ANNUAL PROJECT REPORT 2016

CASSAVA CARP
(RUFORUM Grant No. RU 2014 CARP 04)

Developing a community-based cassava seed system for increased productivity and market linkages in Uganda

Reported By:

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CASSAVA CARP EXECUTIVE REPORT SUMMARY

The Cassava community action research project (Cassava CARP) is aimed at enhancing sustainable production, processing and marketing of cassava and cassava products among the cassava farming communities. The project is focusing on quality cassava planting material, appropriate agronomic practices and promotion of relevant technologies for improved performance of selected value chains. The primary entry point is to ensure access to virus-free and good quality cassava planting material of farmer preferred and elite varieties. Through existing multi-stakeholder innovation platforms, farmers and other actors are being engaged in each of the four pilot study districts, where cassava plays a vital role of food security and bio-resource. The focus districts include Kole and Apac (Northern Uganda), and Serere and Bukedea (Eastern Uganda); and some R4D activities at Makerere University Agricultural Research Institute at Kabanyolo (MUARIK, Wakiso district).

Since its inception in October 2014, the project has identified some key challenges facing cassava production, processing and marketing in the study areas. These have incited investigative research topics for students while others are key areas of incubating business ideas with university graduates. Through community knowledge workers (CKWs), the project has started engaging the communities in solving their challenges while sometimes providing direct support in terms of basic materials. The project is evaluating planting material, bioethanol, high quality flour, and composite porridge flour as key products for value chains for improvement. To this effect, the project has identified and virus-cleaned at least one farmer preferred cassava variety in each community. Virus free stock materials are now assembled for farmer preferred varieties including Bao, Bukalasa (B11) and Migyera (NASE 03) for northern, central and eastern Uganda, respectively. In each district, a mother garden of has been established consisting of clean and elite varieties (NASE 14, NASE 19 and NAM 130). To ensure sustainable supply of quality planting material, pre-basic (nuclear stock) and basic seed sources has been established at the tissue culture laboratory and screenhouse, respectively, at Kabanyolo.

The project is also building human resource capacity in research (1 PhD, 3 MSc, 5 BSc) as well as supporting incubation of business ideas along the cassava value chains. The project team of research scientists, a post-doctoral fellow, postgraduate and undergraduate students work with farmers to generate and diffuse knowledge for improved management of cassava pests and diseases, and processing and marketing of cassava products. Two MSc (Agricultural Economics) students have completed their research and they will be submitting their theses in the first quarter of 2017. The third MSc (Crop Science) student and the PhD student are expected to complete their research in the fourth quarter of 2017. In order to enhance cassava value chain actor interaction, the project has developed a web-based mobile app that link farmers to researchers, extension workers, input dealers and traders. The app (www.cassava-carp.org) is now available for piloting after registering all the target 600 farmers (households; translating into 3,000 people) and training of resource persons who will be capturing data for the farmer, expert, translator and administrator levels. Many expected outcomes of the project will directly impact on the rural communities especially those involved in cassava production and associated value chains.

1.0 BACKGROUND, RATIONALE AND CONCEPTUAL FRAMEWORK

Cassava is a very important staple food crop in Uganda, particularly among farmers in the northern and eastern districts of the country. These areas are prone to drought, and pests and diseases prevalence. The crop is a great resource in terms of food and income security. It is ranked as the number one most important food crop in the selected study districts of Lango and Teso sub-region. Some farmers sell the fresh tubers to nearby markets while others process the tubers into dry chips for better storage and long distance marketing. Some farmers also process the dry chips into flour for food, sale or bioethanol production. However, in the last two decades, the crop has been devastated by virus diseases namely Cassava mosaic disease (CMD), and Cassava brown streak disease (CBSD). These viral diseases are systemic and therefore largely spread through planting material. CMD causes serious yield losses in susceptible varieties that are mostly landraces or old varieties. Varieties released in the last 20 years are mostly resistant to CMD, but very susceptible to CBSD. CBSD affects quality of the tubers through root necrosis and rotting making them unfit for consumption or use, it can lead to up 100% yield loss. The widespread nature of these diseases makes access to quality planting material a key challenge to cassava production by the resource poor farmers. These diseases limit the great potential of the crop as a food and income resource especially for the smallscale farmers. The other contributor to low cassava productivity is the poor farmer knowledge and use of appropriate agronomic practices.

Despite the field production constraints, sometimes production exceeds local household consumption levels in certain bumper harvests periods of the year ushering in new challenges such as wastage due to rotting of fresh tubers. This is further exercabated by poor post-harvest handling and low prices of fresh tubers. In order to avoid post-harvest losses, farmers have been engaged in traditional processing through peeling and drying chips to make flour and other products (MAAIF, 2010). However, this is not enough and as a result calls for other interventions such as secondary processing like high quality flour, porridge composite and bioethanol production. These products are also require improved processing technologies, marketing and market linkages, and information sharing if farmers are to maximise the benefits from cassava. Furthermore, there is need to make the cassava crop more competitive by exploiting its physiological efficiency in converting solar enegry into carbohydrates. This requires carefully evaluations of the varieties and productions systems with respect to its ecophysiology and soil requirements.

This cassava CARP project was conceived on the premise that fostering interactions of the various actors along the cassava value chains can lead to enhanced sustainable production, for to improved livelihoods. Multi-stake holder platforms are key for such interactive linkages and testing pre-conceived research questions. The key research intervention areas and focus products and shown in Figure 1. The different nodes of the flow chart are handled by scientists, students or research technician as described in the subsequent sections of this report. Progress has been made at various levels for each of the 6 key result areas. The first project result area (deliverable) has been completed during the reporting period of 2016. The project has identified and virus-cleaned at least one farmer preferred cassava variety in each community. Mother gardens have been established consisting of clean and elite varieties in Apac, Kole, Serere and Bukedea districts.

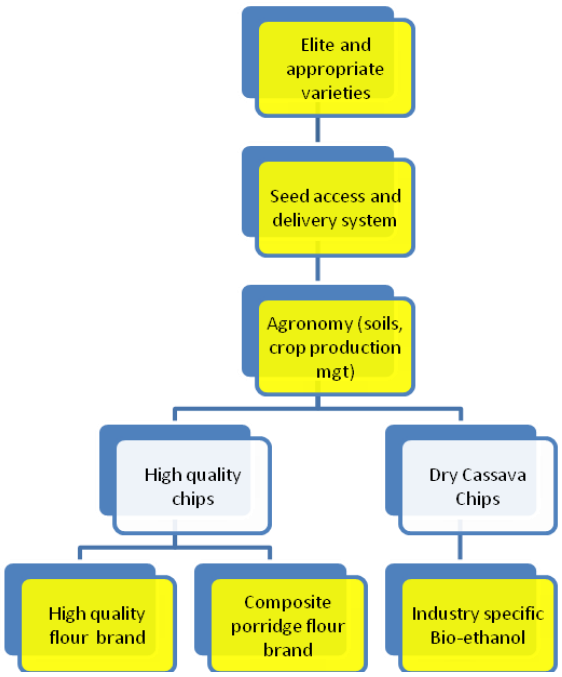

Figure 1: Cassava CARP project focal deliverables: i) Assemblage of virus-free elite cassava varieties (6), ii) Improved access to clean cassava planting material, iii) Eco-physiological prediction models for cassava production, iv) New farmer markets for cassava flour, v) Fortified cassava based flour brand, and vi) A technically efficient cassava in bio-ethanol production protocol.

2.0 ACHIEVEMENTS

2.1 Student Training

The project is contributing towards human capacity building through supporting graduate research at PhD and MSc levels, and BSc research topics. All the students are registered at Makerere University College of Agricultural and Environmental Sciences. The students (1 PhD and 3 MSc) have received the appropriate project support like tuition fees, stipends and field costs. Students' academic programmes, research topics and supervisors are indicated in below (Table 1). A brief description of each student's progress is given below. All the students have participated in the reconnaissance studies in the selected farmer communities – to enable improve the study tools and research topics. Undergraduate students were also supported during their special topic research and supervision (Table 2).

Table 1: Cassava CARP project students' academic programmes, research topics, supervisors and progress timeframe

Student (academic program)	**Supervisors**	**Topics (and community)***	**Start and end dates**
Ms R Mukebezi (PhD – ARI)	Dr B. Obaa Dr F. Kyazze	The role of innovation platforms in enhancing the performance of the cassava value chains in eastern and northern Uganda (Kole, and Serere)	Jan 2015 – Dec 2017
Mr. D Opolot (MSc Agric. Econ.)	Prof J. Mugisha Dr A. Kasharu	Economic profitability of bioethanol production enterprise among the rural based cassava farming communities in	Jan 2015 - Dec 2016

		northern Uganda (Apac)	
Mr S. Okurut (MSc Agric. & A/Econ.)	Prof J. Mugisha Dr A. Kasharu	Factors affecting marketing and market access for high quality cassava flour in Eastern Uganda (Bukedea)	Jan 2015 – Dec 2016
Mr M.E Erongu (MSc Crop Science)	Dr S.B Mukasa Dr H. Talwana	Use of plant virus recovery mechanism for mass production of cassava planting material (Kabanyolo)	Oct 2015 - Aug 2017

* Students were assigned a farmer community (district) to which they are tightly linked for interactions and research. However, for cross-cutting research questions, a student is able to carry out work in any community under this project.

MSc (D Opoolot)
The student completed fieldwork September 2016. He is now in the final stages of writing the MSc thesis. He attended the 5th RUFORUM biennial conference which took place October 17-22, 2016. During the conference he was actively involved in various activities notable being rapporteur, social media reporter. Before the closure of the university he made presentation on his research work in Saturday weekly graduate seminars; an initiative of the first supervisor Prof Johnny Mugisha. It is during these presentations his work was critiqued and this enabled improvements. The student's plans to submit his thesis by December 2016 were derailed by the closure of the University October-December 2016. He is currently finalizing writing his thesis for submission by March 2017.

MSc (S Okurut)
The student completed fieldwork by September 2016. He attended the 5th RUFORUM biennial conference October 17-22, 2016 in Cape Town, South Africa. The student's plans to submit his thesis by December 2016 were derailed by the closure of the University October-December 2016. He is currently writing his thesis. The plan is that he submits his thesis by March 2017.

MSc (M.E Erongu)
The student started on the project October 2015. He has now developed his research proposal. He attended the 5th RUFORUM biennial conference October 17-22, 2016 in Cape Town, South Africa. He should be in position to defend the proposal by March 2017.

PhD (R. Mukebezi)
The student defended her PhD research proposal. She still has one year of collecting data before embarking on data analysis and thesis writing. She was not able attend the 5th RUFORUM biennial conference October 17-22, 2016 in Cape Town, South Africa due to a maternity leave. She is expected to complete December 2017.

BSc Students
The BSc special research projects are short term research activities for 6 months. They are part of the requirements for the award of BSc degrees of Makerere University that impart research and scientific writing skills to students. They are supervised by an academic staff of the department. BSc research topics that contribute to the overall goal of the Cassava CARP project are indicated below (Table 2).

Table 2. On-going and proposed research topics for BSc students

Name of student (Programme)	Supervisor	Topic	Status
Musinguzi A (BSc Agric III)	Prof S Kyamanywa	Cassava variety preference by major pests and vectors	On-going
BSc Student 2:		Evaluation of cassava peels for use in small ruminant production in Uganda.	Proposed topic
BSc Student 3:	Dr J. Bisikwa	Effect of spacing and method of planting on stem cutting production.	Proposed topic
BSc Student 4:	Prof M Tenywa	Mapping soils for best cassava production.	Proposed topic
BSc student 5:	Dr Talwana	Model for predicting cassava production of selected varieties.	Proposed topic

2.2 Research (student research topics - synopsis)

Profitability of High Quality Cassava Flour Production

The cassava production system in Uganda is comprised of smallholders producing mostly for subsistence. The system faces a number of challenges including low prices, pests and diseases, declining soil fertility, limited value addition, rapid postharvest deterioration, and poor market. The main cassava products that is to say cassava chips and fresh roots are rebuffed in local product markets due to safety concerns and due to their poor quality. These challenges have made smallholder production of cassava largely unprofitable. Processing of fresh cassava roots into high quality cassava flour (HQCF) has been introduced and integrated into cassava production at farm level with a long term objective of increasing cassava incomes. However, for HQCF production to increase cassava incomes, it must be profitable in the first place. Empirical evidence on whether adoption of HQCF production at farm level is a profitable decision is missing, yet this information can guide efforts that seek to scale out the technology and subsequent adoption of the technology. This study utilizes information from 5 key informants from Budaka district to establish the profitability of HQCF production. Empirical results show that the production cost for each Kg of HQCF is 1,290 UGX against a price of a 1,200 UGX, the group therefore incurs a loss of 90 UGX per Kg. We recommend building the capacity of farmers to lobby for better prices, introduction of cheap transport alternatives like ox-carts and establishment of contracts between farmers and the factories procuring the flour.

Economic Analysis of Traditional Cassava Bioethanol Production in Northern Uganda

The importance of bioethanol production from cassava in improving livelihood of many rural farmers has been previously reported in Uganda. Despite its relevance as a source of income to the rural communities, bioethanol remains a local farmer product characterized by low quality. Its production at farmer level is also at a low scale. Given the increasing demand for bioethanol attributed to variety of uses, it is not clear whether farmers gain substantial income from its production vis a vis selling their cassava in different forms notably fresh roots and dry chips. This study aimed at assessing the economic feasibility of bioethanol production at farm level from cassava as major feedstock. The study was conducted in the three major cassava growing districts of Apac, Kole and Lira between April and May 2016. Gross margin analysis was carried out to establish the profitability of bioethanol production. Using a multistage sampling strategy, 300 respondents were purposively selected for the study using a semi- structured questionnaire. Preliminary

analysis of the gross margins and returns to variable costs from 30 processors revealed positive gross margin and returns to variable costs of production. Positive gross margin therefore is an indicative of a profitable rural bioethanol processing.

Cassava virus disease management research

Yield losses due to Cassava mosaic disease (CMD), caused by geminiviruses, can be as high as 70%, and extinction of farmer preferred local varieties has been reported in Uganda. Despite efforts to breed for resistance, there is increased incidence of CMD especially among farmer preferred varieties. Some of the varieties previously released as resistant have also shown some mild CMD symptoms. It is not clear whether this is due resistance break down or emergency of new geminiviruses or other viruses. Secondly, some originally infected plants have been reported to become symptomless, a phenomenon known as recovery. The phenomenon of recovery reported in cassava could be exploited to produce virus-free planting materials but it has not been well characterized. Factors that influence its occurrence and exploitation need to be well understood. Our preliminary results with the farmer preferred variety Bao, which is popular in northern Uganda, showed a recovery rate of 7%. The recovered plants are now being evaluated for stability with respect to yield and disease and virus-free status at Makerere University Agricultural Research Institute Kabanyolo (MUARIK). Similar studies are being carried out on variety NASE 03, a popular cassava variety in Eastern Uganda. The study will generate information on how to optimize recovery as an alternative cheap approach for generating virus-free cassava planting materials.

Innovation platforms and their influence on cassava production and marketing

Several studies indicate how the self-organizing nature of innovation platforms (IPs) influences actor interaction and networking. However, most of these studies tend to be biased towards the high level IPs than the lower level IPs. This study assessed how organizational structures within community level IPs influenced actor interaction. Data were collected from two community IPs in eastern Uganda which were engaged in the production and marketing of cassava and cassava based products through focus group discussions and key informant interviews. Group size, the decision-making process and internal rules and regulations shaped the structure of the community IPs and ultimately influenced the way actors related and shared information. Members within the small homogeneous groups felt more inclined to work together and willingly share information due to the enhanced cohesion among them. The higher degree of cohesiveness within the groups promoted buildup of more interactive relationships among the members. Participatory decision-making provided opportunities for actors to freely air out their views regarding the key issues affecting the platform which consequently enhanced information sharing. Effective enforcement of rules and regulations in the IP influenced how actors related and shared information.

2.3 Research for Development and Business Incubation

A suitable fermentation protocol for improving quality in locally produced ethanol

Cassava's efficiency as an energy source depends on sugars and starch in the roots which can be fermented into ethanol, a renewable energy (biofuel) with other various applications. In Uganda, farmers produce ethanol (an important source of income) with region specific feed stocks via hydrolysis and fermentation bio-reactions that require optimization for increased ethanol quantity and quality. This study evaluated cassava ethanol production processes and identified crucial stages in the fermentation and ethanol

recovery processes Suggestions for improvement were thus put forward and are being evaluated for their impact. The critical stage and most variable was sample treatment before fermentation. This determined the available sugar and hence the quantity of ethanol produced (Table 1). Reduction in starch content (62 to 37%) with fermentation time was indicative of hydrolytic activity of fermenting organisms. Main sugars included the hexoses (78%), pentose (4%) and trioses (9%). Pre-treatment procedure affected yeast cell counts (44 cells/ml for roasting and 62 cells/ml for soaking) while sugar utilization followed the same pattern. Production of ethanol is vital to livelihoods of cassava farmers. The fermentation pre-treatment methods limit efficiency and hence output/income from this venture. This research aims at providing suitable processes for increased output and incomes at cottage level.

Web Application development

Mobile communications technology has quickly become the world's most common way of transmitting voice, data, and services in the developing world. Given this dramatic change, mobile applications (m-apps) in general hold significant potential for advancing development. They could provide the most affordable ways for millions of people to access information, markets, finance, and governance systems previously unavailable to them. M-apps are software designed to take advantage of mobile technology and can be developed for technology besides mobile phones. But mobile phones have many key advantages: affordability, wide ownership, voice communications, and instant and convenient service delivery. The Cassava CARP project developed a web-based platform for farmers in northern and eastern Uganda to support CBSD reporting and surveillance (www.cassava-carp.org). The web based mobile based app will be used in cassava farmer profiling and production modeling system. It will also serve as a good resource for knowledge sharing and monitoring of disease epidemiology. This needs to scale up in terms of functional features and geographical reach.

Business Idea Incubation

Agribusiness has the potential to reduce poverty and drive economic growth in developing countries like Uganda. The agricultural sector is a major source of food supply, income and livelihood for over 60% of the rural population and is an important contributor to foreign exchange earnings. Therefore, agribusiness incubation has emerged as a critical tool that can be used to create competitive agribusinesses and to accelerate the development of the agricultural sector. Consequently, besides the postgraduate and undergraduate student topics, the project team (Appendix 1) opted to have an open window for good business plan development that could be undertaken by undergraduate students for about 6 months. Furthermore, for good ideas that can be incubated into business plans would be supported to further create demand or market linkages for cassava farmers. Therefore, in collaboration with the Consortium for enhancing University Responsiveness to Agribusiness Development (CURAD) at MUARIK and CHAIN number of business ideas for incubation have been identified. The business ideas were indentified and are listed in Table 3. Some practices, like rapid multiplication of cassava stems (Figure 2) will be shared among the cassava producing communities in order to improve timely access to quality planting material. Other business ideas being evaluated with the hope of developing bankable business plans are listed in Table 3.

Table 3: Topics identified for business incubation under the Cassava CARP Project

Incubatees (and Mentor(s))	**Topic/Business Idea**
Mr David Bukenya (Anthony Pariyo,)	Commercial production of cassava planting material: a profitability analysis
Dr E. Nuwamanya Dr Robert Kawuki	An efficient fermentation protocol for production of bio-ethanol from various cassava varieties.
Mrs Norah Ebukalin (Dr J. Bisikwa)	Branding and quality certification with Uganda National Bureau of Standards (UNBS) of a composite porridge (made from cassava, sorghum and soybean)
Charles Musoke (Dr Apollo Kasharu)	High quality cassava flour business planning and enterprise.

Figure 2: Ratoon 1 crop during rapid multiplication of cassava for stems of elite and clean varieties. This practice will be shared among farmers in each of the four districts.

3.0 COMMUNITY ENGAGEMENT

For each community (district), a number of engagements have been initiated (Table 3). In each district a community knowledge work (CKW) actively is driving field activities together with the respective student.

Table 3: Cassava CARP project Interventions at community level in the different districts

District (Farmer group) and CKW	**Interventions at community level**	**Pictorial**
Apac (KUBERE) Ms. Mercy Apio	• Established cassava mother garden (NASE14) at Chegere sub-county. • Support to cassava bio-ethanol producing women groups (Chegere)	

Kole (KUBERE) Ms. Mercy Apio	• Established cassava mother garden (NASE14, NASE 19) at Bala (Aumi) • Support to cassava bio-ethanol producing women groups (Kole) • Market linkages for bioethanol production	
Serere (SOSPPA) Mr. J. Okalebo	• Established cassava mother garden (NASE14, NASE19, NAM130) at Kyere sub-county. • Market linkages for HQCF • Branding of cassava based composite porridge flour	
Bukedea (P'KWI) Mrs N. Ebukalin	• Established cassava mother garden (NASE3, NASE14, NASE19, NAM130) with P'KWI. • UNBS label for high quality flour	
Kabanyolo (MAK TC Laboratory) Mr C. Lugoloobi	• Optimising tissue media and conditions for rapid cassava multiplication • Virus elimination of farmer preferred and elite cassava varieties • Multiplication of G0 of elite cassava varieties: Bao, Bukalasa, NASE03, NASE14, NASE19, and NAM130. • Established a field cassava mother garden (Bao, Bukalasa, NASE3, NASE14, NASE19, and NAM130) at MUARIK.	  

In order to reach out to the farmers following the devastating prevalence of CBSD, a script for a jingle was written and transcribed in the local language – Luo for northern Uganda. The one minute jingle was played on Radio Apac everyday just before the morning news for 3 months. This raised a lot of awareness in Lango sub-region about the Cassava CARP project, CBSD and RUFORUM (attached Cassava RU_FORUM.mp3)

5.0 PROJECT MANAGEMENT AND VISIBILITY

Besides the individual student progress reports, a number of project level activities, meetings, seminars and a conference were undertaken during 2016. The students (MSc and Post-doc) made presentation on progress of his research in one of the side sessions on 21st/ October 2016. The conference provided the student greater opportunity to learn and interact with renowned top notch scientists. The project management activities are summarized in Table 4.

Table 4: Project management activities and accomplishments

Activity Area	**What has been done (Accomplishment)**
Project team meetings	• Meeting 1: Evaluation of students' research topics (April 2016) and progress (Oct 2016) • Meeting 2: June 2016 Annual review meeting at Kabanyolo • Meeting 3: Meeting of Cassava CARP and Mobile App teams at Makerere University, January 05, 2017.
Student progress and reports	• The students developed their research proposals and presented them to the project team (April 2016). • Payment of tuition fees for the PhD and MSc students • Students quarterly progress reports, and project report
Field studies	• Farmer group discussions were held in Apac, Kole, Bukedea and Serere districts during 2016. • Developed a baseline survey tool for mapping the actors in the cassava value chain in northern and eastern Uganda. • Community specific research or development needs were identified (see graduate student topics and incubation ideas)
Kabanyolo laboratory and on-station studies	• 6armer preferred cassava varieties and established in a screenhouse at Kabanyolo. • Obtained clean planting material of three new varieties (NAM 130, NASE 14, and NASE 19) from NaCRRI for further multiplication and use in establishment of multiplication blocks in each of the communities. • Started tissue culture work on farmer varieties for virus elimination studies at Makerere University Tissue Culture Lab.
Equipment	• Repaired an insect free screenhouse • Installation of the plant growth chamber at Kabanyolo for use in production of disease free farmer preferred cassava varieties. • Procured the students' laptops.
Financial reporting	• Total budget (Oct 2014 – Sept 2018) for four years is USD 372,420. • Received first disbursement of the funds (Oct 08, 2014) of USD 146,210 • Balance as at December 31 of USD 10,541. • Balance as at January 31 of **USD 2,441**. • Accountability and financial report has been prepared by the project accounts assistant, Ms Olivia Najjemba, and will be submitted separately after internal university auditing.

6.0 WORKPLANS AND PROGRESS

Table 5: Activity Schedule and Progress

Outputs [and persons involved]	**Yr1**	**Yr2**	**Yr3**	**Yr3**	**Yr4**	**Yr4**
			H1	**H2**	**H1**	**H2**
Output 1: Awareness of the impact of CBSD and CMD on cassava production in selected IPs						
Priority list of farmers needs for cassava production generated (Year 1) [Dr. B. Obaa; Dr Mukasa; PhD Student]	X					
Mapping cassava value chains and actors (Year 1) [Dr. B. Obaa; Dr Mukasa; PhD Student]	X	X				
Awareness levels of the benefits of using quality planting material increased (Year 2-4) [Dr. B. Obaa; Dr Mukasa; PhD Student]		X				
Elements for enhancing performance of IPs in management of CBSD, cassava production and marketing identified (Year 1-3) [Dr. B. Obaa; Dr Mukasa; PhD Student]	X	X				
Output 2: Community-based multiplication and delivery of virus-free cassava planting material						
Number of elite cassava varieties for multiplication assembled (Year 1) [Dr Kawuki; Dr Mukasa; Lab Techn.]	X					
Protocols for rapid multiplication of quality cassava planting material (Year 1-2) [MSc1; Dr Mukasa; Lab technician]	X					
Improved infrastructural capacity for plant TC and virus indexing at Makerere University (Year 1-2) [Dr Mukasa; Lab technician]	X					
Model and support for multiplication and delivery of quality planting materials (Year 2-4) [Dr Mukasa; CURAD]		X				
Output 3: An integrated soil management system for improving cassava productivity						
Optimum soil properties and agronomic requirements for cassava production (Year 3) [Prof Tenywa; Dr J Bisikwa; MSc2]		X				
Eco-physiological models for cassava production in different regions for different varieties (Year 2-3) [Dr. Mukasa; Dr Kawuki]		X				
Cassava pest management strategies under different farming communities established (Year 2-3) [Dr. Talwana; Dr J Bisikwa]						
Output 4: Technologies and market linkages of for cassava products						
Cassava processing technologies and cassava products inventory documented. (Year 1) [Prof. Mugisha; MSc1; CURAD]	X					

Economic analysis of the cassava flour values chains [Prof. Mugisha; Dr Kasharu; MSc2]	X	X				
Economic analysis of the cassava bioethanol value chains [Prof. Mugisha; Dr Kasharu; MSc1]	X	X				
Mobile web app development and testing (Year 2-3) [Dr Drake Mirembe; Dr Mukasa]		X				
Output 5: Enhanced human capacity for sustainable cassava production and marketing						
MSc students trained (production economics; marketing; pathology; agronomy; tissue culture) (Year 1-3) [Prof Mugisha; Dr Obaa; Dr Mukasa; Res./ team]	X	X				
PhD student trained (group dynamics and innovations) (Year 1-3) [Dr Obaa; Dr Mukasa, Research team]	X	X				
Post-Doc students trained (Year 1-3) [Dr Mukasa, Research team]		X				
Project management meetings and quarterly reports [Dr Mukasa, Research team]	X	X				

Key:

	Period for planned activity (output)
X	Planned activity completed at the time of reporting

4.0 PUBLICATIONS

Students were encouraged to publish, either as popular science publication (e.g. news, stories) or scientific/ academic papers. Students have also written abbreviated progress so far in form of extended abstracts. These were presented during the fifth RUFORUM Biennial Conference (October 17-21, 2016), Cape Town, South Africa. Some of these publications can be found on the Cassava CARP website - www.cassava-carp.org. Published stories include:

i) P'KWI Farmers to Reap Big From Cassava Processing (by Stanslus Okurut and Settumba Mukasa)
ii) Farmer show preference for local cassava varieties for food security in Uganda (by Moses Erongu and Settumba Mukasa)
iii) How a farmer group moved from Seed Multiplication to Value Addition: The case of Cassava Composite Porridge by SOSPPA. (by R. Mukebezi and S.B Mukasa)
iv) Women in Apac Earn a Living from Rural Cassava Bioethanol Production (by Deogracious Opolot and Settumba Mukasa)

Extended abstract titles are indicated below:

i) Mukebezi et al. 2016. Formation processes and actor composition within community level innovation platforms in Teso sub-region and how they influence cassava value chains.

ii) Erongu et al. 2016. Use of Recovery Mechanism for Production of Gemini Virus free Cassava (*Manihot esculenta* Crantz) Planting Material
iii) Nuwamanya et al. 2016. Towards the development of a suitable fermentation protocol for improving quality in locally produced ethanol in Uganda.
iv) Opolot et al. 2016. Economic analysis of rural traditional cassava bio-ethanol processing in northern Uganda
v) Okurut et al. 2016. Does Adoption of High Quality Cassava Flour Production Enhance Cassava Profitability? Evidence from smallholders in Eastern Uganda.

Popular science publications:
During the first season of 2016, there was a devastating resurgence of CBSD in northern Uganda. This outbreak was published in one of the Uganda dailies, the Daily Monitor (Figure 3). This report was followed by another related publication that linked food insecurity in the region to CBSD (Figure 4).


northern

Daily Monitor
TUESDAY
MAY 17, 2016
www.monitor.co.ug

Chairman warns against tree cutting. The Gulu Municipality chairman, Mr Martin Ojara Mapenzi, has decried the continued cutting of trees in the municipality. He says although authorities have increased their efforts to stop the cutting of trees for charcoal, many residents have opted to transport the charcoal at night in order to escape from the police and district authorities. [Stephen Okello, Monitor]

Wetland destruction irks leaders in Gulu Municipality

BY JAMES OWICH

GULU: Gulu Municipal Councillors are calling for the demarcation of wetlands within the municipality, arguing that the level of encroachment is on the rise.
The most affected wetlands are, Pece Channel, Wii Aworinga, Aywee, Bwona-Gweno, Opitino and Layibi, all in Gulu Municipality.
In 2014, the environment department started demarcating the wetlands, but this was halted, leaving several local farmers and developers to continue destroying the natural resource.
However, in the new financial year, the above wetlands are earmarked for demarcation
Mr Francis Okello Amodo, the councillor for Labourline parish in Pece Division says the destruction of the water catchment areas has not only led to the drying up of wetlands, but also contamination of water

Cassava disease threatens food security

Symptoms. The disease causes root constriction and a dry hard rot when the root is cut. It also causes cracks and discolouration in the tubers while the harvested roots have corky, yellow-brown spots.

BY BILL OKETCH

KOLE/APAC. Researchers have warned of a serious threat posed by cassava brown streak disease (CBSD), saying it could cause food insecurity in Lango.
The worst hit areas are Chegere Sub-county in Apac District and Bala Sub-county in Kole District, where nearly 100 per cent of residents are farmers. Many famers interviewed by this newspaper do not know the origin of this disease.
Dr Settumba Mukasa, the principle investigator with Cassava Community Action Research Project (cassava CARP) at Makerere University, told *Daily Monitor* that more than 500 farmers in the affected areas had reported "challenges of rotting tuberous roots."
He said the farmers were feeling the pain because the disease is now infecting their local variety known as *bao* previously believed to be immune to the disease.
"So the only solution is to destroy all the affected plants, look out for clean planting materials from reliable sources," Dr Mukasa said.
Ms Lillian Mercy Apio of Women of Uganda Network confirmed that many women in Bala have resorted to maize flour as a source of food for their families.
Ms Sarah Okello, 34, a cassava farmer in Bala, has for 15 years relied on cassava as a cash crop but her dreams of becoming a commercial farmer have been dashed by the disease. Ms Okello had two gardens of cassava but most of the tubers have rotted after they were hit by the disease. She is at a loss as to how she will continue feeding and educating her three children.
Since the outbreak of the disease, cassava CARP has established five mother gardens: three in Lango and two in Teso to provide cassava farmers with clean planting materials.

Cassava tuberous roots infected with brown streak disease. PHOTO BY BILL OKETCH

WHAT IT IS
Cassava brown streak disease is a devastating viral infection that affects the edible parts – the tuberous roots and sometimes leaves – leading to a total loss of yields in most cases. It is spread by white flies.

Three arrested over chairman's death

Nebbi
Traders face eviction

Figure 3: Daily Monitor report on cassava brown streak disease threat to food security in northern Uganda.

5.0 CHALLANGES AND WAY FORWARD

Farmer needs were slightly different from the perceived challenges prior to the onset of this project. For instance, in some cases cassava productivity was not viewed as a constraint. Storage, processing and marketing of farmer produced fresh cassava and cassava products were mentioned as key community challenges. This could be due to the fact that farmers largely produced for food and they always produced more than they can consume not regarding productivity levels. However, for the cassava crop to remain competitive locally and internationally, we need to look at farmer productivity levels and the unit cost of producing a kilogram of fresh or dried cassava. This must be comparable to the world figures. At this point, cassava will become an import substitute e.g. for imported cassava starch, for use in animal feeds, confectionary and the brewery industry.

It was also noted that farmers preferred their own local varieties for food. Variety Bao was the most widely grown variety in northern Uganda while Migyera (NASE03) was the most popular in eastern Uganda. The recently released varieties are preferred for processing

including bio-ethanol production. Therefore, to cater for both categories of fresh tuber consumption and processing, this project has put emphasis on recovering old varieties through virus cleaning and multiplication. The virus-cleaned varieties will be put back to the communities with appropriate cropping practices and information on how best to exploit their food production potential.

At the onset of the project, value addition and marketing of cassava were observed as key challenges following reconnaissance studies. In fact most students' research topics were focused on value addition, market linkages, and understanding group dynamics for enhanced cassava value chains performance (IPs). During January – May 2016, we realized a sharp increase in demand for cassava and cassava products, especially cassava flour where the price moved from UGX 700 to 1,300 per Kg. By December 2016, the cost of cassava flour at farm gate was UGX 1,500 per Kg (1 UGX = 3,500). The increased demand for cassava was largely due to high prevalence of CBSD and CMD which led to reduced food in northern Uganda and demand from the brewery industry that stepped up in using cassava in beer production. This created a severe food shortage and hence food insecurity in the region (Figure 4). Farmers are looking for coping mechanisms – replanting cassava yet there is limited access to disease free planting material. Other crops are currently more challenged by the prevailing drought spells. Therefore more support is needed towards production of clean planting materials of selected varieties. There is need to emphasize awareness creation (e.g. via local governments, media houses, position papers) about CBSD and its management. This is key in order to fight the pandemic at a community, regional and national levels.

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northern

Daily Monitor
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District suspends tree cutting. Nwoya District authorities have suspended the licensing of tree cutting in an effort to reduce environmental degradation. This comes after the district council approved the environment action plan recently. The district chairperson, Mr Patrick Okello Oryema, in an interview with *Daily Monitor* said no permits will be issued for activities that degrade the environment citing commercial charcoal burning and cutting of trees for timber. [Denis Omony, Monitor]

Children starve as food crisis hits Apac

Likely cause. Local leaders have blamed the catastrophe on the outbreak of cassava brown streak disease.

BY BILL OKETCH
editorial@ug.nationmedia.com

APAC. Child headed households in Nambieso Sub-county, Apac District, are starving following a food crisis in the area.

"We now eat one meal a day while sometimes we sleep hungry," said a 10-year-old orphan, Samuel Okello, adding that his eldest sister Sandra Auma, 17, cannot afford the high food prices charged in the markets.

Many farmers only recently planted crops, and still need to buy food.

All varieties of beans have reportedly nearly doubled in cost and peas have increased by about a third, while corn has gone up by a third, millet nearly doubled and cabbage up by nearly two-thirds.

Food in the local restaurants is available, but more expensive menus are discouraging customers.

Local leaders have blamed the catastrophe on the outbreak of cassava brown streak disease (CBSD), which researchers have warned could cause food insecurity in Lango sub-region.

"Much as people have been planting cassava for the last two years, when you go to harvest it you find that the tuberous roots have all rotten," Mr Jimmy Emmanuel Okello Ecun, Nambieso LC5 councillor told *Daily Monitor* in a telephone interview on Monday. He said people who can afford to now buy cassava from Aduku Sub-county (Apac District) but the extremely vulnerable individuals are sleeping hungry.

Children in Apac District eat raw mangoes following the food crisis in the area. PHOTO BY BILL OKETCH

Worrying trend

The LC1 chairman of Akoko-dako village, Etek iber parish in Nambieso Sub-county, Mr JP Haruna, said: "This may affect the opening of second term as children will not be able to study on empty stomachs."

The prices of livestock have dropped significantly as people run to the markets to sell their animals to buy foodstuff.

A big bull that used to fetch between Shs700,000 to Shs1 million is now being sold at between Shs400,000 to Shs500,000. The price of a goats which was initially at Shs100,000 has reduced to Shs45,000 while chicken that used to sell at Shs25,000 is now sold at Shs4,000 and Shs8,000.

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PUBLIC ANNOUNCEMENT

District health workers to wear name tags

BY MARTIN OKUDI
editorial@ug.nationmedia.com

ADJUMANI. Adjumani District local government will provide name

Mr Michael Ojja, the Adjumani hospital administrator, welcomed the initiative, saying the the policy is

Figure 4. The sharp rise in the prevalence of CBSD and CMD led to reduced food in northern Uganda and thus a sharp rise in demand for cassava.

In all the districts we had challenges in management of the mother gardens. The original idea was to have the mother gardens within the farming communities – therefore the project hired a garden (2-3 acres) from one of the group members. Among some groups,

this later proved difficult to ensure ownership of the mother garden from the person who rented out the land. Other members became suspicious that the person who rented out the land who take all the benefits (stems and the roots). In one case at Amolodyang (Kole) the person care-taking the mother garden was suspected to have sold off all the stems – disguised as theft. The confusion forced the project to establish another mother garden in Aumi (Bala, Kole) (Figure 5). Therefore, there was need to study the group dynamics of each community. More support towards establishment and ownership of community mother gardens is needed. It was also apparent that women managed mother gardens were better and promising to give further reaching impact in the communities.

Figure 5: Emergency delivery of clean cassava planting material that was used to establish a mother garden with the Aumi women group, Bala, Kole.

The closure of the University during October-December 2016 affected research progress. During this time it was not possible to have close student supervision, especially the MSc Agricultural Economics students, who were in their final stages. It was also not possible to carry out any financial transactions and hence field activities were curtailed. From October 2016 to December it was not possible to make field visits and supervisions. We hope to catch up with the lost time by engaging the students even the ones that have completed their research.

ACKNOWLEDGEMENT

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Reported by:

Dr. Settumba Mukasa,

Assoc Professor and PI - Cassava CARP Project

Appendix 1: PROJECT PARTNERS

The project is being implemented by a consortium of partners and institutions from the public and private sectors as well as farmer groups and community based organizations. Makerere University (MAK) is the lead institution in partnership with the National Crops Research Institute at Namulonge (NaCRRI), Coalition for Health, Agriculture and Income Networks in Uganda (CHAIN Uganda), The Popular Knowledge Women's Initiative (P'KWI), Kubere Information Centre (KIC), and Soroti Sweetpotato Producers and Processors Association (SOSPPA). Below is the list of key project team members:

- Dr Settumba Mukasa (PI, Plant Biotechnology/Virology), DAP, MAK.
- Dr. Robert Kawuki (Cassava Breeding), NaCRRI-NARO.
- Mr. Anthony Pariyo (Cassava Seed System), NaCRRI-NARO.
- Prof. M.M. Tenywa (Soil Scientist), DAP, Makerere University (MAK).
- Dr. H. Talwana (Entomologist), DAP, Makerere University (MAK).
- Prof. J. Mugisha (Agric. Econ.), SAS, Makerere University (MAK).
- Dr. B. Obaa (Agric. Extension), DEIS, Makerere University (MAK).
- Dr. J. Bisikwa (Agronomist), DAP, Makerere University (MAK).
- Prof. S. Kyamanywa (Business Incubation), Consortium for enhancing University Responsiveness to Agribusiness Development (CURAD).
- Dr. Apollo Kasharu (Farmer Linkages), CHAIN Uganda.
- P'KWI Farmer Group, Bukedea districts, Eastern Uganda (CKW, Mrs Norah Ebukalin).
- SOSPPA Farmer Group, Serere districts, Eastern Uganda (CKW, Mr Joseph Okalebo).
- Kubere Farmer Group, Kubere Information Centre, Apac/Kole districts, Northern Uganda (CKW, Ms Mercy L Apio).