans for each of the two pack-houses established with project support.
2.4	Sustainable multi-stakeholder platforms for further RTB VC innovation created	4 platforms created and operational (one per crop)	70%	*Banana*: Western Region Banana Innovation Platform established, formalised, and registered. One sub-county platform formed from scratch. *Sweetpotato*: Meetings of the existing Central and Eastern region platforms facilitated. As a sustainability strategy, 202 executive members of the national and regional platforms' committees trained in good governance. *Potato*: Eastern Regional Potato Multistakeholder Innovation Platform established from scratch and launched. BugiZARDI expected to keep on facilitating the regional platform and identify alternative sources of funding. *Cassava*: Idle existing district platforms revamped and strengthened with a number of meetings facilitated by the project. Platforms existing prior the intervention are likely to have reached a sufficient level of maturity to autonomously continue their operations or be able to seek additional support. However, the ones established by the project from scratch (e.g. potato regional and the banana sub-county platforms) or found idle (e.g. the cassava district platforms) may not survive if members are not sufficiently active to successfully identifying sources of funding, including through fee-based mechanisms.
3.1	Project's website containing documented methods, technologies, and knowledge products	• 1 functional project's website • Series of project publications (e.g., scientific articles, manuals, guidelines, MSc theses, technical reports and protocols) available online	100%	A functional project website has been developed and is currently up and running (http://www.rtb.cgiar.org/endure/). Project documents, reports and publications are available on line and the website's content was regularly updated as the project progressed. The most recent project reports and publications are being migrated to CGSpace (https://cgspace.cgiar.org/handle/10568/82596) to ease management of and access to the repository.
3.2	Capacity built in key national partners for reducing PHL and increasing use of RTB	• At least 3 training events held per RTB crop • Researchers from NARO involved in the design and implementation of the research for all crops • At least 5 MSc students supported and supervised	100%	• At least nine major training events have been held for national partners. Cross-crop learning within the Ugandan scientific community has been facilitated through workshops, science days, and official launches of project innovations. • NARO researchers have been involved in the research design and implementation for all crops. • Ten postgraduate students (Master's level) have been identified, granted fellowships, supervised and coached for undertaking studies to complement project research activities.

No.	Output	Target	Achieved	Description
3.3	Outputs of research disseminated throughout agricultural knowledge and information systems	• Communications plan developed • At least 2 articles published • At least 3–5 presentations and posters given at fora and symposia • At least 5 project publications (e.g., manuals, guidelines, technical reports) produced and disseminated for each crop	95%	Project communications and visibility plan developed. Four sub-plans developed for each subproject. **Knowledge products:** • 1 article published in peer-reviewed journal and available online • 4 articles submitted to peer-reviewed journals • 18 presentations and posters given at fora and symposia • 41 project publications: - 22 technical reports - 8 manuals - 1 protocol - 2 brochures - 8 leaflets Additional project publications and articles are being finalised and submitted.

APPENDIX 5. ACHIEVEMENTS TOWARDS PROJECT-WIDE OUTPUTS

No.	Output	Target	Achieved	Description
1.1	Current main RTB postharvest challenges and priorities for improvement identified with key RTB production communities (women and men) and VC actors	• Main postharvest constraints and causes of PHL identified • Relevant PHL estimated according to specific criteria for all crops • Marketing opportunity and constraints understood	100%	An inception workshop was held in March 2014 and attended by 45 participants (29 M, 16 F) representing the various CGIAR (CIP, IITA, CIAT, Bioversity, and ILRI) and non-CGIAR partners (CIRAD, NARO, Makerere University, NGOs, private sector, etc.) potentially interested in being involved in the implementation of the project. During the workshop, four crop-specific multi-agency teams were established to jointly identify the main RTB postharvest challenges, opportunities, and priorities. Taking also into account the outcomes of the planning meeting held in mid-2012, seven preliminary business cases for research were developed by the teams. Scoping studies were conducted to validate initial hypotheses and assumptions as well as provide initial estimates of PHL. To properly equip the teams in adopting the PMCA approach and tools during the scoping studies and the development of the final business cases, a 4-day PMCA training was held in June 2014 and attended by 19 participants (15 M, 4 F) from the different teams (see 3.2). Based on the findings of the scoping studies, scoping reports were produced and final business cases for research funding were submitted to Project Management in September 2014. The reports of the inception meeting and PMCA training can be found in Annex CC2 and Annex CC3.
1.2	RTB technologies and their application for reducing PHL and expanding utilisation prioritised and gaps for research identified	At least 2 technologies for each crop group inventoried and product development/pilot experiences reviewed, including via online sources and literature review, and gaps identified	100%	The scoping studies conducted by the four teams entailed a review of relevant literature and collection of primary data through individual interviews and focus group discussions to address identified gaps. The seven business cases presented options for funding research around a number of technologies and other innovations such as: • Banana: marketing of different presentation forms, cushioning, weight-based pricing mechanisms, sucker-staggering, processing of banana into beer and juice, etc. • Sweetpotato: storage of fresh roots, silage-making, business models for silage commercialisation, etc. • Potato: traditional stores, ambient stores, pre-harvest practices for extended shelf-life, grading & sorting, etc. • Cassava: pruning, waxed cassava, high RH storage, marketing model for dry chips, chipping technologies, etc. Eventually, following the feedback received by lead experts during a specific poster session organised during the 2014 CRP-RTB Annual Review and Planning meeting, as well as transparent internal and external reviews of the business cases, four were selected for funding in October 2014 (hereinafter referred to as subprojects). All the seven business cases and relevant posters can be found in the project's website. Funded business case are presented in Annexes B1, S1, P1, and C1.
1.3	RTB varieties with improved postharvest characteristics	At least 10 RTB varieties tested and validated for improved	100%	**Banana:** A VC study (Annex B3) found a mismatch between varieties grown by farmers and the ones most demanded by market. Four varieties were identified and promoted by the project either because they were highly preferred by consumers (Nakitembe, Musakala, and Mbwazirume) or because of the

No.	Output	Target	Achieved	Description
	identified, tested, and validated with target communities (women and men) and VC actors across a range of production, marketing and storage environments	postharvest characteristics, including where relevant nutritional factors, with stakeholder platforms		longer intrinsic shelf-life and potential for export (Kibuzi). To enhance farmers' access to planting material of these varieties, 10 mother gardens have been established (5 in Rakai and 5 in Isingiro districts in western Uganda, 40% managed by women). The mother gardens were originally supplied with 1,500 plantlets (from tissue culture at NARL-Kawanda) and host farmers trained on how to keep the material clean. Currently each garden serves 2–3 nearby farmers groups hosting macro-propagation chambers established by the project. They were trained in multiplication techniques, management of chambers, and business planning. Three multiplication techniques have been introduced and trialled (split corm, decapitation, and enhanced nutrition). Cost-benefit analyses indicated (Annex B7) the split corm method as the most viable technique in terms of the amount of seed produced and economic viability. Two seed distribution models were promoted: (1) *Recovery model* suitable for local resource poor farmers and (2) *Business model* for sales outside the community. Properly labelled and packaged clean planting material of these varieties is being sold to nearby farmers; sales to buyers outside the project area have commenced. Leaflets (including agronomic, culinary, and other attributes of the varieties as well as contacts of multipliers) were produced in three languages (see Annex B9 for the English version) and distributed to farmers and traders. **Sweetpotato:** On-farm (in Kamuli and Masaka districts) and on-station (at the Ugandan Martyrs University) trials were conducted with four varieties (NASPOT 12 O, NASPOT 13 O, NASPOT 11, and a local variety) to identify the most suitable dual-purpose variety and the response to detopping (partial vine removal), at 85 day after harvesting. Results show that NASPOT 11 is the most suitable variety producing a good balance of food (roots) and feed (vines), as reflected by its root-vine ratio. It performed well in both target districts, in terms of yield and disease resistance. Furthermore, it was the only variety in which detopping stimulated vine production without affecting root yield. This is a valuable characteristic in dual-purpose varieties since it allow farmers to early access feed during the dry season. One MSc student has been enrolled for supporting this research component (see 3.2). NASPOT 11 is currently being actively promoted and the planting material sold by the silage business centres established by the project (see 1.5). **Potato**: Ten varieties already registered in Uganda and commonly grown in western Uganda (with potential to perform well in eastern Uganda) and 8 clones from CIP breeding program were evaluated on-station at NARO-BugiZARDI over two seasons in 2016. Yield differed significantly between the two seasons. In season one, Rwangume performed best at 19.3 t/ha, while in season two, clone 392797.22, commonly known as Unica in countries where it is registered, yielded 62.5 t/ha. All but one variety/clone in season two yielded greater than the best performing clone of season one at 24.2 t/ha and greater. Clones 392797.22 and 398208.704 were the most adapted, therefore recommended for the Mt Elgon region because they are high yielding and the most resistant to diseases, in particular late blight (Annex P6). The varieties/clones were also assessed for their postharvest attributes, in particular storability, consumers' acceptability and processing characteristics. With the exception of Shangi, they were all suitable for storage having a dormancy periods of 2 months or

No.	Output	Target	Achieved	Description
				greater (Annex P4). The highest dry matter content was recorded in 398208.704 and 393385.4 (21.9% and 20.8%, respectively), making them adapted for processing, while the lowest dry matter was recorded in Rwanshaka and Victoria, (19.2% and 18.5%, respectively), making them more suitable for table use. Clone 392797.22 was the most overall acceptable, followed by Rwangume, Kinigi, and Rwanshaka. Clone 393385.39 had the lowest consumer acceptability score overall, followed by 393079.4. Considering agronomic and postharvest performance, clone 392797.22 performed the best overall and should be considered for official release. The Rwangume variety has recently been released as NAROPOT 4. Agronomic and postharvest research was supported by two MSc students (see 3.2). **Cassava:** Sixteen varieties were collected from the three main fresh root trading routes to Kampala (incl. target districts of Masindi and Kyenjojo) and analysed at NARL-Kawanda and NARO-NaCCRI (the Cassava Regional Center of Excellence) to determine varietal differences in PPD and, in turns, how PPD affects biochemical composition and eating quality of the roots as well as suitability to the two proposed shelf-life extension technologies (see 1.4). The varieties were rapidly screened to select 9 varieties that were relatively more tolerant or resistant to PPD and with good eating quality. These were selected as candidates for shelf-life extension trials and included seven indigenous landraces and 2 improved varieties, NASE14 and TME14. TME14 and two popular local varieties (Bukalasa and Nyaraboke) showed the best potential for shelf-life extension (Annex C5).
1.4	RTB on-farm storage and processing systems trialled and validated	At least 4 on-farm storing and processing technologies selected for dissemination with stakeholder platform	95%	**Sweetpotato:** In partnership with the Livestock CGIAR Research Programme, the subproject tested options for on-farm silage-making for pig feed using sweetpotato vines (95%) and non-commercial roots (5%). Micro-silos trials were conducted at MUARIK (Makerere research station) with 5 treatments based on SP vines and locally available ingredients (e.g. maize bran and cassava flour, each at 2.5% and 5% inclusion levels) to test efficiency with which SP vines would ensile. Results show that SP vines and roots can produce silage of acceptable quality even when no external ferment starter is added. However, addition of a solid starter, such as maize bran, served to absorb the moisture that would accumulate as effluent at the bottom of the silo and eventually lead to spoilage. The silage had crude protein content higher than 19%, therefore meeting the requirements for growing pigs, except for poor balance of essential amino acids and low dry matter (Annex S5). However, the low dry matter content would not make it a suitable diet for young pigs. To determine the effect of SP silage diets on performance of growing pigs, both on-station and on-farm trials were set up. Farmers hosting the on-farm trials were trained in biosecurity measures (with a focus on African Swine Fever) and silage-making (see 2.3). Four diets with increasing levels of SP silage were tested. Results revealed significant differences in feed intake, final weight, daily live weight gain, and feed conversion rate (FCR) among the experimental diets. A diet composed solely of SP silage resulted in poor growth and FCR. Daily feed intake and daily weight gain improved as the level of supplement increased (Annex S6). An economic analyses showed that supplementing on-farm SP silage with maize bran at 40% inclusion is only marginally less efficient than fully commercial diets, often out of reach of smallholders,

No.	Output	Target	Achieved	Description
				but outperforms the conventional farmers' feeding practices, ensuring a 32% reduction in feeding costs (Annex S7). The 60:40 ratio method was promoted among pig farmers in the target sites (see 2.3). Two options for making on-farm SP silage were refined and validated. The original tube silo method (Annex S15) was refined to improve effluent management and shelf-life of the silage (Annex S16) and is suitable for smallholders, while the stack silo is more suitable for semi- and commercial farmers. Feeding trials and economic research were supported by two MSc students (see 3.2). **Potato:** Two ware potato on-farm storage options were tested: collective ambient stores (capacity of 40–50 t) and improved traditional individual stores (capacity of 4–8 t). Four collective stores and 12 individual stores were constructed at different altitudes in order to determine how external climatic conditions may affect the storability of the tubers. During construction, efforts were made to ensure skills and capacity transfer to local artisans in order to facilitate sustainability and scalability. Samples were collected at regular intervals and analysed according to a number of set criteria, including the extent of physical and economic (quality) losses occurred during the storage period. Results show that based on the difference in temperature and RH within the stores, together with the genetic makeup of the potato varieties, the potatoes in the stores located at lower altitude (Mbale town, 1,200 masl) should be kept for a maximum of 6 weeks. Those located at higher altitude (Kapchorwa and Bennet, 1,800–2,300 masl) can be stored for up to 9 weeks (Annex P4). Storing suitable varieties of potato (see 1.3), even for just a few weeks, would allow significant extension of the marketing window, thus evening out the supplies and benefitting from the price increases after the bumper harvest. An economic analysis (Annex P5) showed that storing potatoes can be highly profitable. Unsurprisingly, the highest profitability is achieved with lower construction costs ($6,000) and longer storage period (i.e. 9 weeks: BCR: 7.7; NPV: UGX 134 million; IRR: 109%; ROI: 668% and payback period of less than a year). The profitability considerably reduces when the highest construction cost ($14,500) is assumed, but storage remains a viable business even in the least favourable scenario characterised by extremely high (and unlikely) construction cost and a short storage period of just 3 weeks (BCR: 1.6; NPV: UGX 31 million; IRR: 14%; ROI: 64% and payback period of less than 4 years). The cost of storage losses, and in particular economic losses due to quality degradation, may be high; but this is outweighed but the high market price that stored potatoes would fetch. The key enabling factors for on-farm storage are mostly related to engineering aspects to keep the storage construction cost low and an enhanced capacity of small-scale farmers to work together to ensure that the stored utilisation is optimised. Therefore, store management plans were developed for the farmers' associations hosting the collective stores in order to ensure proper management of the stores and minimize free-riding (see one example in Annex P12). **Cassava:** The project tested two postharvest shelf-life extension technologies: root waxing technology and high RH storage. On-station trials were conducted at NARL-Kawanda where PPD scoring, biochemical analysis, and sensory testing of the treated roots were conducted at regular storage intervals to assess the effectiveness of the two technologies. The results suggest that there are no negative effects on the physical and chemical properties of the treated roots over 21–28 day storage period

No.	Output	Target	Achieved	Description
				depending on the variety. However, sensory evaluation of the boiled forms of the roots showed that waxing or RH storage (combined with pruning, see 1.5) maintained the tasting qualities of the stored roots for up to 14 days depending on the variety (Annex C6). Consumer evaluation of the preserved roots revealed that the eating qualities of waxed roots are highest (probably related to increased sweetness due to conversion of starch into sugars) followed by RH stored roots compared with untreated cassava roots (cooked within 1–3 days of harvesting, similar to the current practices). Two MSc students were involved in the on-station research on root waxing and RH storage (see 3.2). The consumers were willing to pay UGX 2,391 for 1 kg of waxed roots, UGX 1,629/kg for high RH stored roots, and UGX 1,000/kg for the untreated roots. Waxing technology might be particularly suitable for high-end outlets, such as supermarkets, while RH storage is a cheaper technology that may be more suitable for large-scale distribution. Market testing was conducted to promote the shelf-life extended roots and receive feedback from retailers, caterers, and consumers. However, additional research is required to comprehensively assess the economic viability before recommending mass scaling. Two pack-houses have been established, one managed by a farmers' association that has been selected and trained in required agronomic practices (see 2.3), based on the capacities that have been built during the visit of the research team to CIAT Colombia (see 3.2). Manuals for setting up and managing a pack-house have been produced and disseminated (Annex C7 and Annex C8). Linkages with a number of potential buyers have been established and sales are slowly picking up.
1.5	Other RTB technologies to reduce PHL and expand utilisation validated	At least 6 other RTB technologies to reduce losses tested and validated with stakeholder platforms	100%	**Banana:** • CIRAD, in partnership with NARO, estimated the optimal harvest time for bananas to ensure both better postharvest properties and optimum eating qualities. The research was conducted on one variety only (Kibuzi) and found the optimum harvest time in the two target districts at 133–142 and 133–150 days after flowering, respectively (Annex B4). A MSc student supported the initial set up of the field experiments (see 3.2). • 56 pilot farmers (23 F) hosted demonstration sites for sucker-staggering. Late establishment of the trials and prolonged drought in the study sites led to withdrawal of several farmers and prevented reaching conclusive results on its effectiveness in evening out supplies and reducing PHL. However, eight farmers (5 F, 3 M) have successfully implemented suckers-staggering and the first staggered suckers flowered around December. • Storage temperature experiments determined storage conditions that can extend the shelf-life of three banana products: bunches, unpeeled fingers, and peeled fingers. Results indicate that the best temperature range for preserving bananas is 12–18^{0}C which increases shelf-life to over 12 days compared with 5 days at room temperature. Peeled and untreated banana at 18^{0}C keeps for 4 days compared with a few hours at room temperatures (Annex B6). Therefore a simple charcoal cooler would be sufficient to substantially extend the shelf-life and reduce PHL. With support from the project, the chilled banana forms were made available on retail basis by a female entrepreneur who currently uses a charcoal cooler in Bugolobi market, Kampala. This has enabled her plan her activities better as she peels enough bananas for a week compared with peeling as clients come. The project has registered over 10 orders for charcoal coolers from banana retailers. Additional research is required to assess the economic viability of banana cold storage.

No.	Output	Target	Achieved	Description
				• Convenient presentation forms of cooking bananas (including clusters, unpeeled, and peeled fingers that are sorted, graded, and labelled by cultivar) were piloted. Due the smaller portion they respond to new demographic trends, offer opportunities to increase retail margins and can contribute to reduce wastage. Two wholesale traders and two supermarkets (Mega and Uchumi) participated in the initial pilot. The banana team provided business training to two women (one in Rakai and one in Isingiro) who recently moved into wholesale—an activity dominated by men—and helped them gain access to credit, markets in Kampala and banana exporters as part of a strategy to promote women's participation in market-chain links with higher margins. These women are also acting as role models for other women and households in their communities while some participants in the trainings (see 2.3) have started supplying banana that meet the quality standards of more demanding markets, e.g. for export of high quality, properly packaged, clusters. • A weight-based pricing mechanism has been introduced with some initial success with the export market and some high-end retail markets. A study revealed that banana VC actors are willing to adopt this mechanism. However, for effective standardisation of the cooking banana pricing system, all actors need to be brought on board to understand how the system works and what benefits it would bring (Annex B3). • The project trialled the introduction of cushioning during transport to minimise bruises and PHL, but retailers were reluctant to pay a premium for protected bunches, which discouraged the wholesaler. **Sweetpotato:** The project promoted silage making as a business (off-farm) and the provision of related services. Eleven potential silage entrepreneurs have been identified in Masaka and Kamuli districts according to set criteria. They were supported with training in entrepreneurial skills and business planning to help them start their enterprises and ease access to financial services (see 3.2). The project established and launched 3 silage business centres (2 in Masaka and 1 in Kamuli) which are offering fee-based services such as training in silage making, selling silage, and chopping SP vines. Those centres trained youth and farmer groups that purchased their own shredders, and linked farmers to markets through a large private firm, Pig Production and Marketing Ltd., which is also promoting silage use. **Potato:** Storability experiments (see 1.4) were conducted also on potatoes kept in a collective store hosted by the local potato trader association (Mbale Potato Dealers Association. Furthermore, based on the result of the VC study (see 2.1) that identified damage during harvesting as the main cause of PHL, a new experiment was designed to assess different harvesting methods. Four lifting methods were compared for their efficiency in lifting potato: (1) hand hoe; (2) ordinary ox-drawn lifter modified from groundnut lifter; (3) ox-drawn lifter modified based on farmers' recommendations; and (4) tractor-drawn single sieve single-row potato lifter. The findings confirmed that a high proportion of tubers are left unharvested in the ground (38%) or are damaged during harvesting (e.g. 19% of harvested tubers) when using hand hoes. The tested lifters substantially reduced the proportion of

No.	Output	Target	Achieved	Description
				tubers presenting cuts and bruises, and therefore unmarketable (7–9%). Farmers appreciated the tractor-drawn lifter but, being this difficult to access, showed great interest for the ox-drawn lifter modified according to their recommendations (Annex P7). **Cassava:** As in 1.4 but, in this case, options for adopting shelf-life extension technologies at trader level (not necessarily on-farm) were explored. Brica Investments, a sole enterprise, has operationalised the second pack-house and several batches of waxed cassava have been processed and trailed on the market. Furthermore, during the capacity building in Colombia (see 3.2), the research team has appreciated how the pruning of cassava (defoliation of the plants 6 days before harvest) can slow down PPD. Research findings showed that pruning is a potential valuable low-cost technology for extending cassava roots shelf-life (for 4–7 days) of some varieties and reducing PHL along the VC (Annex C5). Pruning caused slight changes in sugars and carbohydrate composition of roots and caused a reduction of cyanogenic potential after 7 days of storage (possibly due to remobilisation of nitrogen that probably took place after pruning). In some varieties, pruning considerably increased the acceptability of stored roots and in none of the varieties it led to reduced acceptability. However, inconsistent varietal responses to pruning were observed and this calls for additional research. Preliminary results indicate that varieties such as Nyaraboke, Njule, TME14, and Hoima are the ones that better respond to pruning. Pruning is a recommended practice for roots meant for shelf-life extension treatments (waxing and RH storage).
2.1	Current RTB value chains and food access situation assessed and priorities for improvement and enhanced gender equity identified with key VC actors/ stakeholders	Priorities for improvement shared and agreed with stakeholders in 4 VCs	100%	All subprojects conducted *market and value chain studies* in order to (1) map the VC of which pilot farmers and traders are part of; (2) assess margins along the chain; (3) validate priorities for improving postharvest management; (4) further refine the estimation of the demand for the proposed innovations and end products; and (5) deepen the analyses of PHL. Even though each study was unique and responding to the specific needs and priority of each team, guidelines were produced to harmonise as much as possible the research design and outputs. The main findings of the studies were shared with partners, collaborators, and relevant stakeholders to validate and refine the priorities of the interventions. **Banana:** The main findings of the study (Annex B3) are: The most market demanded varieties are not widely grown in the project sites: Kibuzi is grown by 25% male and 20% female farmers in Isingiro district, while in Rakai district it is grown by 15% male and 13% female farmers. Mbwazirume was found to be grown only in Rakai by 8% male and 4% female farmers, while Nakitembe is grown by only 2% male farmers in Isingiro and 3% male farmers in Rakai. Only 2% of both male and female farmers grow Musakala in Isingiro and Rakai. At retail level 47% of banana is sold in bunches, 17% in bags of unpeeled bananas, 11% in clusters, 15% as heaps of unpeeled banana and 10% as peeled bananas. About 32% of the retailers reported that there is an increased demand for peeled bananas. Approximately 90% of the consumers are willing to purchase good quality and sorted bananas at a

No.	Output	Target	Achieved	Description
				premium if availed on the market. About 55% of consumers are not satisfied with the quality of bunches sold in the market and 58% are not satisfied with the quality of peeled bananas sold in some open markets. About 98% of the producers, 40% retailers, 75% supermarkets and 50% consumers are willing to embrace the weight-based pricing system. Postharvest losses were estimated at each node of the value chain. Overall, the proportion of marketed banana affected by physical losses was estimated at 21% (corresponding to 9% of harvested bananas). Economic losses (leading to important price discounts) affect 10% of marketed banana (4% of harvested bananas). Therefore 13% of harvested bananas (corresponding to over one million tonnes a year) incur either physical or economic losses. **Sweetpotato:** Several studies have been conducted. Current pig feeding practices were studied and the findings revealed that most farmers practise opportunistic feeding, which results in poor growth rates. Sweetpotato vines is the main fodder during the wet season, particularly in Kamuli, while during the dry season farmers face feed scarcity and have to resort to expensive - and often low quality - purchased feed and home-made mixes. Due to lack of affordable feed many farmers have to sell off their young piglets (Annex S3). The study validated the results of research as part of the scoping study that indicated that in Masaka, the proportion of SP crop residues utilised at household level, mostly for pig feeding, was 40%, while in Kamuli was 52%. This study indicated a potential for better use of SP and other RTB crop residues as pig feed in the smallholder pig farming systems in Uganda, but the major constraint is the poor access to technologies for preserving these resources, such as silage. This findings were presented in a paper published in a peer-reviewed journal (Annex S9). Since the viability of the silage technology is dependent on availability of SP residues a baseline survey estimated root and vine wastage at the various nodes of the SP value chain. It revealed that farmers waste 600kg of vines per acre per season, though this was higher form farmers without pigs (710kg) compared to pig farmers (540kg). The total wasted vines and roots has the potential of generating 67,838 tonnes of silage per year which translates into an overall revenue of 27,135 billion Ugandan shillings if sold at 400 UGX per kg as is being done by a few entrepreneurs who had already started selling silage. A paper has been produced and submitted for publication. A willingness-to-pay study showed that pig farmers are willing to pay an average of 668 UGX per kg of supplemented SP silage (40% maize bran inclusion) which is higher than the breakeven price of UGX 545 per kg. One MSc student was enrolled for conducting research in this area. **Potato:** A market study showed that various actors store ware potato under poor conditions and for short time. About half of farmers store up to one third of harvested potatoes for no more than four weeks; traders store for up to six days and processors for just four days on average. About 96% of farmers incur PHL but processors and traders who store potatoes incur higher losses (85%) as compared to farmers (78%) mainly due to poor postharvest management practices. Postharvest losses were

No.	Output	Target	Achieved	Description
				estimated at each node of the value chain. Overall, the proportion of marketed potatoes affected by physical losses was estimated at 30% (corresponding to 28% of harvested tubers). Economic losses affect 8% of marketed potatoes (7% of harvested tubers). Therefore 36% of harvested potatoes (corresponding to about 60,000 tonnes a year) incur either physical or economic losses. One MSc student supported this research component (3.2). Since mechanical damages during harvesting and pre-mature harvesting where identified among the major cause of PHL, two additional studies were conducted. The first to evaluate the efficiency of different harvesting methods (see 1.5). The second to understand the reasons for and implications of harvesting the tubers prematurely. Premature harvesting was found to significantly reduce ($P \leq 0.05$) the yield and, despite the higher price fetched, the gross income of farmers. Premature harvesting also compromises the quality of potato and prevents the possibility to store the tubers and obtain better return at a later stage. These findings were presented at a congress of the African Potato Association (APA). An additional research also found that potato marketing along the entire value chain was greatly influenced by periodic supplies and demand from neighbouring countries, primarily Kenya and South Sudan. **Cassava:** A market and value chain study revealed that all respondents purchase cassava in fresh form while 75% purchase it in dried form (chips and flour) as well. On average, about 50% and 30% of cassava produced by farmers in target areas is sold or consumed in fresh form, respectively. The preferred form to consume cassava is as fried chips, followed by boiled and steamed. An average of 16 tonnes of fresh cassava is supplied by each wholesaler to major markets in Kampala weekly, while each retailer procures and sells about 1,200 kg of fresh cassava roots weekly. Annual market demand of fresh root was estimated to be about 300,000 tonnes, and projected to increase by 25% in 2018. The preferred quality attributes included sweet taste as well as soft and mealy texture. Unlike other actors in the fresh cassava value chain, retailers, the vast majority of whom are women, incur high level of losses due to the rapid postharvest physiological deterioration of the roots. In fact, they are the value chain actors that keep the cassava for longer having to sit the whole day in open markets or at their roadside kiosks awaiting for buyers. While the amount of roots that have to be thrown away (physical losses) is rather limited, almost half of the roots are sold at discounted price due to PPD, particularly when the demand is low. The annual overall financial loss due to PPD in Uganda was estimated at over USD 30 million (Annex C3). One MSc student has assessed the willingness-to-pay for roots with extended shelf-life (see 3.2). **Crosscutting:** A comparative analysis of PHL along fresh cassava, banana, and potato value chains in Uganda showed that relative losses (% of harvest crop) are particularly high in potatoes but the banana value chain is the most affected in absolute terms (volume of losses). The findings were presented at an international conference and can contribute to policy prioritisation as they show that a diverse set of interventions is required to tackle PHL.

No.	Output	Target	Achieved	Description
2.2	New market opportunities to expand use of RTB assessed and prioritised with stakeholder participation	1 new market opportunity identified per RTB crop	100%	During the preparatory phase (year 1) the different teams identified and analysed new market opportunities and the most promising innovations that culminated into the 4 subprojects were implemented.
2.3	RTB producer/ processor groups strengthened for equitable participation and innovation in VCs	At least 20 producers, traders, and processors strengthened per crop	100%	The project provided training and technical assistance to build the capacities of VC actors in a number of domains (e.g. technological aspects—both pre- and postharvest—, entrepreneurship, agribusiness, collective actions, etc.). In some cases specific assessment of training needs have been carried out with project beneficiaries (e.g. potato subproject). The main capacity building events that have been held under each subprojects are reported below. A summary of farmers' direct involvement in training as well as other project activities can be found in Appendix 6. **Banana:** In 2015: • 10 farmers hosting the banana mother gardens trained in multiplication techniques with a focus on how to maintain the integrity of the planting material. • 266 farmers (154 M, 112 F) trained in sucker staggering as well as record keeping to enable tracking the uptake of the technology. • 104 farmers (56 M, 48 F) and one trader trained in collective marketing, food safety, quality requirements and traceability for export in Rakai district; 118 farmers (92 M, 26 F) were also trained in Isingiro district. • Selected pilot farmers trained by KAIKA and NARO on introduction of the weight-based pricing system. In 2016: • 56 farmers (38 M, 18 F) trained in banana agronomic practices. • 26 farmers (15 M, 11 F) trained in banana planting materials multiplication techniques. • 250 farmers (70 M, 180 F) trained in establishment and management of macro-propagation chambers and hardening shade. • 110 farmers (71 M, 39 F) trained in business planning. • 96 farmers (29 F and 67M) trained by UFVEPA in a second phase of quality management, food safety and record keeping. The training covered also marketing aspects and a marketing protocol was purposively developed, translated in local languages and distributed (see Annex B8 for the English version) Furthermore, the project has supported the development of four gender-responsive business plans (two for seed multiplication and two for differentiated banana products).

No.	Output	Target	Achieved	Description
				Sweetpotato: In 2015: • After completing the ToT in biosecurity measures, data collection, and calibration of feeding equipment provided by ILRI (see 3.2), the implementing partners operating in the project's districts imparted the acquired knowledge to 69 farmers (27 M, 42 Fs), including the 16 pilot and 8 control farmers. • 152 farmers in Masaka district (67 M, 85 F) and 125 farmers in Kamuli district (58 M, 67 F) were trained on SP silage-making by some of the partners that have attended the ToT training on silage (see 3.2). The first version of the SP silage-making manual (Annex S10) and the brochure on improved tube silage-making method developed by the project (Annex S15) were used during the training (Annex S18 and Annex S19). In 2016: • A second training on silage-making and use was organised at the end of the year to provide 109 farmers (38 M, 61 F) in Masaka and 140 in Kamuli (64 M, 76 F) updated recommendations based on the results of the different experiments and trials (Annex S20). Training material included an improved version of the silage-making manual (Annex S11), a brochure (Annex S16), and guidelines on how to feed silage to pigs (Annex S14). • 54 farmers (39 M, 15 F) in Masaka and 59 in Kamuli (41 M, 18 F) were trained by a Pig Production and Marketing Ltd. in pig and pig meat marketing in order to strengthen their capacities to supply the processing firm and meet its quality requirements (Annex S22). A training manual was produced and distributed to participants (Annex S12). • 16 potential silage entrepreneurs were selected and trained in business enterprise, marketing, market intelligence, financial management, and record keeping (Annex S21); using a training curriculum which was developed taking into account the results of a capacity needs assessment (Annex S8). The project has also supported the development of 14 gender-responsive business plans: 11 for silage business entrepreneurs (either individuals or groups) and 3 for expanding the operations of the silage business centres established by the project. **Potato:** In 2015: • A business capacity need assessment of the four associations hosting the collective ambient stores was conducted (Annex P8). The identified gaps have been communicated to the members who validated the findings and prioritised the skillset areas for action. Based on this, a curriculum for management and business skills training was developed and validated by each of the four associations (Annex P9). Afterwards, a training manual was purposively developed (Annex P11) and a series of trainings held (Annex P15). • 119 members (65 M, 54 F) of the farmers and traders associations hosting the collective stores trained on farmers associations' organisational structure and governance as a foundation for business engagement. As a result, new functional committees (e.g., Finance Committee,

No.	Output	Target	Achieved	Description
				Production and Quality Control Committee; Marketing Committee and Store Management Committee) have been established in each association and committees' members elected. • 106 members (54 M, 52 F) trained in enterprise analysis and business planning and 103 members (53 M, 50 F) in record keeping and store management. In 2016: • 41 farmer representatives (26 M, 15 F) from the three associations hosting the stores were trained in pre-harvest practices while 57 farmers (25 M, 32 F) and 15 traders (11 M, 4 F) were trained in postharvest management practices (Annex P14). A manual and a leaflet were purposively developed and distributed to participants (Annex P10 and Annex P13). • The business training continued with 101 members (58 M, 43 F) trained in marketing, 110 (57 M, 53 F) in savings and resource mobilisation and 104 (55 M, 49 F) in basic financial literacy. Furthermore, the project supported the farmers' associations hosting the collective stores to develop store management plans defining how the association will manage the stores and avoid members' free-riding behaviours, including: i) how association-owned and member-owned potatoes are stored; ii) how preference is given to storage space; iii) whether a fixed fee or a percentage of the sale's revenue is charged by the association for storage space; iv) storage rules, e.g., frequency/quantity of potatoes entering and exiting the store; etc. An example is given in Annex P12. Finally, business plans were developed for each of the four associations hosting the collective stores. **Cassava:** In 2015: • The cassava team carried out trainings for 33 farmers (16 M, 17 F) for building the capacities of farmers and extension staff (2) around the area where the pilot pack-houses had to be set up. During the training received in Colombia (see 3.2), the research team appreciated that a number of agronomic practices affect PPD and can also contribute to increasing cassava yield and the proportion of roots suitable for the shelf-life extension technologies. Therefore, practical training focused on pruning as well as ridging, planting techniques and improved harvesting methods that can minimise mechanical damages responsible for accelerating the PPD. About one acre of cassava was allocated by the selected farmers' organisation for piloting the new pre-harvest and harvesting practices. In 2016: • 39 farmers (18 M, 21 F) trained in disease management, planting and pruning; while 52 (21 M, 31 F) attended the training on harvesting, sorting, grading, waxing, relative humidity storage and packaging (Annex C11). • 5 different sessions of training in entrepreneurial and business skills were delivered in the two project sites. In addition to extension agents, traders and government officials, they were attended by 33 (16 M, 17 F), 52 (21 M, 31 F), 50 (20 M, 30 F), 66 (29 M, 37 F) and 60 farmers (25 M, 35 F), respectively (Annex C10). Furthermore, the project supported the development of business plans for each of the two pack-houses established with project support.

No.	Output	Target	Achieved	Description
2.4	Sustainable multistakeholder platforms for further RTB value chain innovation created with participation by public/private, sector, NGOs, and CBOs	4 platforms created and operational (one per crop)	70%	Simple exploratory investigation were conducted by all subprojects to map the current relevant multistakeholder platforms in Uganda and the on-going interventions in a bid of supporting their establishment and development. Banana and cassava are among the 10 prioritised crops under the current Uganda's Agricultural Sector Development Strategy & Investment Plan. For these crops, the plan emphasises the importance of forming multistakeholder platforms as a way to foster the sector's growth and development. In some cases, project's partners were already members of existing platforms. It has been noted that most of these platforms are not functioning well and are mostly project-based, raising concerns about their long-term sustainability. Therefore, in most cases, it has deemed appropriate to work towards their strengthening rather than establishing new platforms from scratch which, due to the short duration of the project, were likely to collapse at the end of the intervention. The project supported representatives of implementing partners to join and actively engage in local, regional and national platforms. **Banana:** At the project onset one national banana platform and a regional platform for the western region were under establishment. The project linked up with the regional platform and presented the projects' interventions during stakeholders meetings with platform's key-persons. The members were then involved in trainings and various other activities. In 2016 the platform was eventually formalised and registered as a cooperative union. Activities to enhance the coordination of the value chain were initiated, especially by amplifying farmers' voice. Next activities include finalisation and operationalisation of the business plan and branding strategy. The Western Region Banana Innovation platform was established on a self-sustaining basis and it is owned and managed by banana stakeholders: members pay an initial membership fee and an annual subscription fee. District, sub-county and village platforms are expected to be formed and linked to the regional one. The project has supported the formation of one sub-county banana platform (Banana Cooperative Union) in Isingiro, where project activities were conducted. It is currently being formalised and one member of the subproject team was elected as interim executive leader. Members of the team are also contributing to the establishment of the national platform. **Sweetpotato:** There are a number of operational pig platforms: one national and four regional (central, eastern, western and northern regional pig platforms). There is a national Steering Committee at national level that supervises the regional platforms (that are autonomous) and organises periodic meetings with their representatives. No formally established SP platforms were identified apart from the SP seed systems community of practice. The SP team opted to use some of the existing pig platforms (national, central region and eastern region platforms) to further its work on SP silage for pig-feeding since feeding is recognised as one of the priority areas addressed by these platforms. Representatives of the SP team participated in two meetings of the regional platforms. In the first one SP silage was extensively discussed; in the second one the platform members participated actively in developing the criteria and selecting entrepreneurs potentially interested in silage business. Until December 2015 the national and regional platforms had been facilitated by SNV with

No.	Output	Target	Achieved	Description
				financial support from ILRI. However, when ILRI funding came to an end, the project stepped in and provided support to the infant platforms, though not at the same level provided by ILRI, in order to allow them to survive. In 2016, the project facilitated the meetings of the central region and eastern region platforms and, as a sustainability strategy, 202 executive members of the national and regional platforms' committees were trained in good governance with support from CIP and ILRI. **Potato:** The International Fertilizer Development Center (IFDC) has established a national Steering Committee for potato in Uganda focusing on seed distribution and new varieties for processing. CIP representatives regularly participate in the meetings. Apart from that, no other potato platforms were identified. Therefore, it was decided to establish an eastern region potato multistakeholder platform from scratch, building on the structure of the national Steering Committee and lessons from the Kenyan national potato platform. Potential members were introduced to the idea of establishing a potato platform during a meeting in December 2014 and general expectations were discussed. A follow up meeting was then held in October 2015 with key participants from IFDC, district agricultural officers, CIP-Uganda/Nairobi, NARO-KaZARDI and NARO-BugiZARDI. Members discussed the geographical scope, stakeholder involvement and an action plan was drafted. Participants agreed that the platform should be initially facilitated by NARO-BugiZARDI and have a focus on developing innovative approaches for tackling challenges in the potato value chain, particularly on postharvest management and marketing. The Eastern Regional Potato Multistakeholder Innovation Platform was officially formed in early 2016 and three meetings were held throughout the year, with financial support of the project. A nine-member Executive Committee was selected and work plans were refined. BugiZARDI is expected to keep on facilitating the regional platform and identify alternative sources of funding (including a fee-based membership) for ensuring its sustainability. In the short run limited level of funding may be provided by the Government of Uganda through NARO as part of the ATAAS project. **Cassava:** Following the DSIP recommendations, a national cassava multistakeholder platform was established with a private sector-led approach. The Chair is from the private sector while the Secretariat is hosted at Ministry of Agriculture, Animal Industry and Fisheries. Some representatives of the project's implementing partners (e.g. NaCRRI) are among its members. Furthermore, local platforms were formed in the main cassava producing districts and regions, mostly facilitated by the National Agricultural Advisory Services Programme. In the cassava subproject's implementation area, district level platforms exist in both target districts (Kabarole and Kyenjonjo). In addition, a regional platform has been set up for the Rwenzori region. The initial exploratory investigation found that local platforms had lost momentum and were weak (for example, they do not meet regularly, are not inclusive of all actors in the value chain, and members' roles and responsibilities are not clearly defined) as confirmed by project's collaborators that had already joined these platforms (e.g., District Agricultural Officers and private sector players). Therefore, the project team focused on revamping and strengthening the local platforms by providing limited support, mainly for facilitation of meetings. A number of meetings were held with the key actors, local district staff in both districts,

No.	Output	Target	Achieved	Description
				and the private sector in a bid to broaden the memberships and building more sustainable, inclusive and effective private sector-led platforms in both districts.
3.1	Project's website containing documented methods, technologies, and knowledge products suited to target audiences (researchers, extension services, communities, NGOs, etc.)	• 1 functional project's website • Series of project publications (e.g. scientific articles, manuals, guidelines, MSc theses, technical reports and protocols) available online	100%	A functional project website has been developed and is currently up and running (http://www.rtb.cgiar.org/endure/). Project documents, reports and publications are available on line and the website's content was regularly updated as the project progressed. The most recent project reports and publications are being migrated to CGSpace (https://cgspace.cgiar.org/handle/10568/82596) to ease management of and access to the repository. Photos can be found in specific Flickr albums that can be accessed by following the link: https://www.flickr.com/photos/106872707@N03/albums/with/72157677770602186.
3.2	Capacity built in key national partners for reducing PHL and increasing use of RTB	• At least 3 training events held per RTB crop • Researchers from NARO involved in the design and implementation of the research for all crops • At least 5 MSc students supported and supervised	100%	**Main training and capacity building events:** • A 4-day training on PMCA approach and tools was held in June 2014 and attended by 19 participants (15 men and 4 women) in order to build the capacities of the four commodity teams in market research and gender mainstreaming required for the preparation of the final business cases (Annex CC3). • A 3-day Meeting-cum-Training event has been held in December 2014. The training sessions strengthened the capacities of the 60 participants (42 male and 18 female from all 4 research teams) to adopt PMCA and mainstream gender in research activities. The event has also improved networking and learning across the teams. During the event an initial assessment of the capacities of the national partners in a number of key areas was undertaken (Annex CC4). • The banana team organised a 5-day inception and PMCA training workshop in February 2015 (18 participants: 14 men and 4 women). Three days were fully devoted to strengthening participants' capacity to adopt the PMCA approach and use Phase 2 tools during their research activities (Annex B10). • In the SP subproject, project partners have been trained in using relevant PMCA tools during the two-day 1st Technical meeting held in February 2015. Furthermore, in July 2015, key implementing partners (NARO-Mukono Zonal Agricultural Research Institute, VEDCO, and CHAIN Uganda) attended a 2-day ToT in biosecurity measures to prevent outbreak of ASF, data collection and calibration of feeding equipment organised by ILRI. These partners, as well as other selected participants, such as extension staff and National Livestock Resources Research Institute (NaLiRRI) staff, also benefitted from a 2-day ToT training held a MUARIK in August 2015. The training aimed at strengthening the technical capacities of 31 participants (6 female) expected to continue training farmers in silage making after the closure of the project (Annex S17). The 1st SP silage-making manual developed by the project was used during the training (see 3.3). A second training was held in November 2016 with the attendance of 38 ToT (12 female) in order to provide updated

No.	Output	Target	Achieved	Description
				recommendation on silage-making and use based on the research findings (Annex S20). • In July 2015, six members of the cassava subproject (2 NARL-Kawanda, 1 NARO-NaCRRI, 2 IITA and 1 IIRR) travelled to Colombia to participate in a nine-day training organised by CIAT to strengthen their capacities in PPD assessment and shelf-life extension technologies. Despite the cost, the training was deemed necessary since these technologies were completely new in Uganda and the researchers had to gain knowledge and hands-on experience on how to adopt and adapt them to the Ugandan context (Annex C9). Colombia was selected not only because of the presence of CIAT but also because these technologies are already in use under commercial setting. The capacities of the cassava team were strengthened in the following areas: 1) varietal selection for waxing and RH storage; 2) PPD evaluation; 3) methods for root waxing and RH storage; 4) pre- and postharvest factors that promote the effectiveness of shelf-life extension technologies; and 5) options for developing marketing channels and business models. • In December 2015, the gender team organised a four-day training for the banana and potato teams to: 1) strengthen gender awareness among partners and beneficiaries (lead farmers and traders); 2) impart skills and tools for identifying, analysing and devising strategies for mitigating gender-based constraints in exploiting selected market opportunities; 3) build capacities in gender-responsive business planning; and 4) review and customise the crop-specific gender strategies that had been drafted by the gender team. A similar training was organised for the sweetpotato and cassava teams in May 2016. Additional details are provided in Section V. The workshop reports can be found in Annex CC5 and Annex CC6. • In line with the PMCA approach the innovations were officially presented in final events with the participation of interested stakeholders, including market chain actors, R&D organisations, local authorities and development practitioners. Each subproject organised a specific two-day event and key representatives of the other project-teams attended as well. On the first day (science day), the relevant research team presented the key findings of their research and discussed their initiatives to development the value chain (in some cases other R&D organisations where given the opportunity to present their ongoing and past work in the RTB postharvest research arena). On the second day, field visits were held to officially launch and showcase the innovations to the participants in colourful events to which other relevant organisations and private sector players were invited to present products and services in dedicated booths. Most events were attended by well over 100 participants. • Finally, the project culminated with a well-attended end of project workshop (101 participants) which was held back to back with a public exhibition at the Entebbe Botanical Gardens to showcase the innovations and technologies generated during the project implementation. A poster session was also held and the four best posters (one from each subproject) were awarded (Annex CC7). **NARO involvement:** Researchers from NARO have been involved in the research design and implementation of all subprojects. In particular, staff of the following NARO institutes have conducted research under this

<table>
<tr><th>No.</th><th>Output</th><th>Target</th><th>Achieved</th><th>Description</th></tr>
<tr><td></td><td></td><td></td><td></td><td>
project: National Agricultural research Laboratories-NARL (banana and cassava subprojects), Mukono Zonal Agricultural Research Institute-MuZARDI (SP), National Livestock Resources Research Institute-NaLiRRI (SP), BugiZARDI (potato), NaCRRI (cassava).
A NARO socio-economist, member of the banana team, was supported to present at the RUFORUM Conference held on October 2016 in Johannesburg, South Africa. A NARO food scientist was supported to present at 1st World Congress of Root and Tuber Crops (WCRTC) held on January 2016 in China.
<u>Postgraduate students:</u>
• Ten postgraduate students (MSc level) have been identified and granted fellowships for undertaking studies to complement project research activities. Together with the students' supervisors, project partners have provided the students with guidance and support for developing full research proposals for award of degrees and coached them to conduct their research. One student has graduated, two dropped off due to personal reasons while the remaining have submitted their thesis and are expected to defend it by end 2017-early 2018.
• Three MSc students (two working with the SP team and one with the potato team) presented their research findings at the congress of the African Potato Association (APA) held in Addis Ababa, Ethiopia.
The details of the students and the research topics are reported below:
<table>
<tr><th>Subproject</th><th>Student</th><th>University</th><th>Course</th><th>Topic</th><th>Status</th></tr>
<tr><td>SP</td><td>Marsy Asindu (M)</td><td>Makerere</td><td>MSc Agribusiness and Natural Resources Economics</td><td>Demand and acceptability of SP silage as pig feed by smallholder pig farmers in Uganda</td><td>Pending defence</td></tr>
<tr><td>SP</td><td>James F. Ojakol (M)</td><td>Makerere</td><td>MSc Animal science</td><td>SP silage as a basal diet for growing pigs</td><td>Pending defence</td></tr>
<tr><td>SP</td><td>Elizabeth Akiror (F)</td><td>Uganda Martyrs University</td><td>MSC Agroecology</td><td>Evaluation of SP varieties for suitability as dual purpose varieties and their cutting management</td><td>Pending defence</td></tr>
<tr><td>Potato</td><td>Caroline Nabukera (F)</td><td>Makerere</td><td>MSc Agricultural and Applied Economics</td><td>Ware potato PHL, storage, and market performance in eastern Uganda</td><td>Pending defence</td></tr>
<tr><td>Potato</td><td>John T. Senkumba (M)</td><td>Makerere</td><td>MSc Food Science and Technology</td><td>Evaluation of different potato varieties under differing postharvest storage conditions</td><td>Pending defence</td></tr>
</table>
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No.	Output	Target	Achieved	Description					
				Potato	Winnie L. Kwaka (F)	Makerere	MSc Crop Science	Potato variety evaluations for suitability in Eastern Uganda	Pending defence
				Banana	Juliet Masawi (F)	Makerere	MSc Food Science and Technology	Optimum harvest maturity of cooking bananas	Dropped off
				Cassava	Sharon Acheng (F)	Makerere	MSc Biochemistry	Improving cassava shelf-life and reducing its postharvest deterioration through the waxing technology	Dropped off
				Cassava	Elizabeth Nyakaisiki (F)	Kyambogo	MSc Food Science and Technology	Effectiveness of relative humidity storage as a method of extending the shelf-life of fresh cassava roots	Degree awarded
				Cassava	Innocent Kwagala (M)	Makerere/ Pretoria	MSc Agricultural and Applied Economics	Farmer and trader acceptance and willingness to pay for shelf-life extended fresh cassava	Pending defence

No.	Output	Target	Achieved	Description
3.3	Outputs of research disseminated throughout agricultural knowledge and information systems	• Communications plan developed to guide project and identify target audiences, needs, and appropriate communication channels for delivery of strategic messages • At least 2 articles published and available in print and online • At least 3–5 presentations and posters given at fora and symposia • At least 5 project publications (e.g., manuals, guidelines, MSc theses, technical reports and protocols) produced and disseminated for each crop	95%	**Communication and Visibility Plan:** The project's communications and visibility plan was initially drafted by the CIP-SSA communication specialist. During a 2-day workshop in March 2015, the communications and visibility plan was discussed, reviewed, and finalised by the implementing partners, facilitated by the communication specialist. The final version of the plan is presented in Annex CC8. Based on this, each subproject team has then developed and implemented its own communication and visibility sub-plan. **Knowledge products:** • 1 article published in peer-reviewed journal and available online • 4 articles submitted to peer-reviewed journals • 18 presentations and posters given at fora and symposia • 41 project publications: - 22 technical reports - 8 manuals - 1 protocol - 2 brochures - 8 leaflets Details and linkages to relevant annexes are provided in Appendix7. Additional project publications and articles are being finalised and submitted.

APPENDIX 6. FARMERS PARTICIPATING IN PROJECT ACTIVITIES

Activity	Women	Men	Total
Training activities			
Banana: Training sucker staggering	112	154	266
Banana: Training quality, food safety marketing	74	148	222
Banana: Training agronomic practices	16	38	54
Banana: Training plantlets multiplication	11	15	26
Banana: Training macro-propagation	180	70	250
Banana: Training business planning	39	71	110
Banana: Training collective marketing	67	29	96
Sweetpotato: Training biosecurity and disease management	42	27	69
Sweetpotato: Training silage making (initial)	152	125	277
Sweetpotato: Training silage making (final, w. validated technology)	137	102	239
Sweetpotato: Training pig and pig meat marketing	33	80	113
Sweetpotato: Training business skills for selected entrepreneurs	4	12	16
Potato: Training pre-harvest techniques	15	26	41
Potato: Training postharvest management	32	25	57
Potato: Training leadership and governance	54	65	119
Potato: Training enterprise analysis and business planning	52	54	106
Potato: Training record keeping and store management	50	53	103
Potato: Training marketing	43	58	101
Potato: Training saving and resource mobilization	53	57	110
Potato: Training basic financial literacy	49	55	104
Cassava: Training agronomic practices for shelf-life extension	21	18	39
Cassava: Training waxing and RH storage	31	21	52
Cassava: Training entrepreneurial skills 1 (Kyenjojo)	17	16	33
Cassava: Training entrepreneurial skills 2 (Kyenjojo)	31	21	52
Cassava: Training entrepreneurial skills 3 (Kabarole)	30	20	50
Cassava: Training entrepreneurial skills 4 (Kabarole)	37	29	66
Cassava: Training entrepreneurial skills 5 (Kabarole)	35	25	60
Sub-total	**1,417**	**1,414**	**2,831**
Other activities:			
Pilot/host farmers (technology trials)	20	16	36
Cassava waxing pack house (farmer led model)	34	11	45
Farmer entrepreneurs with business plans (sole entrepreneurs)	2	5	7
Farmer entrepreneurs with business plans in groups/associations	150	137	287
Science days	42	43	85
End of project workshop & exhibition	6	4	10
Sub-total	**254**	**216**	**470**
Total	**1,671**	**1,630**	**3,301**

Note: Some farmers may have attended more than one training session and been also involved in some other activities. Therefore, the sums are likely to be inflated and should be consider with caution.

APPENDIX 7. LIST OF INTERNATIONAL PUBLIC GOODS

Articles:

Dione M.M., Pezo D., Kyalo G., Mayega L., Nadiope G. & Lukuyu B. (2015). Perception and practices of farmers on the utilisation of sweetpotato, and other root tubers, and banana for pig feeding in smallholder crop-livestock systems in Uganda. *Livestock Research for Rural Development,* Vol. 27, Article 226. It can be found at http://www.lrrd.org/lrrd27/11/dion27226.html. Annex S9.

Kikulwe et al. Assessing the extent and determinants of postharvest losses along the cooking banana value chain in Uganda. Submitted to *International Journal of Agricultural Sustainability*.

Nalunga et al. Perceptions towards weight-based pricing system for cooking banana. Submitted to *Appetite*.

Ajambo et al. Gender roles and constraints in the green cooking banana value chain: Evidence from south western Uganda. Submitted to *Enterprise Development and Microfinance*.

Asindu et al. Sweet potato wastes in major pig producing districts in Uganda: An opportunity for investment in silage technologies Submitted to *Journal of Agribusiness in Developing and Emerging Economies*.

Presentations at fora and symposia:

A presentation entitled "The use of sweetpotato residues as feed in rural and peri-urban smallholder pig systems in Uganda" has been given by D. Pezo at a Conference of the CoP on Sweetpotato Marketing, Processing and Utilisation (Nairobi, May 2015).

A leaflet outlining the objectives and progress of the sweetpotato silage research has been produced and distributed to the participants to 6th Annual Technical and Steering Committee Meeting of the Sweetpotato for Profit and Health Initiative (SPHI) held in Kigali in September 2015. Annex S13.

In December 2015, S. Mayanja has given a presentation entitled 'Experiences of using the WEAI tool in Uganda' at a seminar organised by IFPRI/CIAT Uganda.

The following presentations have been given at 1st World Congress of Root and Tuber Crops – WCRTC (Nanning, 18-22 January 2016) http://www.gcp21.org/wcrtc/:

- Muyinza et al.: Effectiveness of cassava stem pruning for inducing delay in postharvest physiological deterioration (PPD) of fresh roots – Oral presentation.
- Wanda et al.: The impact of PPD in the fresh cassava roots value chain and current mitigation measures in Uganda. Perspectives and actions of value chain actors – Oral presentation.
- Wanda et al.: Extending the shelf-life of fresh cassava roots for increased incomes and postharvest loss reduction in Uganda: Current business case – Poster session.
- Nyamutoka et al.: Postharvest physiological deterioration effects and gender dynamics in the retail marketing of fresh cassava roots; a case study in Uganda – Poster session.
- Mayanja et al.: Understanding gender dynamics and their contribution to designing 'winning' sweetpotato postharvest interventions – Poster session.

The following presentations have been given at the 10th Triennial Conference of the African Potato Association – APA (Addis Ababa, 9-13 October 2016):

- Nabukeera et al.: postharvest management practices and market performance along ware potato value chains in eastern Uganda - Oral presentation.

- Akiror et al.: effect of vine harvesting on root and vine yield of different sweetpotato varieties in Uganda – Oral presentation.
- Asindu et al.: silage-based diets: a potential investment opportunity to address challenges in the sweetpotato and pig value chains in Uganda – Oral presentation.
- Namanda et al.: potato farmer and market's strategies to cope with seasonalities and implications for postharvest losses in eastern Uganda – Poster session.
- Mayanja et al.: Understanding gender dynamics and their contribution to designing 'winning' sweetpotato postharvest interventions - Poster session.
- A poster entitled **"**Effect of feeding supplemented sweetpotato silage on pig performance in smallholder production systems in Uganda" has been presented by P. Lule at the World Congress on Innovations for Livestock Development - WCILD (Nakuru, 26-30 June 2016).
- A poster entitled "Stay visual inspection or go weighing? Insights from a value chain analysis for cooking banana in Uganda" has been presented by A. Nalunga at the 5th Biennial RUFORUM Conference (Cape Town, 17-21 October 2016).
- A presentation entitled "The extent and determinants of postharvest losses: Evidence from the cooking banana value chain in Uganda" has been given by E. Kikulwe at the AC&SD Conference organised by CIRAC (Montpellier, 12-14 December, 2016).
- A presentation entitled **"**Effectiveness of cassava leaf pruning for inducing delay in postharvest physiological deterioration of fresh cassava roots" has been given by H. Muyinza at the Annual NARO Conference (Kampala, 22 December, 2016).
- A presentation entitled **"**Postharvest losses along the cooking banana, potato and cassava fresh value chains in Uganda**"** has been given by E. Kikulwe on behalf of D. Naziri at the 1st All Africa Postharvest Congress and Exhibition (Nairobi, 28-31 March, 2017).

Technical reports:

- Structure of the cooking banana value chain in Uganda and opportunities for value addition and postharvest losses reduction. Annex B3.
- Optimization of the harvest stage for reducing cooking banana postharvest losses: a multi-criteria approach targeting matooke end-product. Annex B4.
- Gender situational analysis of cooking banana value chain and strategies for gender equity in postharvest innovations. Annex B5.
- Storage temperatures for shelf-life extension of different banana presentation forms. Annex B6.
- Technical report: Cost-benefit analysis of cooking banana seed multiplication methods. Annex B7.
- An evaluation of current pig feeding practices on smallholder farms in Masaka and Kamuli districts of Uganda. Annex S3.
- Gender situational analysis of sweetpotato and pig value chains and strategies for gender equity in postharvest innovations. Annex S4.
- Characteristics of silage based on sweetpotato with combinations of local feed resources in Uganda. Annex S5.
- Effect of sweetpotato based diet on performance of growing pigs in Uganda. Annex S6.
- Economic analysis of sweetpotato silage-based diets for smallholder pig farmers in Uganda. Annex S7.
- Capacity needs assessment of potential sweetpotato silage producers, traders and service providers. Annex S8.
- Gender situational analysis of ware potato value chain in eastern Uganda and strategies for gender equity in postharvest innovations. Annex P3.
- Effect of storage conditions on the processing quality of different potato varieties grown in eastern Uganda. Annex P4.

- Economic viability of ware potato storage in ambient stores in eastern Uganda. Annex P5.
- Evaluation of potato (Solanum tuberosum, L.) genotypes for adaptability in Mt. Elgon region of Uganda. Annex P6.
- Improved potato harvesting techniques. Annex P7.
- Potato associations capacity needs assessment and action planning. Annex P8.
- Potato associations training curriculum. Annex P9.
- Market opportunities and value chain analysis of fresh cassava roots in Uganda. Annex C3.
- Gender situational analysis of fresh cassava value chain and strategies for gender equity in postharvest innovations. Annex C4.
- Postharvest Physiological Deterioration (PPD) tolerance of selected Ugandan cassava varieties. Annex C5.
- Efficacy of pruning, waxing and relative humidity storage in extending shelf-life of fresh cassava roots. Annex C6.

Manuals:

- Sweetpotato silage making manual 1.0 – 2 languages. Annex S10.
- Sweetpotato silage making manual 2.0 – 2 languages. Annex S11.
- Training guide on pig marketing. Annex S12.
- Guidelines for ware potato harvesting and storage. Annex P10.
- Training guide for business skills for potato associations. Annex P11.
- Potato store management plans – 3 languages. Annex P12.
- Setting up a pack-house for waxing and relative humidity storage of fresh cassava roots. Annex C7.
- Fresh cassava roots handling for waxing and relative humidity storage. Annex C8.

Protocols:

- Cooking banana marketing protocol – 3 languages. Annex B8.

Brochures:

- Improved tube silage making method (in Luganda). Annex S15.
- How to make sweetpotato silage. Annex S16.

Leaflets:

- Project flyer. Annex CC1.
- Banana flyer. Annex B2
- Sweetpotato. Annex S2
- Potato flyer. Annex P2
- Cassava flyer. Annex C2
- Leaflet of the banana market demanded varieties – 3 languages. Annex B9.
- Guidelines for feeding sweetpotato silage to pigs. Annex S14.
- Guide to store ware potato. Annex P13.

APPENDIX 8: SUMMARY OF MEDIA COVERAGE

	Media outlet	What	When	Link
1	Scidev.net	Meeting cum training	Jan 15	http://www.scidev.net/sub-saharan-africa/agriculture/news/adding-value-to-rtbs.html
1b	Scidev.net (Facebook)	Meeting cum training	20 Jan 15	https://www.facebook.com/SciDevNetSSA?fref=ts
2	African Farming and Food Processing Magazine	Meeting cum training	Jan 15	http://www.africanfarming.net/crops/agriculture/project-to-add-value-to-ugandan-agricultural-produce
3	'The Monitor' in the Farming Weekly feature	Meeting cum training	Feb 15	http://www.monitor.co.ug/Magazines/Farming/Uganda-selected-as-focus-for-project-on-root-crops--bananas/-/689860/2611266/-/743lcs/-/index.html
4	PAEPARD platform	Meeting cum training	Jan 15	http://paepard.blogspot.com/2015/01/new-technologies-for-storing-use-of.html
4.b	Global Forum on Agricultural Research	Meeting cum training	Jan 15	http://www.egfar.org/news/imported/new-technologies-storing-use-roots-tubers-and-bananas
5	Daily Monitor	Making good silage	22 Apr 15	http://www.monitor.co.ug/Magazines/Farming/good-silage-sweet-potato-vines/-/689860/2692786/-/vobxw3z/-/index.html
6	Next Generation Cassava	Cassava training at CIAT Colombia	8 June 15	https://nextgencassava.wordpress.com/tag/cassava/
7	New Vision	Silage training	Set 15	http://www.newvision.co.ug/news/673028-farmers-trained-in-silage-production.html
8	Daily Monitor	Launch potato stores	10 Nov 15	Only in print edition (scanned copy available upon request)
9	Scidev.net	African top stories 2015	28 Dec 15	http://www.scidev.net/sub-saharan-africa/agriculture/feature/africa-science-stories-2015.html
10	CTA	RTB crop pig feed_(content from RTB blog)	10 Jan 16	http://agritrade.cta.int/fr/layout/set/print/Agriculture/Sujets/Commerce-regional-ACP/Livestock-value-chain-Uganda-Roots-tubers-and-banana-plants-are-next-generation-pig-feeds
11	Daily Monitor	MSc research on silage as basal diet	6 Apr 16	http://www.monitor.co.ug/Magazines/Farming/Making-use-of-potato-vines-as-silage/-/689860/3146870/-/kp5yloz/-/index.html
11a	MSN News	MSc research on silage as basal diet	6 Apr 16	http://www.msn.com/en-za/news/other/making-use-of-potato-vines-as-silage/ar-BBrpYms
12	FAO Save Food newsletter (May 16)	Banana PHL assessment (content from RTB blog)	13 Apr 16	http://www.freshplaza.com/article/156396/Uganda-High-post-harvest-losses-in-cooking-bananas
13	Daily Monitor	Silage benefits	22 Jun 16	http://www.monitor.co.ug/Magazines/Farming/Kalungu-farmers-appreciate-benefits-potato-vine-silage/-/689860/3260480/-/shfnlyz/-/index.html

14	New Vision (Harvest Money)	Silage for increased yield	12 Jul 16	Only in print edition (scanned copy available upon request)
15	ACIAR (Facebook)	Cassava work (link to photo story)	12 Jul 16	Only in print edition (scanned copy available upon request)
16	ACIAR (Facebook)	Potato and Banana Gender work	28 Jul 16	Only in print edition (scanned copy available upon request)
17	ACIAR (Twitter)	Potato and Banana Gender work	28 Jul 16	Only in print edition (scanned copy available upon request)
18	APA conference 2016	Potato and Banana Gender work (content from RTB blog)	9 Aug 16	http://www.africanpotatoassociation.org/understanding-gender-roles-in-ugandas-potato-value-chain/
19	FAO Sustainable Food Value Chains Knowledge Platform	Innovation injects income opportunities into the banana value chain	17 Aug 16	http://www.fao.org/sustainable-food-value-chains/news-events/details-news/en/c/434207/
20	Sustainable Procurement Platform	Potato and Banana Gender work (content mainly from RTB blog)	27 Sep 16	http://sustainable-procurement.org/news?c=search&uid=76ffce37
21	Daily Monitor	Cassava shelf-life	5 Oct 16	http://www.monitor.co.ug/Magazines/Farming/Search-for-ways-to-improve-cassava-shelf-life/689860-3404868-9ahwckz/index.html
21a	All Africa	Cassava shelf-life (cross posted from Monitor)	5 Oct 16	http://allafrica.com/stories/201610050531.html?utm_content=bufferb269e&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer
22	Daily Monitor	Sweetpotato silage	12 Oct 16	http://www.monitor.co.ug/Magazines/Farming/Sweet-potato-Uganda-farmers-importance/689860-3413082-5ek66v/index.html

APPENDIX 9. LIST OF ANNEXES

	Cross-cutting
CC1	Project flyer
CC2	Workshop report: Inception meeting
CC3	Workshop report: PMCA Training
CC4	Workshop report: Meeting-cum-training event
CC5	Workshop report: Review and validation of gender strategies for the banana and potato subprojects and training in engendered business planning
CC6	Workshop report: Review and validation of gender strategies for the cassava and sweetpotato subprojects and training in engendered business planning
CC7	Workshop report: End of project workshop
CC8	Communications and Visibility Plan
	Banana
B1	Cooking banana business cases
B2	Banana flyer
B3	Technical report: Structure of the cooking banana value chain in Uganda and opportunities for value addition and postharvest losses reduction
B4	Technical report: Optimization of the harvest stage for reducing cooking banana postharvest losses: a multi-criteria approach targeting matooke end-product
B5	Technical report: Gender situational analysis of cooking banana value chain and strategies for gender equity in postharvest innovations
B6	Technical report: Storage temperatures for shelf-life extension of different banana presentation forms
B7	Technical report: Cost-benefit analysis of cooking banana seed multiplication methods
B8	Cooking banana marketing protocol - English
B9	Leaflet of the market demanded varieties – English
B10	Workshop report: Inception and PMCA training workshop
B11	Workshop report: PMCA final event
	Sweetpotato
S1	Sweetpotato silage business cases
S2	Sweetpotato flyer
S3	Technical report: An evaluation of current pig feeding practices on smallholder farms in Masaka and Kamuli districts of Uganda
S4	Technical report: Gender situational analysis of sweetpotato and pig value chains and strategies for gender equity in postharvest innovations
S5	Technical report: Characteristics of silage based on sweetpotato with combinations of local feed resources in Uganda
S6	Technical report: Effect of sweetpotato based diet on performance of growing pigs in Uganda
S7	Technical report: Economic analysis of sweetpotato silage-based diets for smallholder pig farmers in Uganda
S8	Technical report: Capacity needs assessment of potential sweetpotato silage producers, traders and service providers
S9	Article: Perception and practices of farmers on the utilisation of sweetpotato, and other root tubers, and banana for pig feeding in smallholder crop-livestock systems in Uganda
S10	Manual: Sweetpotato silage making 1.0 (in English)
S11	Manual: Sweetpotato silage making 2.0 (in English)
S12	Manual: Training guide on pig marketing
S13	Leaflet: SPHI leaflet
S14	Leaflet: Guidelines for feeding sweetpotato silage to pigs
S15	Brochure: Improved tube silage making method (in Luganda)
S16	Brochure: How to make sweetpotato silage
S17	Training report: ToT on sweetpotato silage making
S18	Training report: Farmer training on sweetpotato silage making in Masaka district

S19	Training report: Farmer training on sweetpotato silage making in Kamuli district
S20	Training report: Training of Trainers and farmers' training on validated sweetpotato silage making and use in Masaka and Kamuli districts
S21	Training report: Business skills for potential sweetpotato silage entrepreneurs
S22	Training report on pig marketing
	Potato
P1	Ware potato business cases
P2	Potato flyer
P3	Technical report: Gender situational analysis of ware potato value chain in eastern Uganda and strategies for gender equity in postharvest innovations
P4	Technical report: Effect of storage conditions on the processing quality of different potato varieties grown in eastern Uganda
P5	Technical report: Economic viability of ware potato storage in ambient stores in eastern Uganda
P6	Technical report: Evaluation of potato (Solanum tuberosum, L.) genotypes for adaptability in Mt. Elgon region of Uganda
P7	Technical report: Improved potato harvesting techniques
P8	Technical report: Potato associations capacity needs assessment and action planning
P9	Technical report: Potato associations training curriculum
P10	Manual: Guidelines for potato harvesting and storage
P11	Manual: Training guide for business skills for potato associations
P12	Manual: Potato store management plans (example in English)
P13	Leaflet: Guide to store ware potato
P14	Training report: Enhancing ware potato storage - Critical steps in pre and post-harvest and storage management of potato in field for best ware quality
P15	Training report: Entrepreneurial skills for ware potato production, postharvest handling and marketing
	Cassava
C1	Fresh cassava roots business cases
C2	Cassava flyer
C3	Technical report: Market opportunities and value chain analysis of fresh cassava roots in Uganda
C4	Technical report: Gender situational analysis of fresh cassava value chain and strategies for gender equity in postharvest innovations
C5	Technical report: Postharvest Physiological Deterioration (PPD) tolerance of selected Ugandan cassava varieties
C6	Technical report: Efficacy of pruning, waxing and relative humidity storage in extending shelf-life of fresh cassava roots
C7	Manual: Setting up a pack-house for waxing and relative humidity storage of fresh cassava roots
C8	Manual: Fresh cassava roots handling for waxing and relative humidity storage
C9	Training report: South-South collaboration for strengthening capacities in assessing the postharvest physiological deterioration (PPD) of fresh cassava roots and technologies for shelf-life extension
C10	Training report: Capacity building in entrepreneurial and business skills for operationalizing fresh cassava roots pack-house
C11	Training report: Capacity building in agronomic practices, waxing and relative humidity storage technologies for shelf-life extension of fresh cassava roots