Final Report on the Great Lakes Cassava Initiative

REPORT

CRS
CATHOLIC RELIEF SERVICES

CATHOLIC RELIEF SERVICES
GREAT LAKES CASSAVA INITIATIVE – FINAL REPORT

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List of Acronyms

AED	Agro-enterprise Development
AGRA	Alliance for a Green Revolution in Africa
ASARECA	Association for Strengthening Agriculture Research in Eastern and Central Africa
BecA	Biosciences eastern and central Africa
C:AVA	Cassava: Adding Value for Africa
C3P	Crop Crisis Control Project
CBSD	Cassava Brown Streak Disease
CBSV	Cassava Brown Streak Virus
CGO	Country Grants Officer
CIALCA	Consortium for Improving Agriculture-based Livelihoods in Central Africa
CIAT	International Center for Tropical Agriculture
CIIFAD	Cornell International Institute for Food, Agriculture and Development
CMD	Cassava Mosaic Disease
CPM	Country Program Manager
CRS	Catholic Relief Services
CU	Cornell University
DEWN	Disease Early Warning Network
DRC	Democratic Republic of Congo
ECHO	European Community Humanitarian Office
FAO	Food and Agriculture Organization
FERA	Food and Environment Research Agency
FG	Farmer Group
FY	Fiscal Year
GCP	Global Cassava Partnership
GIS	Geographic Information Systems
GLCI	Great Lakes Cassava Initiative
GPC	Global Plant Clinic
GPS	Global Positioning System
ha	Hectares
ICM	Integrated Crop Management
ICT	Information and Communication Technology
ICE	Information, Education and Communication
IITA	International Institute of Tropical Agriculture
INERA	National Institute for Agronomic Study and Research (Democratic Republic of

	Congo)
ISABU	Burundi Institute of Agronomic Sciences
ISAR	Institute of Agronomic Sciences of Rwanda
ISTRC	International Symposium on Tropical Roots and Tuber Crops
KARI	Kenya Agricultural Research Institute
KEPHIS	Kenya Plant Health Inspectorate Services
M&E	Monitoring and Evaluation
NARO	National Agricultural Research Organization (Uganda)
NARS	National Agricultural Research Systems
NASH	Nucleic Acid Spot Hybridization
NGO	Non-governmental Organization
NPPO	National Plant Protection Organization
NRI	Natural Resources Institute
OFDA	Office of Foreign Disaster Assistance
PASS	Program for Africa's Seed Systems
PCR	Polymerase Chain Reaction
PFA	Paid Field Agent
PRA	Pest Risk Analysis
PVS	Participatory Variety Selection
RCI	Regional Cassava Initiative
QMP	Quality Management Protocol
RAB	Rwanda Agricultural Board
SILC	Savings and Internal Lending Community
TAC	Technical Advisory Committee
TC	Tissue Culture
TSBF	Tropical Soil Biology and Fertility Institute
VOF	Voice of the Farmer
VFA	Voluntary Field Agent

Chapter 0. Introduction

Within the context of an existing disease (Cassava Mosaic Disease, CMD) and an emergent disease (Cassava Brown Streak Disease, CBSD), The Great Lakes Cassava Initiative (GLCI) had an overall goal of distributing clean planting material of disease tolerant or resistant varieties to 1.15 million farmers to six countries—Burundi, Democratic Republic of Congo, Kenya, Rwanda, Tanzania and Uganda—during the four years of the project period. The target farmers were poor and vulnerable, though not exclusively, and the project policy was zero tolerance to contributing to the spread of CMD and CBSD by distributing diseased material.

With this goal in mind, GLCI was set up with five components—partnership, disease, training, seed and farmer groups. Partnership was the overarching component to coordinate the different aspects of technical work needed to achieve the goal of the project. The disease component aimed to study CBSD when there was little known of the disease and to ensure that diseased material did not get distributed to low disease and disease-free areas. The training component was responsible for building capacity for the local partners and farmer groups to become technically and managerially capable of serving as delivery channels to produce and disseminate the clean planting materials for the beneficiaries. The farmer group component established, registered, characterized, trained and monitored the farmer groups and ensured that they produced quality planting material and disseminated it systematically. Monitoring and evaluating (M&E) and gender were not set up as components but rather as programming activities that cut across all components. Together they made up the integrated research and development program (Figure 1).

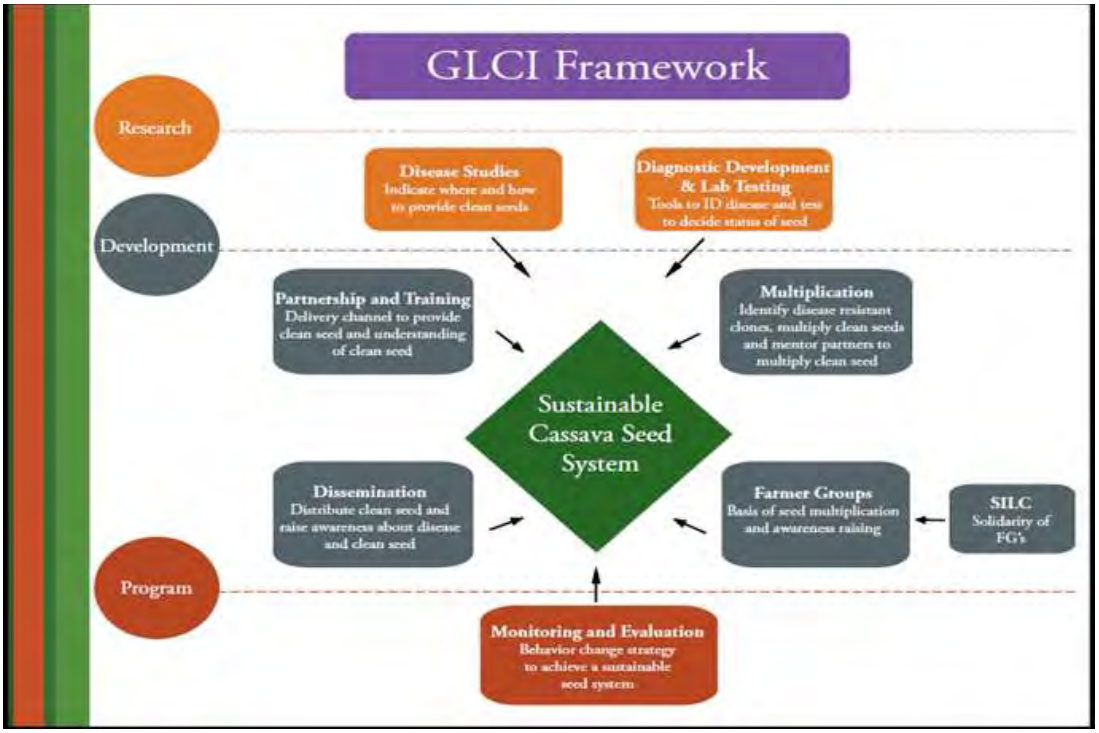


Figure 1. GLCI operating framework

The actual implementation of these components had an overlapping division of labor, particularly among training, seed and farmer groups. Both training and farmer group components were involved in

training of the farmer groups; while both the seed and farmer groups had responsibilities for farmer groups producing seeds. The following chapters highlight what each component was able to achieve during the life of the project.

This final report is organized by the components and programming activities, each of which is a chapter. Each of the chapters on the components and program activities consists of two parts—Part 1 documents the process of establishing and implementing the activities of that component, and Part 2 documents the assessment, evaluation, lessons learned, and recommendations of the component. Chapter 1 is on partnership, Chapter 2 disease, Chapter 3 training, Chapter 4 seed, and Chapter 5 farmer groups, Chapter 6 monitoring and evaluation, and Chapter 7 Gender. Each chapter contains various annexes, all of which are cited in the text in the chapters.

These chapters are preceded by a summary of the general results, sustainability plan, scalability plan, challenges encountered, and lessons learned. The full final report consists of the following:

- GLCI final report summary, based on the Bill & Melinda Gates Foundation final report format
- Seven chapters of narratives
- Annexes of each chapters
- Annex of IP documents

Chapter 1. Partnerships and Planning

Catholic Relief Services (CRS) implemented the Great Lakes Cassava Initiative (GLCI) with research and technical support from the Africa-based International Institute of Tropical Agriculture (IITA) and the UK-based Food and Environment Research Agency (FERA). GLCI collaborated with the National Agricultural Research Systems (NARS) and the plant health and phyto-sanitary institutions (National Plant Protection Organizations - NPPOs) in each of the six countries. Fifty-five CRS local partners implemented activities on the ground directly with farmers, in coordination with CRS country programs and the GLCI regional technical team based in Nairobi.

This complex web of vertical and horizontal partnerships was the bases for success of GLCI. These partnerships provided a platform for integrated research and development, from which many innovations were developed. These innovations established a rigorous seed system within the context of diseases, built a model to manage the large scale of field staff and farmer groups, and developed an ambitious field-based monitoring and evaluation (M&E) system. These innovations underlined the success of reaching, and documenting, 1.35 million beneficiaries with clean planting materials of improved varieties. Reaching this target all relies on these partnerships.

The regional learning alliance meeting was the major annual event that brought the partners together to review and plan and this was where all the different types of partners network, share information, and compare experiences with the diseases and the activities they were implementing. As not all of the 200+ partner staff involved in GLCI can participate in this regional meeting, each country held country-wide review and planning meeting twice a year to plan for the following harvest, dissemination, and planting season. To ensure that the project in all six countries was on track, the regional team conducted country performance reviews to review the technical and managerial progress and performance of all the partners. GLCI was supported by a group of experts in diverse fields that served on the Technical Advisory Committee (TAC) which met once a year to review and plan from the outside experts' perspective which also helped keeping the project on track.

GLCI had the most extensive relationships with the Regional Cassava Initiative (RCI) of the Food and Agriculture Organization (FAO). RCI overlapped with GLCI in five countries, and had the similar nature to GLCI, though, had more limited scope of work, as it was confined mainly to multiplication and dissemination. Nevertheless, as GLCI and RCI were the two large seed providers to farmers in these countries, it was essential that the two projects coordinate, particularly on the varieties that are appropriate to multiply in light of the diseases.

Working in partnerships, internally within GLCI partners and externally with other stakeholders engaged in cassava seed system, is the cornerstone of the success of GLCI. This chapter contains two parts. The first part reports on the process of building the partnerships and planning during the four years of the project. This reports on the internal activities which built the close relationships among the GLCI partners and the external networking with other cassava stakeholders. It recaps the essence regional learning alliance meetings, the bi-annual country planning meetings, the country performance reviews, the TAC meetings, the case studies that served as the internal evaluation, and the end-of-project events to review the internal partnership and planning of GLCI over the life of the project.

The second part of this chapter is an assessment of the internal GLCI partnerships in order to analyze, from the partners' perspectives, what aspects of the GLCI partnerships worked, how they felt about their relationships with the diverse institutions involved in GLCI, what they valued the most in this partnerships, what challenges faced them, and finally what they recommend to improve such partnerships as lessons learned that can be applied to future projects.

Part 1. The Process of GLCI Partnerships and Planning

Regional learning alliance meetings

Regional learning alliance meeting was the venue for the selected GLCI team members to come together once a year to review the progress of, and learn lessons from, the year passed and plan for the activities for the following year. It is the most important meeting of the year for partnership building, knowledge and information sharing, as well as a time to ensure full integration of all components of the project and a uniformed approach among the vast number of the partners.

The first review, learning and planning meetings were held in January 2009 in Musoma, Tanzania. country program managers (CPMs), NARS and key partner supervisors from all GLCI countries met for this workshop. Two representatives of phyto-sanitary and seed certification agencies from Tanzania and DRC also participated. Topics included how to better train farmers through institutional service support structure development, farmer group characterization and cassava value chain assessment to identify training needs. The other main topic was the revision of the Quality Management Protocol (QMP) to make sure that tertiary fields are evaluated and certified before dissemination of planting material. All countries developed training action plans to implement these critical disease, seed and training issues. (LA Appendix 1 - Jan 2009)

To make up for the lost meeting in 2008 as the project was just starting, another Learning Alliance meeting was held in May 2009 in Bukavu of the Democratic Republic of Congo (DRC). Participants for the May 2009 meeting in Bukavu included CPMs. Country presentations highlighted challenges and suggestions for improvement. Field visits included trainings in farmer group characterization, participatory production chain mapping, the QMP and use of global positioning systems (GPS). Meetings concluded with planning sessions. (LA Appendix 2: May 2009)

GLCI held its third regional learning alliance meeting in Butare, Rwanda in January 2010. Participants included CRS regional, headquarters and country program staff, IITA and FERA scientists, government officials, and more than 40 partner staff from each country including field agents, supervisors, research technicians and scientists. The meeting focused on successes and challenges, the M&E system, disease survey and source site testing results, seed multiplication and dissemination, participatory variety selection, crop management trials, information and communication technology, Savings and Internal Lending Communities (SILC), agro-enterprise development (AED), gender and diversity and compliance. (LA Appendix 3: Jan 2010)

GLCI held its final regional learning alliance meeting in Kisumu, Kenya in September 2011. Participants included CRS regional, country program and headquarters staff, IITA and FERA scientists, government officials, and more than 50 partner staff from each country including field agents, supervisors, research technicians and scientists. Dr. Regina Kapinga, Gates Foundation program officer, also participated in her first GLCI learning alliance meeting. Due to the cassava platform formed by CRS, IITA, and FAO, and the joint concept note subsequently developed by the platform, the coordinator of the FAO RCI also

attended the meeting. In addition, two members of the Tegemeo Institute of Agricultural Policy and Development of Egerton University, which will undertake the external evaluation of GLCI, attended the meeting and gave a presentation on the initial external evaluation plan. Key topics of the learning alliance included successes, challenges, and lessons learned during the 3.5 years of the project. (LA Appendix 4: Sept 2011)

Bi-annual country planning meetings

All countries held pre-planting, country planning meetings attended by all partners in January/early February and July/early August, the latter forming the basis of the annual work plan. One regional staff was always assigned to attend one of these country planning meeting to ensure the uniformity and quality of the review and planning. For several days, the regional and country staff engaged in reflection, discussion, and planning. Partners presented progress reports and developed new annual plans. GLCI used new tools to help partners understand targets and their role in the GLCI goal. Increased partner understanding led to better targeting. Countries submitted annual plans in September each year and these formed the basis for budget allocations and annual plans for the following year.

Country grants officers (CGOs) were trained in Tanzania and Uganda and the CGOs then trained partner staff. The CGOs focused on partners with difficulties in reporting, notably with computerized accounting, being tied to specialist accounting packages or connection with a number of projects with different reporting formats. New finance staff and grant officers were trained in GLCI financial management and donor requirements. During these training and re-training, they were refreshed on how best to support implementing partners during their field visits. Transcribing information was a source of delays and errors, so online assistance and specialist training continued until the CGO had this accounting system.

Country performance reviews

The grants manager visited Burundi and Tanzania in the beginning of 2010 to assist the CGOs to support partners in financial reporting. Particular emphasis was made on identifying and visiting the weaker partners. All staff were now in post by this time but staff changes at the country level were frequent, both within CRS and the partners. More frequent and quality support by CPMs and CGOs to partners and consistent training, including with the AidStation laptops was needed to assist in getting new staff up to speed. At project level, improved, systematic communications should assist in the same way.

During FY2010 the GLCI regional team conducted administrative and programmatic reviews with country program staff and partners in Burundi, Kenya, DRC and Rwanda. GLCI trained partner staff in programmatic and financial management and identified areas for follow up and support for 2011. (Performance Reviews Appendices 1a-d).

Regional team members, country program staff and select partners in coastal Tanzania and Uganda conducted administrative and programmatic reviews during the first half of 2011. During the visits, partner staff were trained in project programmatic and financial management. Areas that require more support were identified and country programs and sub-grantees would follow up based on the recommendations. (Performance Review Appendix 1e_Uganda).

Technical Advisory Committee meetings

The TAC was established and held its first meeting in Kampala in April 2008. The second TAC meeting scheduled for October was postponed pending the full results of the Cassava Brown Streak Virus (CBSV) survey and the baseline study. It was held in Burundi in February 2009. The main focus of the meeting was to review and approve a draft of the revised work plans. A major issue raised at the meeting was the need for closer contact between GLCI staff and TAC members and this was to be addressed.

The TAC felt that more appropriate decisions could be made when this information was to hand. Also, the meetings were seriously under-budgeted having originally been conceived as a Steering Committee of local experts. The rapport and enthusiasm at the first TAC meeting was poorly utilized. This was partly due to the preoccupation with CBSV, but also due to the lack of budget. Means to finance the TAC and their involvement in ongoing activities thus needed to be examined. It was proposed to reduce the number of TAC members to free funds for more frequent meetings or consultancies as a way to include the TAC in daily activities; e.g. involving them in learning alliance meetings. It was resolved that the following TAC meetings would include more field visits so that members can provide technical advice.

During the second TAC meeting held in Burundi in February 2009, the main focus of the meeting was to review and approve a draft of the revised work plans. A major issue raised at the meeting was the need for closer contact between GLCI staff and TAC members and this will be addressed.

The TAC met again in Entebbe, Uganda in January 2010. The TAC commended the progress made and worked with objective team leaders to develop ideas to streamline and strengthen activities. They noted progress made with respect to CBSD, but highlighted the need for a pragmatic approach to disease tolerance levels in the distributed material. They also noted that the number of target beneficiaries would be achieved, or even surpassed, following the distribution of material from the final planting of March/April 2011. The TAC recommended that a Phase II should be sought and should concentrate on the current six countries emphasizing disease, seed and AED (TAC Appendices 1a-b - 2010)

The TAC met the last time in Bagamoyo, Tanzania in January 2011 and reviewed the GLCI activities and visited the field. Participants included: Regina Kapinga, Malachy Akoroda, Mike Thresh, Nusura Hassan, Reinhardt Howeler, Richard Lamboll, Tom Remington, Robert Delve and the GLCI regional team. GLCI updated the TAC on project progress and the TAC provided advice on how to proceed in the final year of project implementation and beyond. Key suggestions included: 1) to pursue the documentation and dissemination of the accomplishments and lessons learned in the project, 2) to document not only the direct recipient beneficiaries of the improved cassava planting material but also those indirectly benefitting, 3) to review the sustainability plan and 4) to use case studies to develop a second phase of the project. Please see TAC Appendix 2 - 2011 for details.

Internal evaluation and case studies

As part of the impact evaluation contracted by the foundation, GLCI worked with the consultant and originally identified seven case studies: 1) multiplication and dissemination - individual vs. group, 2) QMP, disease testing and surveillance, 3) productivity increases due to clean material at household level, 4) partner and farmer group strengthening, 5) cost effectiveness, 6) modeling virus accumulation and longer term scaling-out, and 7) M&E which were to be conducted before the end of the project.

Three questionnaires were designed for partner staff, farmer groups and beneficiaries, first based on three exploratory studies, then pre-tested after the questionnaires have been designed. After the pre-tests, the questionnaires were finalized. The interviews were conducted in July and August 2011, followed by analyses in September and October, and writing then continued to the end the project. The sampled countries included Kenya, Rwanda, and Tanzania, selected based on the characteristics of diseases and the importance of cassava. The partners and farmer group samples were selected based on the quality and performance of each, and, based on which, good, average, and poor partners and farmer groups were interviewed. Beneficiaries were difficult to locate and gather, thus the only selection criterion was the time when they had received the seeds from the project. Those who received the seed less than a year before would have little to report, thus those who had planted and harvested the disseminated seeds became the target respondents.

The case studies were reorganized based on the data and analyses availability and the final seven studies included the following: 1) Partnership, 2) Training-- partner and farmer group strengthening, 3) Farmer groups and multiplication and dissemination - individual vs. group, 4) Seed system, 5) the use of geographic information systems (GIS), 6) increases due to clean material at household level, and 7) Documentation of the GLCI M&E system. Each of these seven case studies is cited in the relevant part of this final report, and attached as appendices.

End of project meetings

Country closeout meetings were held in February and March 2012. In these meetings, GLCI participants shared lessons learned as well as successes, challenges, and achievements of the project with donors, government agencies, NARS, national and international non-governmental organizations (NGOs) with similar programs, and other interested stakeholders. In these meetings, the partners gave a presentation of their overall achievements and challenges; followed by discussions on where and how the lessons learned can be applied. The participants reviewed the existing relevant projects in the country to which the partners were either involved or could potentially be involved and applied the skills learned from GLCI. The essence of the meetings was captured mainly in the form of recordings of the questions and answers. The appendices of the reports from DRC, Kenya, and TZ Coast are representative of the discussions in these closeout meetings. (Country Closeout Meeting Appendices 1-3)

A regional event was held in April 2012 at the Tribe where selected partners from all six countries were present. The ministry, donors, and church partners were also invited. Five themes—scale, documentation, innovations, integrated research and development, and partnerships—were displayed in five booths each of which was manned by a combination of partners to showcase their achievements, and to answer questions of the invited guests.

This event was somewhere replicated in Washington D.C., where seven GLCI staff/partners were present to present in each of the five themes. CRS staff, donors, and stakeholders were invited to attend this event. GLCI officially closed at the final presentation at the Gates Foundation event where the GLCI team presented the different aspects of the project to the foundation. By this time, all the field activities have already been terminated; the final meeting with the program officers marked the ending of GLCI.

Networks and linkages

GLCI maintained linkages with other major players in cassava throughout the life of the project. The first linkages was marked by the joint sponsorship of two meetings with FAO (Bukavu, October 2008 and Entebbe, February 2009) to which the Association for Strengthening Agriculture Research in Eastern and Central Africa (ASARECA) was also invited. GLCI also attended two ASARECA planning meetings and ASARECA and FAO staff attended a joint workshop to discuss the results of the source site survey and jointly agree on a way forward. In addition, the GLCI project director attended the launch of the Gates-funded "Cassava Virus Capacity Enhancement" project in December 2008. Arrangements were made to combine activities and methodologies, notably disease surveys, germplasm exchange and epidemiological studies on CBSV. Linkages were developed for field activities with Cornell University and the International Center for Tropical Agriculture (CIAT).

GLCI held meetings with other major organizations interested in cassava, notably Alliance for a Green Revolution in Africa (AGRA), ASARECA and FAO with a view to harmonizing activities and leveraging resources. The project director also participated in the review of several AGRA/Program for Africa's Seed Systems (PASS) proposals, participated in an ASARECA meeting to develop a "Mega-Project" proposal and has reviewed the proposal. Collaboration with FAO at both regional and national levels has been established leading to joint activities; baseline studies, GIS, awareness and training.

Meetings with other parties interested in cassava in the East, Central and Southern Africa region continued with attempts to integrate activities. GLCI and the activities of FAO in Burundi, DRC, Rwanda and Uganda were well coordinated and further joint activities and funding in coordination, awareness and disease monitoring were discussed. This relationship was reinforced at the QMP meeting in May 2008 when representatives of FAO, USAID and national plant health services were present. GLCI partnered with Cornell International Institute for Food, Agriculture and Development to develop and test training modules for farmer group development. Attempts to coordinate with ASARECA mega-project never quite got going, resulting in some seeming duplication of efforts.

Linkages to other Gates Foundation activities included the CRS Savings and Internal Lending Communities (SILC) Innovations project in Kenya, Tanzania and Uganda. The project director visited the Cassava: Adding Value for Africa (C:AVA) project at the Natural Resources Institute (NRI) to discuss the joint gender activities. At that time, C:AVA personnel were deeply involved in setting-up activities in West Africa and no significant progress had been made on gender. East Africa regional linkages were sought to move these activities forward using data collected in the baseline study.

Two members of the GLCI regional team attended the first meeting of the Global Cassava Partnership (GCP) held in Ghent, Belgium, in July 2008. This meeting proved very effective in widening the international partnership base and insights into new initiatives and research. CRS was one of the only NGOs at the meeting, which was oriented towards breeding and basic research. CRS' presentation was well received as many delegates appreciated the need for delivery systems. Now that GLCI has officially closed, the GCP was again held, this time in Kampala, GLCI had a half-day session to present the delivery system developed by the project.

In the FY2010, GLCI again participated in FAO partner meetings and the project director continued to communicate frequently with the FAO cassava project coordinator to ensure comprehensive coordination of the two major cassava projects in the region. The new project director also visited sub-grantees, IITA and FERA, to build relationship and gain deeper understanding of these institutions. GLCI staff attended, and presented in, both the international chapter of International Symposium on Tropical Roots and Tuber Crops (ISTRC) in Lima, Peru and the Africa chapter in Kinshasa. Meanwhile, GLCI staff regularly visited the regional USAID office in Nairobi and the mission offices in GLCI countries to provide updates on project progress and explore potential for co-funding with USAID. GLCI staff participated in the October 2010 USAID Comprehensive Africa Agriculture Development Program (CAADP) meeting in Nairobi where the process and strategy for USAID agricultural investment in Africa over the next five years was discussed.

During the same fiscal year, the GLCI seed objective leader participated in the Gates Foundation seed system strategy discussion in Seattle. Five CRS staff (two from GLCI) participated in the foundation's stakeholder consultation meeting on the sustainable development of seed systems for vegetatively propagated crops in Nairobi.

During the FAO Regional Workshop on Cassava held in Burundi in June 2011, the project director and the rest of the workshop participants visited four multiplication sites along Lake Tanganika, three of which belong to FAO and one to GLCI, in three locations. During the field visit, clear symptoms of Cassava Brown Streak Disease (CBSD) were observed in all sites and on all the clones. All of the samples collected from the visit confirmed CBSD during lab testing. The clones multiplied by FAO (MH96/5280 and MH96/0287) showed considerably more severe symptoms than that multiplied by GLCI (Mh96/7204). In fact, it was agreed in 2006 that, based on the experience with MH96/5280 in Kenya where this variety seriously succumbed to CBSD, this clone would no longer be multiplied. It was continued to be multiplied by the Burundi Institute of Agronomic Sciences (ISABU) and FAO perhaps because there had been no lab evidence of CBSD in Burundi until this visit.

Quick action was organized by IITA, under GLCI, to collaborate with ISABU to conduct a rapid assessment of the extent and characteristics of this infection. The assessment reported CBSD infection outbreaks on the basis of variety, location, altitude and coverage and confirmed the first outbreak of CBSD in Burundi, particularly along the Lake Tanganyika where, at lower altitude than the highland areas, fostered an abundance of whiteflies. It was theorized that Rwanda and DRC also were at risk of such outbreaks along the lake, thus subsequent similar rapid assessments were conducted in these two countries. The Appendices include a CBSD Rapid Assessment Appendix 1_Burundi that was completed in 2011, and the compilation of reports from CRS, Kenya, and Rwanda which was completed during the project extension period in 2012 (CBSD Rapid Assessments Appendix 2_DRC, Burundi, and Rwanda).

The rapid assessment reports formed the basis of a concept note for an emergency response mitigation project to replace the multiplication sites and farmers fields along the lake. Subsequently, GLCI released tissue culture plantlets of the eight clones that were multiplied by the Genetics Technology International Lab to be fast-tracked for rapid multiplication to provide seeds during this mitigation. This mitigation proposal was jointly submitted by CRS, FAO and IITA. USAID's Office of Foreign Disaster Assistance (OFDA) and the European Community Humanitarian Office (ECHO) showed some interest in supporting the rapid response, but in the end declined as this potential crisis did not fit in the mandate of either institution. This joint effort would have served as a launch pad for the CRS, FAO and IITA platform for the concept note developed by the three institutions. (Emergency Response CN Appendix)

CRS, FAO and IITA are three major institutions that have undertaken projects on cassava seed system within the context of diseases. Given the different strengths of each institution, it is most rational to join efforts to tackle the goal of overall cassava development. Thus the three institutions jointly developed a concept note to integrate all aspects of cassava development, from policy and advocacy (FAO) to disease and breeding (IITA) to seed system and production management (CRS) to postharvest processing and marketing (CRS and IITA) for the countries in East and Central Africa where CBSD and Cassava Mosaic Disease (CMD) pose a serious threat to cassava production.

Drawing on each institution's strength, FAO's major tasks would be policy and coordination, IITA would take charge of technical work on disease studies and breeding, while CRS would be the main field implementer on seed system, production, and postharvest endeavors. CRS, IITA and FAO jointly presented this concept note in November 2011 at FAO headquarters in Rome. Though no immediate interest was expressed for the concept note, we hope the potential power and strength of such a platform will be noticed. This concept note was also meant to be put forth to country-specific donors in order to piece together the funding needed to implement this ambitious endeavor, (Cassava Value Chain CN (CRS-FAO-IITA) Appendix).

Since the CBSD outbreaks that were first observed in June 2011, CRS with GLCI funds, coordinating with FAO, engaged donors and national partners in the following to address the issues of the outbreak.

- **Fundraising:** CRS and FAO sought funds from the following donors to undertake emergency mitigation measures:
  - Gates Foundation: GLCI submitted a pre-concept note to the foundation's Emergency Response team for funds to launch emergency mitigating measures, but these measures did not fall within the portfolio of Emergency Response team.
  - Office of Foreign Disaster Assistance (OFDA): GLCI submitted a concept note to OFDA in Nairobi and the project director was invited to OFDA headquarters in Washington, DC to present and explain the proposed emergency mitigation activities. The presentation was well received, but unfortunately OFDA decided not to fund the project.
  - European Commission Humanitarian Office (ECHO): ECHO expressed concern about the outbreaks and GLCI and FAO discussed possible funding with them. In the end, ECHO was not in a position to fund an emergency centered on disease as its mandate is to support emergencies with an existing food security threat. Until farmers' food security is threatened, ECHO is not able to intervene.
- **Rapid response:** Though not successful in securing the funds, CRS and FAO undertook the following rapid response activities:
  - Conducted a rapid assessment of the extent and characteristics of the CBSD outbreaks
    - The Burundi assessment was funded by GLCI and carried out by ISABU, with supervision from IITA. An additional comprehensive survey is being conducted by ISABU in Burundi to understand the reasons for the sudden CBSD outbreak.
    - The DRC assessment was funded by GLCI, but was delayed by the political instability due to the elections, which barred IITA scientists from entering the country. The assessment will start in late January 2012.
    - The Rwanda assessment was funded by FAO, but due to the reorganization of the Rwanda Institute of Agronomic Sciences (ISAR) into the Rwanda Agricultural Board (RAB), it has been postponed to February.

- Held an emergency national cassava coordination meeting in each country to update stakeholders on the spread of CBSD in the Great Lakes region, co-organized, attended, and funded by GLCI and FAO.
  - The Burundi meeting was held in Bujumbura and was well attended by the Ministry of Agriculture (including the minister), NARS, phyto-sanitary institutions, the Consortium for Improving Agriculture-based Livelihoods in Central Africa (CIALCA), and United Nations and NGO projects. Results of the Burundi CBSD survey were shared with participants, who discussed action plans to halt the spread of the disease.
  - Due to the size of the country, DRC had two meetings (Kinshasa and Bukavu). The objective of the Kinshasa meeting was to inform and involve the ministries and national stakeholders; while the Bukavu meeting focused on the technical aspects of identifying ways forward to tackle the disease.
  - The Rwanda meeting was postponed and rescheduled for February 2012 due to the reorganization of ISAR-RAB. This meeting was coordinated by the national cassava coordination committee and had a strong presence of the district agriculture extension which was highly concerned of the potential impacts of CBSD on their districts.
- Screened existing germplasm for potential CBSD-tolerant material. Burundi, DRC and Rwanda do not yet have CBSD-tolerant material identified, and Kenya, Tanzania and Uganda do not have enough such material to share with other countries. Screening trials, including regular field and grafting trials, co-funded by GLCI and FAO, have been set up in these three countries to assess the existing germplasm for tolerant material.
- The distribution of the tissue culture plantlets of eight potentially CBSD-tolerant varieties to the GLCI countries was timely for these outbreaks. The plantlets were allocated twice to all the countries as the survival rates during hardening were low for all the countries, except Rwanda. The plantlets were then distributed the second time to all but Rwanda which then obtained considerably higher survival rates. GLCI allocated more plantlets to Burundi, DRC and Rwanda so they could get a jump start on eventually multiplying these varieties as foundation seed.

Part 2. The Assessment of the GLCI Partnerships

This part of the chapter reports on the assessment and analysis of the GLCI partnerships, mainly from the partners' perspectives, what aspects of the GLCI partnerships worked, how they felt about their relationships with the diverse institutions involved in GLCI, what they valued the most, what challenges faced them, and finally what they recommend to improve such partnerships as lessons learned that can be applied to future projects. These findings and conclusions were extracted from the case study on partnership. To view the full report, please refer to Case Study Appendix – Partnership.

I. GLCI Partnership Overview

A. Partnership structure

A GLCI regional technical team based in Nairobi manages the project. This regional team coordinates a web of vertical and horizontal partners (Figure 2). The number of the partners in each tier increases as it goes down the ladder. Two research institutions backstop research and technical components of the project, working directly with the six NARS and six NPPOs of each country. This partnership widens further at the local implementation level to 55 of local partners in the six countries, including both faith-based and secular organizations. These local partners in turn support the 3,048 farmer groups they have established to implement GLCI activities in the field.

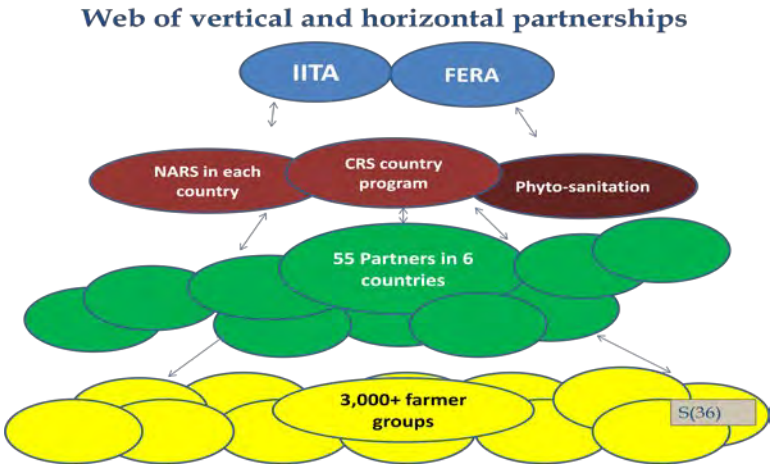


Figure 1. Web of GLCI horizontal and vertical partners

Each category of partners has distinct roles and responsibilities within the network of the partnerships (Table 2). While the CRS regional team coordinates the overall responsibilities of the partners, the CRS country programs coordinate the partners and their activities within each country. An essential role of the CRS country programs is managing relationships with the local partners and building their capacity, mostly embedded in activities, as most of these partners have been long-term CRS partners and often are involved in multiple projects. Due to the complexity of GLCI, CRS embedded extensive local partner capacity building into project implementation.

Table 1. Roles and responsibilities of each category of GLCI partner

Partners	Partners' roles and responsibilities
CRS country programs	**Coordinate** overall activities in each country • Manage relationships with all partners • Build capacity of local partners
IITA and FERA	**Provide scientific knowledge and information** • Conduct cutting-edge scientific research on CBSD • Provide technical backstopping • Provide disease-resistant material • Conduct training for NARS and NPPOs
NARS	**Bridge research and development** • Conduct primary multiplication sites • Conduct PVS and ICM trials • Implement disease surveys
NPPOs	**Provide regulatory policies** • Develop pest risk analysis and move material • Clean and tissue culture material
Local partners	**Coordinate development activities in the field** • Manage secondary multiplication and dissemination • Serve as training delivery channel to farmer groups
Farmer groups	**Act as a delivery channel** • Conduct tertiary multiplication • Engage in dissemination

- **IITA and FERA** conducted crucial research on disease studies and diagnostics that fed into the development activities within the GLCI framework (Figure 3). The results of these studies and diagnostics development were channeled to the partners via the CRS regional team and country programs to assist them in making decisions on multiplication and dissemination.
- The **NARS** was the bridge between research and development. IITA provided training and technical backstopping to the NARS, and in turn relied on them to carry out the work in the field, particularly the annual survey and lab-testing the survey samples. The NARS also coordinated, trained, and supervised partners and farmers groups to conduct Participatory Varietal Selection (PVS), and Integrated Crop Management (ICM) trials; again bridging research and development. Finally, the NARS were an essential element in the multiplication chain as they provided and multiplied the foundation material in the primary fields.
- FERA coordinates the **NPPOs** to develop the regional PRA as the basis to develop the individual country-based PRAs. This is one of the few seed projects that have meaningfully engaged the plant health institutions. Nonetheless, the NPPOs' roles were not as broad as those of the NARS and they were limited to developing PRA and the associated guidelines for planting material movements within the framework of risk analysis.
- The number of **local implementing partners** fluctuated and 55 finished with the project at the end. These local partners were instrumental in implementing the development activities—conducting secondary multiplication sites, implementing PVS and ICM trials, establishing and training farmer groups, supervising tertiary sites managed by the farmer groups, organizing dissemination, and collecting and entering data. They were the engine of project implementation in the field, and the key to project success.
- The **3,000+ farmer groups** were the delivery channel and the pivotal point to reaching scale. Without these farmer groups, the partners could not possibly have directly managed the 5,500 tertiary multiplication sites required to reach the 1.35 million beneficiaries.

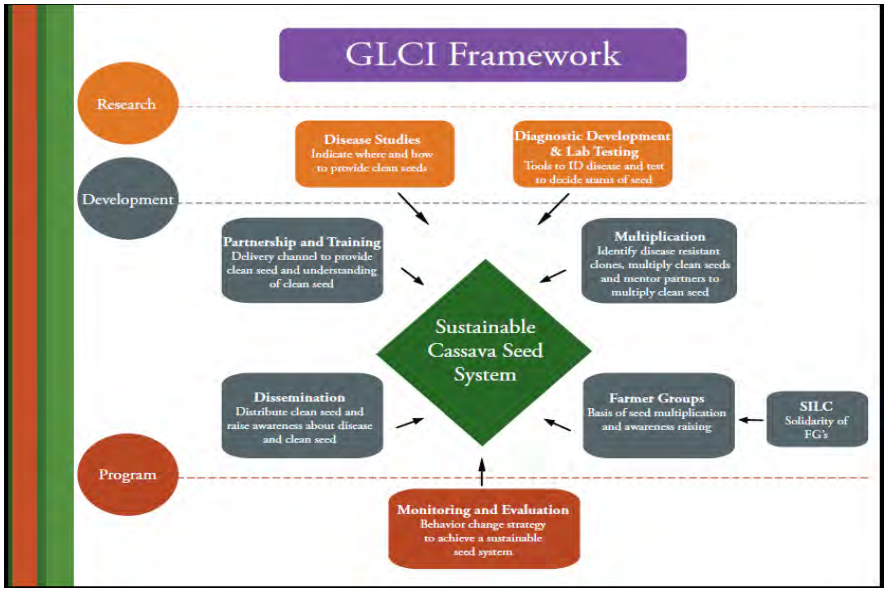


Figure 2. The GLCI research and development framework to create a rigorous seed system

B. Partnership building

GLCI built and maintained its network of partners through regular meetings, training sessions, visits and workshops which brought together representatives from partner institutions from all six GLCI countries and included the following:

- **Annual learning alliance meetings:** The GLCI team came together for an annual learning alliance meeting to review the progress of the past year and plan for the subsequent year. The number of participants ranged between 45 and 55 and included the CRS regional team, CRS CPMs from all six countries, and representatives from IITA, FERA, NARS and NPPOs from selected countries, as well as partner supervisors, paid field agents, volunteer field agents, and occasionally farmers. The location rotated among GLCI countries and partners greatly valued the opportunity to participate in this event to network and build relationships, as well as to review and plan.
- **Bi-annual country planning meetings:** Since not all GLCI partners could attend the annual meetings, each country held a meeting twice a year to review and plan for each season. The CRS CPM in each country coordinated this meeting and invited the NARS, NPPOs, and the Ministry of Agriculture representative were invited to this review and planning. One or two GLCI regional team members would also attend these meetings. These meetings provided opportunities for the partners to network and build relationships within the context of the country.
- **Workshops and conferences:** Over the course of the project, GLCI sponsored partner representatives to participate in workshops and conferences in Africa, such as ISTRC, CBSD scientific meetings, and the GCP conference. Though only a limited number of partners were able to participate, these have been additional opportunities for GLCI partners to meet and network.
- **Training:** Training was a major component of GLCI and the project organized more than 7,000 such events for all different levels of partner staff. Training in computer use and data entry alone brought together all partner staff numerous times in each country. At all such events, partners shared information and built relationships.
- **Exchange visits:** GLCI exchange visits allowed a combination of partners—NARS, NPPOs, local partners, farmers and local authorities—from one country to visit another. The purpose of most exchange visits was disease and disease surveillance, and the participating partners exchanged information on their experiences, failures, and successes in combating cassava diseases.
- **End-of-project events:** Toward the end of the project, each GLCI country held a closeout meeting with partners, Ministry of Agriculture representatives and other stakeholders. This provided a closure for the ministry as well as the partners, but also an opportunity to exchange on the partners' continued involvement in combating cassava diseases in other projects. A regional end-of-project event was held in Nairobi and this provided the opportunity for the partners from different institutions and all the GLCI countries to renew, and at the same time, close, the GLCI relationships though these relationships, built during the four and half-year project, are certain to be sustained in some other capacity.

C. Local partner capacity building

The most comprehensive capacity building took place at the local partner level, though all levels of partners increased their technical capacity due to the complexity of the project. Through the implementation of GLCI, partners increased their capacities in the following areas:

- **Project planning and management:** GLCI was a complex project with a matrix of activities that required rigorous advanced planning and diligent management. The partners learned thorough planning for seed acquisition, calculation, and dissemination in order to coincide these activities with the planting and harvesting season. They also learned to manage large numbers of farmer groups and their multiplication and dissemination activities in an orderly and timely manner.

- **Financial management and reporting:** The partners were trained in precise and timely accounting systems. In the beginning of the project, the partners experienced difficulty in delayed disbursement of funds as a result of their late financial reports and liquidation. It had even caused some partners to miss the rains and planting season. Over the life of the project, such occasions have gradually reduced as the partners learned to manage and report their finances more responsibly and timely.
- **Technical expertise:** Partner supervisors and paid field agents were trained in technical subjects by a combination of face-to-face and e-learning. Topics in which face-to-face training only was provided included: 1) varietal identification; 2) PVS; 3) ICM; 3) cassava storage, preparation, planting and harvesting; 4) QMP; 5) introduction to information and communication technology (ICT); and 6) forming SILC. E-learning courses included: 1) cassava pests and diseases, 2) cassava multiplication, 3) cassava dissemination, 4) farmer group management, and 5) working with adult learners.
- **Technology updates:** GLCI provided 206 partner staff, most of whom had no prior experience with computers, with ruggedized mini-laptops and repeated training in computer use, e-learning courses and data entry. Along with the laptops, the field agents were trained to collect spatial data with GPS to record the coordinates of multiplication sites and farmer group locations. The introduction of these technologies to the field staff thrust them into the modern world of ICT.
- **Network with experts and other partners:** Partners had ample opportunities to meet and network during the frequent GLCI training events and meetings, as well as in workshops, conferences, and meetings which GLCI sponsored partners to attend. As described above, each category of partners has its distinct roles, functions and expertise, and learning from each other's expertise is a major advantage of networking.
- **Broadened world view:** Participation in GLCI exposed the partners to a complex project with multiple levels and categories of partners from six countries. The partners' world view was significantly broadened by the technical components of the project, the nature of integrating research with development, the introduction of the modern technologies, the interrelatedness of the different levels of partners, and opportunities to see the same work in other countries.

II. Partners' perspectives of the GLCI partnerships: survey findings

The perspectives of the international and national institutions are based on the qualitative data, and are quoted directly from the respondents. The perspectives of the local partners, on the other hand, are derived from the analyses of the quantitative data. This section will first present the partners' views of their relationships with other institutions with GLCI, followed by their views of the GLCI performance as the result of the partnerships. The partners also presented their views of the challenges encountered and recommendations for moving forward.

A. Relationships among institutions

The extensive GLCI partnerships can best illustrated by a diagram showing the various levels of partners and their relationships with each other (Figure 4). Overall, this extensive partnership was considered "more than a necessity" by the partners as it was needed to address the common problem cassava diseases in the region, which are not particular to any specific country.

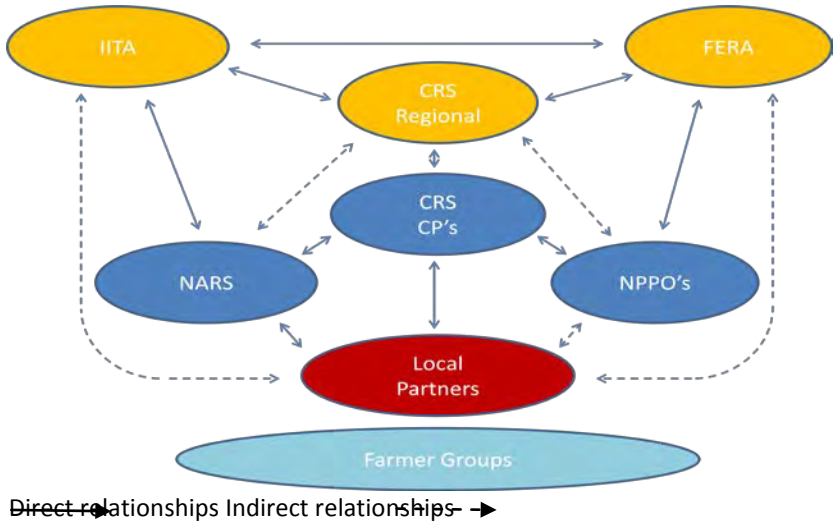


Figure 3. The working relationships of the GLCI partner institutions

1. Feedback from International research institutions: IITA and FERA

The working relationships of IITA and FERA with other partners is illustrated in Figure 5. Both IITA and FERA had direct working relationships with the CRS regional team and with each other. IITA worked directly with the NARS while FERA with the NPPOs. They both had indirect and limited relationships with the local partners.

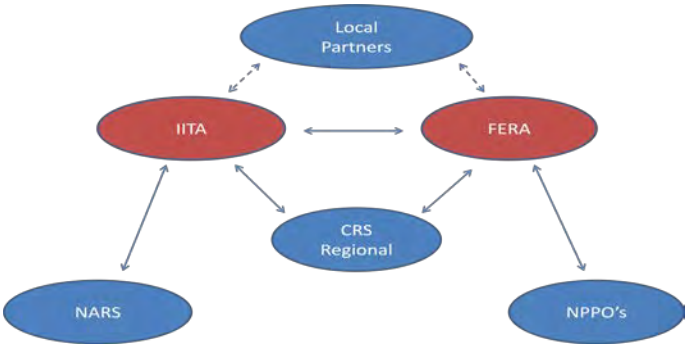


Figure 4. The relationships of IITA and FERA with other partners

Perspectives of overall partnerships

IITA felt that, despite that the "early phases of partnering were difficult for all," the relationship with the CRS regional team was essential, especially once the initial difficulties had been overcome. FERA stated that "The role CRS played in facilitating the better relationship between FERA and IITA is important to state." Maintaining good relationship between these two institutions resulted "in significant complementarity and mutual support between the programs of these two institutions." This complementary relationship formed the basis for the strong scientific knowledge GLCI produced, which, as shown below, was considered by all partners the most appreciated aspect of the GLCI partnerships.

Relationships with other GLCI partners

The NARS were IITA's primary partners in most of their GLCI work, and this partnership was "productive and worthwhile" as they conducted most of the work together. IITA supported NARS and provided capacity building "smoothly and effectively." While IITA's engagement with the NPPOs was limited, their work with KEPHIS was considered by IITA as essential. FERA, on the other hand, fully engaged with the NPPOs, and "added a critical phytosanitary dimension to the GLCI that was hitherto absent." In turn, GLCI "provided a good basis on which to further the capacity of the NPPOs in CBSV phytosanitation and quarantine." FERA's relationship with the NARS was limited to receiving secondment to provide training, and under this arrangement, "GLCI provided a good basis on which to further the capacity of the NARS in CBSV research." It was perceived that this partnership provided "a good example for the need to engage with NPPOs alongside the NARS."

IITA and FERA had only occasional direct association with the local partners, and felt that "whenever this was needed, partnership worked well."

Institutional benefits from GLCI partnerships

IITA appreciated that their partnership within the project "broadened IITA's partnership for cassava research for development." FERA's involvement with GLCI has furthered its "reputation as an international centre for research and risk evaluation" and also supported its "UK role in emergency response." Individual FERA scientists involved in GLCI have received bonus rewards "on 4 occasions over the course of the project in area of statistics, research, testing, and services." Both institutions are strong advocates of this partnership, stating that "results achieved would have been significantly weakened had any of the main collaborating partners been absent. Most significantly, the research/ regulatory/development institution grouping provided the required partnership framework for tackling new disease problems, impacting large numbers of farmers in a diverse agro-ecological environments in East/Central Africa."

2. Feedback from national institutions: NARS and NPPOs

The working relationships of the NARS and NPPOs with other partners is illustrated in Figure 6. NARS have more direct relationships with other partners as they work directly with the CRS country programs, local partners, and IITA; while they had indirect relationship with the CRS regional team. The NPPOs' worked directly with FERA as all their work was channelled through FERA to the rest of the partners. NPPPOs had indirect, almost peripheral, relationships with the local partners, and CRS regional team, and very limited contacts with the country programs.

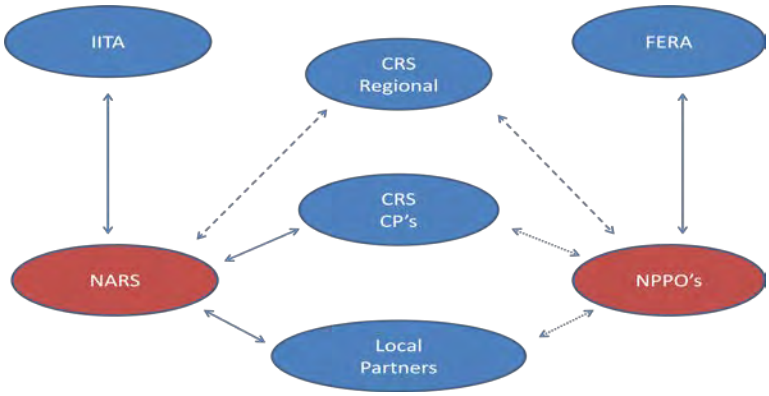


Figure 5. The relationships of NARS and NPPOs with other partners

Perspectives of overall partnerships
The activities of the national institutions were coordinated out of the CRS country programs, and they were the linkages between the international agencies and local partners. These respondents were generally positive about their relationship with the GLCI regional team, stating that "it was good, there was direct contact and communication on different issues" or "very useful as the exchange of the idea/opinions between the leading of the project and partners helped in the implementation of the activities.'' The relationship can also be challenging at times "depending on the person to be in touch." Overall, the feeling was that partnership "with GLCI was important and was a worthwhile venture."

As these institutions' activities were coordinated by the CRS country programs, there were some administrative and logistical challenges, such as financial reporting and conflicts with direct contacts at CRS (CPMs) who may not have sufficient technical background in the eyes of the NARS. Otherwise, the partnerships were generally considered "good and important."

Relationships with other GLCI partners
There was consensus among the NARS respondents that collaboration with IITA was "worthwhile, interesting, and very necessary," to which they attributed the success of the disease objective. Some view the basis of this collaboration as "sharing technical information," but mostly the NARS appreciated IITA's "technical support particularly on annual survey and PVS activities" as well as the training, guidance, and "building capacity of NARS in disease diagnosis, especially in lab implementation and training." Since NARS had limited collaboration with FERA, it is understandable that the NARS were ambivalent about FERA's role within GLCI.

Thus it is also to be expected that the NPPOs felt strongly about the collaboration with FERA, as they highly valued the training opportunities which contributed to "building our capacity in the testing of cassava brown streak virus using molecular techniques." But "even without equipment, FERA has made us what should be in the detection of virus in the laboratory." KEPHIS is "grateful to GLCI and FERA" for building their capacity to become a regional center for CBSV testing.

Unfortunately, the linkage between the NARS and NPPOs was not well established. NARS do not seem to see much point of the role of the NPPOs and some deemed the relationship as "not necessary" while others disregard them since NARS rely more on QMP, rather than NPPO guidance and regulations, for field virus detection. The NPPOs, on the other hand, seemed to appreciate more the collaboration with the NARS, as they considered the "NARS institutions" as "useful as a partner in the GLCI project."

In terms of relationship with local partners, the NPPOs were again far more positive as they considered their "partnership with other local GLCI partners also useful and important," and they felt that the local partners strengthened their role in "monitoring and inspection of seed fields of cassava cuttings to be healthy to provide farm households." The NARS, on the other hand, were more critical of the local partners' deficiency in technical expertise than complimentary of their linkage to the field. They felt the local partners "need some training to understand the techniques they are administering" or "partnership with local partners was very challenging. Most of the partners on the ground were not aware of agricultural research activities before GLCI." The NARS scientists expressed much doubt in local partners' ability in managing the ICM and PVS activities.

Institutional benefits from GLCI partnerships

The NARS and NPPOs respondents felt that the benefits of GLCI partnerships to their institutions were twofold: capacity building and material development.

Capacity building

For the partner institution, the highest value of this partnership was on capacity building to achieve the institution's mandate in cassava pests and diseases management. The partners identified the following areas that contributed to capacity building "in detection of CBSV in cassava was also enhanced to ensure farmers get clean planting materials":

- "Training for scientist and technicians, thus capacity was built for staff to carry out the following:"
  - Virus cleaning of cassava viruses
  - Lab virus diagnosis using molecular techniques
  - Field virus detection using QMP
- Diagnostic lab equipment acquisition which allow the institutions to make functional labs
- Acquisition of office equipments

Technical material development

The partners also developed the following materials under the GLCI partnerships:

- PVS released improved cassava varieties resistant to CMD and tolerant to CBSD
- Provided seed source for partners and farmer groups with material for multiplication
- Enhanced germplasm exchange in the region

3. Feedback from local partners

The local partners had the most extensive working relationships with the CRS country programs and NARS, and to a lesser extent with NPPOs. They had indirect relationships with the CRS regional team, IITA, or FERA (Figure 7).

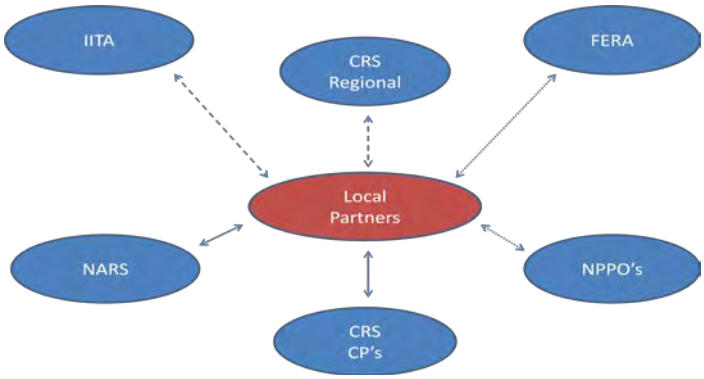


Figure 6. The working relationships of the local partners with other institutions

Perspectives of overall partnerships

The local partners' role was coordinated by the CRS country programs, and 60% of these partners felt that they have had extensive working relationship with CRS; while 28% felt that the level of interaction was moderate. Only a small percentage felt they had little interaction with the CRS regional team or country programs.

Relationships with other GLCI partners

The relationships of the local partners with either the international institutions (IITA and FERA) or the national institutions (NARS and NPPOs) were assessed by two criteria: the levels of interaction and the mechanism of the relationship. The numbers in these three tables are percentage of positive responses.

Table 3 shows that most partners had extensive interactions with other partners. The only exception was FERA, since they mainly worked with the CRS regional programs and the NPPOs. FERA conducted the lab-testing to determine whether sites were suitable for further multiplication or dissemination, but this was centrally coordinated at the CRS country and regional programs.

Table 2. The levels of interactions with the other partners (%)

Level of interaction	IITA	FERA	NARS	NPPOs
Extensively	54	16	76	62
Moderately	36	48	12	22
Vaguely	4	6	4	6
No idea	2	28	4	6

By the same token, although 28% of partners claimed that they did not use any results from FERA, that again was because the lab-testing results were not perceived coming from FERA (Table 4). IITA featured prominently as an institution that partners worked with, even more so than the NARS. Partners felt that they provided feedback from the field to, while also using result much from, the NARS and NPPOs.

Table 3.The mechanism of the working relationship among partners

Mechanism of the relationship	IITA	FERA	NARS	NPPOs
Working directly with them within GLCI	46	8	26	18
Using results from their work	44	50	36	24
Provide feedback and inputs to them	4	12	40	46
Do not use anything from them	4	28	4	10

Institutional benefits from GLCI partnerships

The responses in Table 5 show that gaining scientific knowledge and updates on scientific information is highly valued by the partners. They perceived IITA as the major source for such knowledge and information, and while NARS and NPPOs also provide such value, it is perceived less by the local partners. The value of the national institutions was perceived as more related to the national contexts in that the NARS identified the national priority while the NPPOs provided the policy and regulatory environment (Table 5).

Table 4. The benefits of participating in the GLCI partnership

Benefits of GLCI partnership	IITA	FERA	NARS	NPPOs
Gaining scientific knowledge	78	48	66	62
Providing us equipment and material	36	6		
Improving our quality of work	30	14		38
Networking with the scientists	18	10	32	20
Increase the visibility of our work	10	4	22	10
Help orient work to national context			48	42
None	8	32	6	8

On the other hand, the international and national institutions responded that the benefits of working with the local partners, were, not surprisingly, mainly related to the local partners' interface with farmers. The value addition of having the local partners in the partnership cited include "they implement the science, guidelines, and policies set by us", "they reach farmers/beneficiaries in the way we cannot", "they increase the relevance and quality of our work", and "as the interface with farmers, they facilitate testing and provide feedback on our science, guidelines, policies."

These feedback from the partners clearly indicated that they all appreciated the important contributions made by each of them in this GLCI network; though as mentioned above, FERA's role was less clear to the other partners due to the lack of direct interactions. Thus, it was almost unanimous that all partners contributed, and were essential, in this partnership for reaching the goal of the project (Figure 8).

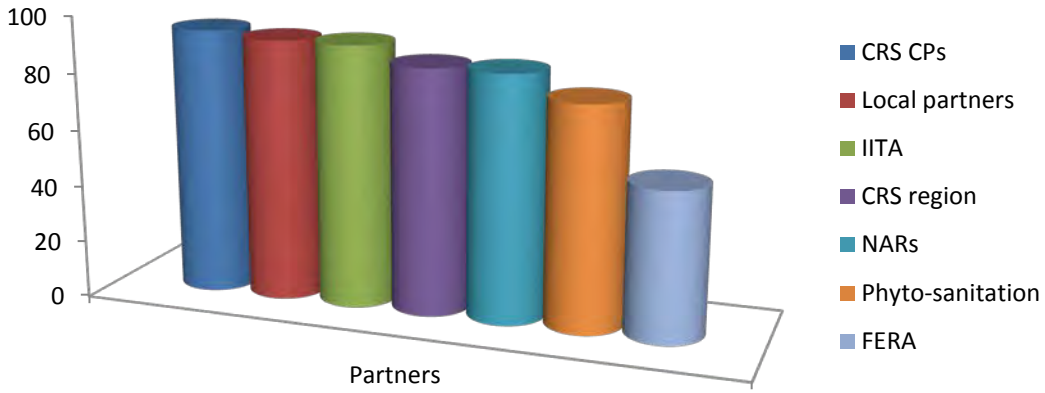


Figure 7. Percentage of respondents that agreed that all partners were necessary

Likewise, 60% of the respondents strongly agreed, while the other 40% agreed, that it was the partnerships that had led to the uptake of the results of disease research and phyto-sanitary policies and regulations with farmers in GLCI.

B. Partners' view of the project performance

The partners' opinion of the project performance was generally positive, though not always overwhelmingly so. Interestingly, the GLCI partnership was considered the second best aspect of the project, next to the quality of training GLCI has provided. These two aspects of the project were surprisingly better rated than the use of technologies for the partners, which was clearly one of the most valued outcomes of GLCI (Table 6). This shows how much value the partners place on their capacity building and on all that is associated with the partnerships. Overall, it was considered that the "broad collaboration, and most importantly, the links established between NGOs and research, have provided an excellent platform for the achievement of the goals of GLCI." In addition, it was evident that "GLCI has aspired to a better standard and provided an example to others."

Table 5. Partners' ranking of aspects of the project performance (%)

Project performance aspect	Strong	Moderate	Acceptable	Weak	Ranking
Training quality	55	40	4	0	1
Integration of all types of partners	43	47	9	2	2
Local use of technologies	45	40	11	4	3
Integration of GLCI components	35	58	8	0	4
Local partner implementation	35	50	15	0	5
Uniformed approach across countries	34	51	17	0	6
Project management structure	17	79	4	0	7
Responding to farmers' needs	28	51	19	2	8
Methods of implementing the project	9	80	9	2	9
Average	**33**	**55**	**11**	**1**	**--**

There are pros and cons to the regional approach versus the country-specific approach to disease management. The regional approach, in this case, underlies this extensive partnership; in other words, this partnership would not exist without this regional approach. Gaining scientific knowledge is not only the most valued benefit of partnering with prominent international and national institutions; drawing on the knowledge of this wide spectrum of partners is also considered the greatest advantage to the regional approach to disease management (Figure 9).

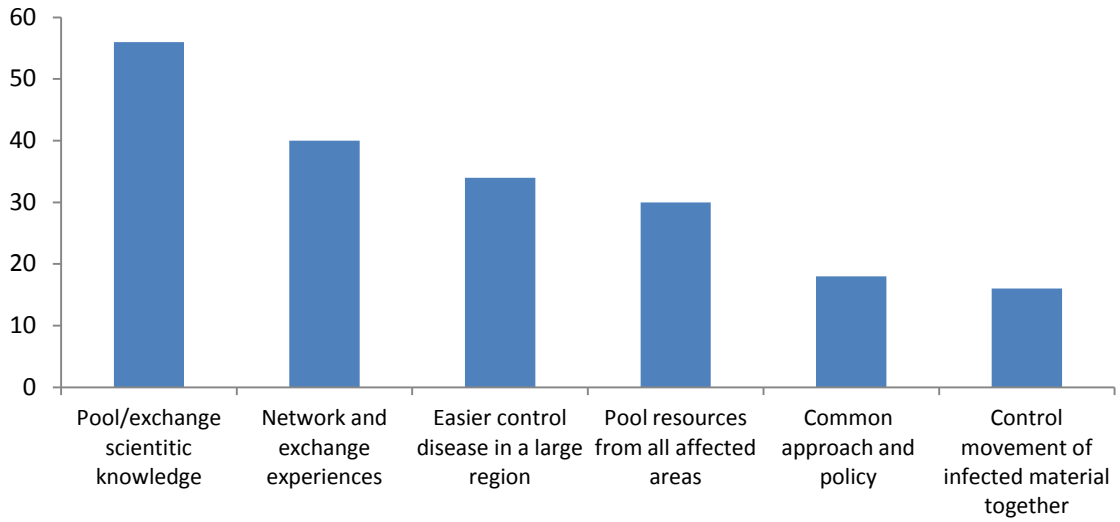


Figure 8. The advantages to the regional approach to disease management (%)

On the other hand, the greatest danger of the regional approach is the tendency to generalize and lack of responsiveness to country-specific issues. Though, in this case, there is much less agreement on the disadvantages than on the advantages (Figure 10).

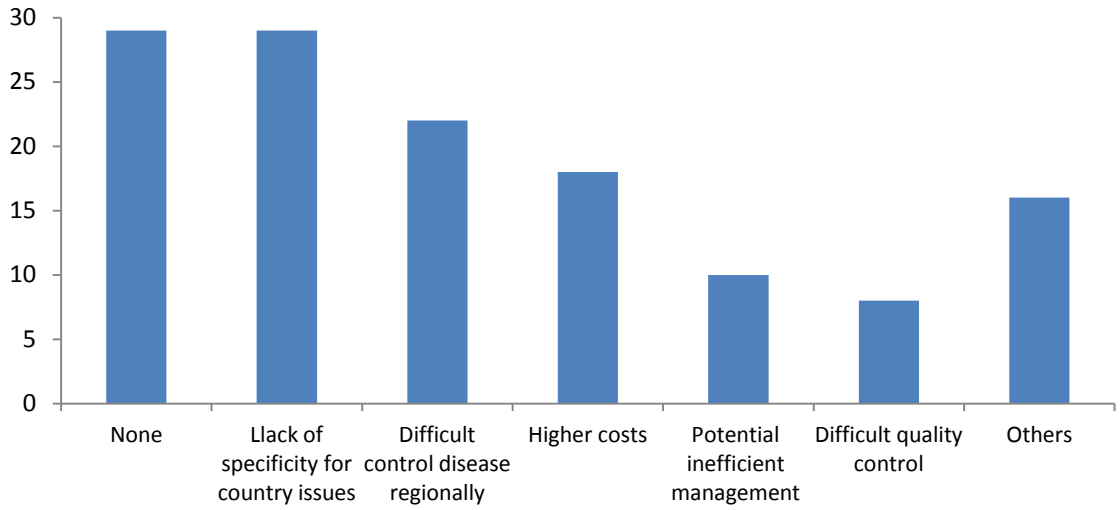


Figure 9. The disadvantages to regional approach to disease management (%)

Considering the advantages and disadvantages to the regional approach to disease management, 75% of the partners advocated the regional approach while 25% supported the country approach.

On a scale 1-10, the partners rated the GLCI partnerships against other partnerships they had been involved in, 87% rated GLCI partnership 7 and above (Table 7).

Table 6. Partners' rating of GLCI partnerships against others on a scale of 1-10

Scale 1 - 10	10	9	8	7	6	5
%	22	9	24	33	9	4

The partners reported that the following were achieved under the GLCI partnerships:
Planting material for farmers

- "Availability of planting material for households was improved, this leads normally to improvement of productivity of cassava"
- "Farmers' access to improved clean cassava planting materials"
- "Availed planting materials and improved livelihood of the vulnerable group of people in the area of implementation of the project"
- "The collaboration has helped a lot in ensuring clean cassava plantlets were distributed in the GLCI partner countries and this will ensure food security in the region"

Farmers' capacity building
"Farmers received training and had their capacity built during the process of the GLCI partnerships."
Establishment of research and implementation platforms
"The broad collaboration, and most importantly, the links established between NGOs and research, have provided an excellent platform for the achievement of the goals of GLCI."

When asked which aspects of the partnerships were essential, the response was "all of them," and the partners felt that GLCI wouldn't have reached its goals without this network of partnerships. The following comments from partners sum up the significance of the GLCI partnership to reaching its goal: "All the major components of the GLCI project were essential, and results achieved would have been significantly weakened had any of the main collaborating partners been absent. Most significantly, the research/regulatory/development institution grouping provided the required partnership framework for

tackling new disease problems impacting large numbers of farmers in diverse agro-ecological environments in East/Central Africa."

C. Challenges of the partnership

The major challenge cited by the partners was financial reporting and fund disbursement, though a management issue, the effects spilt over to the technical work. The confusion about roles and responsibilities during the early days of the project directly impacted the partners' ability to perform. Communications can be challenging in remote areas, particularly in DRC and Lake Zone Tanzania, and can cause delays in field work.

- **Financial reporting and fund disbursement:** A common mutual complaint regarding financial reporting and disbursement was that finance staff said that partners did not submit reports on time while the partners said the complicated financial reporting procedures caused delays in fund disbursement. These delays in turn had on occasion caused the partners to miss the season, and partners were not able "to do all we had planned for." The underlying challenge of this dispute in financial reporting was the lack of an assigned financial project accountant in some of the CRS country programs. Instead, they used pooled accountant whose responsibilities did not solely lie within the GLCI project, and this often caused delays in the accounting procedure. The turnover of accounts staff in some of the countries also contributed confusion and delays in financial reports and fund disbursement, which in turn caused delays in the work in the field. Thus the partners who were in charge implementing the work in the field experienced frustration. The partners felt that "we missed some achievements because of the delay due to funds disbursement system."
- **Roles and responsibilities:** Much of the friction between institutions and partners during the early years of the project were attributed to the lack of clarity of roles and responsibilities. "Many of the early difficulties experienced might have been prevented had there been a clearer collective understand of who should do what." Some partners felt that there was no meaningful follow up on the PVS trials, which indicated a lack of clear definition of whose responsibility it was to follow up. A partner stated that "the coordination at the beginning was not easy" and this points deficiency in coordination which resulted in unclear roles and responsibilities.
- **Challenging communications:** "Communications with some partners at remote sites was a challenge. As NARS, it was not possible to reach all the sites for PVS and ICM follow up. So it was difficult to get data in time when needed."

D. Recommendations on ways to improve the partnership

Before summarizing partners' recommendations on ways to improve, it is worth quoting one partner's response that "partnership was so perfect that I have nothing to add." Under each heading of the recommendations, all the bullet points below are direct quotes from the survey responses.

While the partners showed high appreciation of the partnership, they also pointed out ways to improve it. They called for more frequent meetings for information sharing and networking as the most helpful way to improve this partnership (66%). All other avenues were distant seconds to this request: exchange visits (16%), more human and financial resources (14%), more partner capacity building (8%), and better initial orientation of the project (2%). There were also 12% of the partners thought that nothing was needed to improve upon this partnership.

1. Well defined roles and responsibilities

- Clearer definition of roles and responsibilities from the outset and each partner focuses on its core area of expertise.
- All partners should be involved at the start of the project and the role of each spelt out.

- Partners to be trained to best understand their subject and what is expected of them.

2. Project staff skill sets

- Team-building skills used as a key criterion when selecting senior project staff members.
- CPMs should have background and knowledge on research or agriculture.
- Respect for technical inputs in decision making.
- More staff exchanges that are embedded in the career development aspirations of the individuals and their organizations.

3. Planning, reviews, and information sharing

- Joint progress reviews and planning.
- There is a need to have coordination meetings with all the partners regularly to solve some difficulties for good implementation.
- More communication and sharing available information within partners.

III. Summaries and conclusions

Below are summaries of the partner relationships and partner capacity building within these partnerships and conclusions.

A. Partner relationships

This explored the relationships between the CRS regional team, country programs, international research institutions, national institutions, and local partners. The respondents indicated that, after the initial difficulties during the early years of the project, once the roles and responsibilities were clearly defined, all the institutions settled into their positions in the partnerships.

1. **The international agencies valued the collaboration with the CRS regional team**, after the initial difficulties had been overcome with better defined roles and responsibilities.
2. **The national institutions by and large appreciated their relationship with the CRS country program**, some frictions had been caused by delayed financial reporting and fund disbursement which in turn caused delay or reduction in the fieldwork.
3. **IITA and NARS valued the mutually beneficial relationship** in which IITA provided training, technical inputs and backstopping while the NARS implemented the work in the field. FERA and NPPOs had the similar relationship, and both sides appreciated and valued the collaboration.
4. **Unfortunately, the linkage between NARS and NPPOs was not well established.** NARS does not see the value of the role of NPPOs; though NPPOs had better appreciation of the role of NARS.
5. **Similarly, the NARS had reservations of the ability of the local partners in implementing some of the technical work while NPPOs had greater appreciation for the role of the local partners.**
6. **The local partners put the highest value on gaining scientific knowledge and updates.** They appreciate the presence of IITA in the project, as they value their scientific and technical inputs. FERA's inputs were less known to the local partners, as they were more upstream scientific knowledge and development and less applicable to the partners.

These summaries of relationships point to the following conclusions:

1. **The complementary and mutually supportive relationships between IITA and FERA were the cornerstone of this partnership because the solid science coming out of this synergy lent credit to the development activities.** The scientific knowledge and information developed by these institutions was also most highly valued aspect of GLCI by all the partners. Sub-conclusions can be drawn from this cornerstone of the project.
   - Harmonizing IITA and FERA relationships. It was of the greatest importance for the CRS regional team not only to maintain a good individual relationship with IITA and FERA, but also to harmonize the relationship between the two to ensure the maximum collaboration which led to the science produced.
   - The strong science produced from this synergy provided the foundation for the trust, confidence, and faith of the NARS, NPPOs, and local partners in GLCI. These national and local partners all placed the highest value on the validity of development activities being solidly supported by the cutting-edge science produced under GLCI. This strongly indicates the need and validity of the regional approach to not only a project dealing with diseases, but agricultural improvement in general.
   - Making science more applicable and visible to all partners. FERA's product in basic science provided the backbone of the success in the background and was less visible than the more field-based science produced by IITA. It was the combination of both that led to the success of the project. More efforts should have been placed on making FERA's science applicable to the implementing partners so that more scientific knowledge and information can be shared and imparted.
2. **While the national institutions and local partners all valued their relationships with, and what they gained from, IITA and FERA, the potential synergy between NARS and NPPOs was not realized.** By the same token, the relationships between the local partners and the national institutions, though not strained, could have been more productive. This conclusion points to the following sub-conclusions.
   - Promoting linkages between NARS and NPPOs. While NPPOs did see the value of a working relationship with NARS, the feeling was not mutual. More extensively forged linkage between the NARS and NPPOs would have produced more national synergy.
   - Forging relationships between NARS and local partners. Though the local partners are more directly linked to the NARS, they seem to look more to IITA for scientific guidance. Measures should have been installed to promote local partners' trust and confidence in NARS as that is the relationship that should be nurtured and sustained.
3. **Financial reporting and fund disbursement.** These procedures have caused delays in the highly season-dependent activities by the national and local partners. Resolving this issue will not only reduce conflicts between CRS and partners; more importantly, it will in turn avoid delayed, or even cancelled, field work and improve field efficiency.

B. Partner capacity building

Training and capacity building is rated as the most valuable aspect of GLCI achievement, followed by the integration of the partners within the project. These are two inter-related aspects as capacity building underpins the partner collaboration and integration. Capacity building for the national and local partners under GLCI can be summarized below.

1. **National partners (NARS and NPPOs):** National partners highly valued training for scientists and technicians in lab technologies or field-based virus detection techniques. They also greatly appreciated the equipment supplied by GLCI which has made their labs functional for virus testing.

In addition to the human and material infrastructure for virus testing, the NARS were pleased to have developed disease tolerant or resistant varieties through PVS and produced seed sources for partners and farmers, or the enhanced germplasm to exchange with other countries in the region.

2. **Local partners:** Local partners appreciated most of the extensive training curriculum and the training quality. These trainings updated them on the technical expertise and the scientific knowledge that they valued. The next most appreciated aspect of the project is the learning of the use of technologies, such computers and GPSs.

The following conclusions are drawn from the summary of partner capacity building:

1. **Training and capacity building underpins working relationships of various partners and provides the platform for knowledge and information sharing.** Ultimately this translates to success in implementation, as it is supported by technical and scientific knowledge. GLCI has done well in this area, and it is recommended that future projects place emphasis on capacity building with strong technical and scientific backstopping.
2. **Institutional capacity building requires both human and technology development.** Equipping partners with the tools and technologies allows the institution to fully utilize the human development and scientific updates acquired through training. GLCI provided the NARS and NPPOs with equipment for lab testing capacity, after providing training to the staff and now these partners have functional labs and competent staff to run the labs. This two-prone approach to capacity building is highly appreciated and recommended for future projects.

C. Challenges experienced and recommendations by the partners

The major challenges experienced by partners were financial management and unclear roles and responsibilities early in the project. Thus, well-defined roles and responsibilities were identified by multiple partners as a way to improve partnerships. GLCI salvaged the partnership by clearly defining the individual roles but also identified the synergies to be gained by integrating these individual roles less than half into the project period. It is strongly recommended to, as much as possible; delineate these relationships collectively with all partners involved from the very beginning.

Though no respondents followed up on this challenge by suggesting a more efficient financial management system as a way to improve partnerships, this is clearly a bottleneck that needs to be addressed. Over the project period, the severity of this problem was gradually reduced as the partners learned to follow the rigor of financial reporting of a major project like GLCI. Both the CRS country programs and the partners own some of the responsibility in the bottleneck, which was created collectively. For CRS country programs, it would greatly facilitate the financial management if a financial project account is assigned to the project. This is not the usual practice of the country programs, but is highly recommended to improve the efficiency of financial management.

Partnerships were the bases for success of GLCI. These partnerships provided a platform for integrated research and development, from which many innovations were developed. These innovations established a rigorous seed system within the context of diseases, built a model to manage the large scale of field staff and farmer groups, and developed an ambitious field-based M&E system. These innovations underlined the success of reaching, and documenting, 1.35 million beneficiaries with clean planting materials of improved varieties. Reaching this target all relies on these partnerships. The success of this partnership led most partners to favor the regional approach to such a project which addresses a disease without boundary. This is the same as favoring the partnership approach, as the regional approach by nature is predicated on partnerships.

Chapter 2. Disease

In the context of the emergent Cassava Brown Streak Disease (CBSD) and the scant knowledge available of this disease at the inception of the Great Lakes Cassava Initiative (GLCI), the disease objective was designed to gain scientific understanding of CBSD, to monitor the spread of the disease, and to ensure that farmers received clean planting material in order to contribute to the containment of the disease. The disease objective had the following components:

1. Testing source site cassava material for presence of Cassava Brown Streak Viruses (CBSVs) prior to multiplication
2. Establishing the risk analysis of planting material movement
3. Increasing knowledge in CBSV transmission
4. Increasing knowledge in CBSV epidemiology
5. Monitoring and forecasting CBSV
6. Developing diagnostics tools to identify CBSV in the plants
7. Strengthening regional and local capacity to diagnose and monitor CBSV
8. Identify and distribute CBSD resistant/tolerant cassava genotypes
9. Assessing benefits of disseminating disease-free improved varieties to farmers

The disease component was implemented by the International Institute of Tropical Agriculture (IITA) and the Food and Environment Research Agency (FERA – UK), under the coordination of the GLCI project director, and in conjunction with the seed objective, to ensure the research was designed to feed directly into decisions about multiplication and dissemination. This chapter reports on the progress and process of the results of the research and studies of the disease objective over the life of the project. For a comprehensive understanding of the activities and results of these research activities and studies, please see the IITA Final Report Appendices and FERA Final Report Appendix, and the numerous annexes appended to each of these two final reports.

The Progress, Process, and Results of the Disease Research and Studies

1. Testing GLCI source site cassava material for presence of CBSVs prior to multiplication

During the first year of GLCI, a meeting of representatives of IITA, National Agricultural Research Systems (NARS), regional laboratories, the Association for Strengthening Agriculture Research in Eastern and Central Africa (ASARECA), the UK Central Science Laboratory (CSL – now FERA), GLCI objective team leaders, and the Gates Foundation was held in Nairobi to discuss the new CBSV testing protocol and other aspects of the disease objective. Source sites were to be tested to ensure delivery of clean material. The new protocol was adjusted to increase the number of samples per site from 50 to 300 to allow 95% confidence of detecting a 1% level of infection. Duplicate samples were to be sent to IITA at Biosciences eastern and central Africa (BecA) and to CSL. 129 sites were sampled during the month of July 2008. Not all the results were available from CSL by the end of this reporting period but the initial BecA results using Real Time (RT)-PCR suggested high levels of infection in all countries. Further testing was required to be posted this reporting period, comprising sequencing and further PCR. This showed many positives to indeed be negative. Results of IITA-BecA, CSL (using real-time PCR) and visual symptoms did not correlate well. Please see IITA Appendix A – CBSV Sampling Report on the sampling collection during this first lab testing exercise.

By 2009, it was acknowledged that the number of samples to be analyzed needed to be reduced and the laboratory protocols for source site testing had to be reviewed to save time and costs without compromising accuracy. The Quality Management Protocol (QMP) would be further refined and tested in the expectation that LAMP-LFD or NASH would be available at the end of 2009.

The final laboratory results from the testing of the second batch of 190 source sites (57,000 leaves) in July/August 2009 became available the following October. Nine fields (in Kenya, Tanzania and Uganda) tested positive. All 27 source sites (8,100 leaves) sampled in January 2010 showed no positive samples. These results compared with 11 positive fields from 129 sites in 2008 and indicated that quality-control measures were having a significant and increasing effect and the evidence of a general trend towards reducing CBSV in the GLCI source sites over time. Testing in the September-November 2010 season was reduced due to implementation of the Pest Risk Analysis (PRA) risk framework to determine the need for PCR testing, which considerably reduced costs.

By the July-August 2010 season only 90 source fields were tested as the result of decisions on "smart testing". Out of these, nine CBSV positives were recorded, mainly from Tanzania. This was because Uganda had adopted the use of QMP more rigorously than Tanzania and declassified most of the source sites before sending samples for lab testing. Finally, a further 74 source fields were tested in the last season of 2011, with 8 interception recorded.

Following are the key results of GLCI source site testing.

- Approximately 460 source fields were tested, some 45,000 PCR tests conducted, with measured performance on test efficacy in detecting minimum levels of prevalence of CBSVs in planting material.
- 36 source fields (13.8% of fields within CBSVs endemic areas) were intercepted with CBSVs prior to distribution and multiplication, preventing disease outbreaks with farmers. This approximates to 45,000 farmers prevented from receiving CBSV infected material over the life of the project.
- Testing costs equated to approximately $700 per field; which constituted 1.5% of the project value. In other words, with only 1.5% of the project funds, GLCI was able to have the confidence of the disease-free status of the material disseminated to farmers.
- Most comprehensive certification-styled testing of vegetative planting material for regions.
- Eight cultivars of cassava with reported tolerance to CBSVs were multiplied by tissue culture and tested for freeness from CBSVs prior to distribution to GLCI countries for evaluation.

2. Establishing the state of knowledge on CBSD and its causal viruses, and building consensus on the approach for movement of planting material of least risk in spreading the viruses

During the first year, it was decided that a PRA workshop would be conducted in June 2009 and an analysis produced to provide a basis for project planning and monitoring and to provide a basis for the disease surveys.

PRA activities continued with email exchanges, a website blog and detailed discussions at the learning alliance meeting in Rwanda. At a workshop in Nairobi, draft PRA documents for CBSD were produced and are being refined with national partners. A central risk document that drew upon surveillance strategies and the benefits to farmers of planting clean material was also drafted as an internal management support tool.

The product of the PRA activities was a central Pest Risk Analysis document drafted as an internal management support tool for GLCI and as a guide to national partners. The PRA for GLCI was completed by the third year of the project and attached in this final report, though the document could be updated with new information on CBSV epidemiology results that became available after the PRA had been completed. Please see FERA Appendix B – CBSD Risk Analysis.

Following are the key results of developing PRA.

- Extension of partnering from the GLCI National Agricultural Research Systems (NARS) to the National Plant Protection Organizations (NPPOs) strengthened ownership at the phytosanitary policy setting level.
- Development of a PRA on CBSVs and a "GLCI Best Practice" on risk-assured production and movement of cassava planting material'; the first workshop-developed, participatory PRA on a food security crop undertaken at a regional scale.
- Use of PRA and declaration of CBSV-free areas reduced costs associated with laboratory testing of planting material for CBSVs by approximately $100,000.

3. Increasing knowledge in CBSV transmission

Research on CBSV transmission was accumulative and conducted throughout the life of GLCI. The following summarize the progressive findings and results of the transmission studies:

- **Satellite molecules:** Two DIG-labelled probes have been developed to detect the satellite-II and satellite-III sequences in the cassava genome. These probes have been found to be effective for the detection of homologous satellite sequences associated with Cassava Mosaic Disease (CMD) integrated in the cassava genome. Two types of Sat molecules, named as Sat-1 and Sat-III were detected in over 70% of the samples tested in GLCI project countries. They were detected in CMD affected plants as well as in apparently healthy looking plants of most of the cassava varieties encountered in the fields. Two DIG-labeled probes were developed to detect Sat-II and Sat-III sequences in the cassava genome. These probes were found to be effective for the detection of homologous satellite sequences integrated in cassava genome by Southern hybridization. Integrated forms of satellites were detected in CMD symptomatic and asymptomatic cassava plants and there was no specific association of these molecules with severe CMD symptoms.
- **CBSV transmission by whitefly:** Research to understand the mode of transmission and spread of CBSD has continued. A trial replicated at Kibaha (Tanzania Coast), Ukerewe (Tanzania Lake Zone) and Namulonge (Uganda) strongly suggests that virus infection during the early stages of plant growth results in severe root symptoms in susceptible varieties. Whitefly incidence was low and chemical control did not reduce root necrosis. Whitefly transmission experiments to determine persistency commenced under laboratory conditions at the Natural Resources Institute (NRI), UK.
- **Non-vector transmission of CBSV:** Two trials at the Natural Resources Institute (NRI) to induce mechanical transmission of CBSV and transmission through leaf-picking failed to infect healthy plants suggesting that transmission of CBSV by cutting implements or contact is unlikely in cassava.
- **CBSV transmission and epidemiology:** The main CBSV epidemiology trials were repeated in the October 2009 planting season. Two additional trials to investigate planting material source, fertilization and drought on CBSD expression were planted.
- **CBSV transmission:** Transmission experiments performed using CBSV-free tissue culture showed that CBSV is transmitted by the whitefly, *Bemisia tabaci*, in persistent, semi-persistent, and non-persistent modes. The findings are a first of its kind and a valuable contribution to the knowledge on CBSD spread. These findings imply that, since whitefly can transmit the virus within a short feeding time, systemic insecticides may not be effective in controlling CBSV spread and that whitefly can

rapidly spread CBSV in the field. However, since CBSV is not persistent in the vector, the probability of long-distance spread by whitefly is low.

- **Whitefly abundance is a major contributor to the high rate of CBSV transmission:** Field-based evidence (high number of whiteflies on cassava) supports the conclusion that the presence of high whitefly numbers is one of the major causes of the CBSD outbreak in the Great Lakes region in eastern and southern Africa.
- **Young infected leaves are good sources for CBSV acquisition by whiteflies:** The rate of CBSV transmission was significantly different between the whitefly fed on mature symptomatic leaves (28.5%) and young symptomless leaves (50%). This may reflect the difference in virus loads between the mature and younger leaves and/or the ease with which whiteflies can feed on the young succulent leaves. This requires further investigation.
- ***Bemisia tabaci* vectors both CBSV and CBSUgV:** Recently CBSD causal agents have been classified in two species based on the diversity in genomic sequence, CBSV and CBSUgV. *Bemisia tabaci* is shown to transmit CBSV and circumstantial evidence shows that the same vector is involved in CBSUgV transmission.
- **CBSV is not spread by contact or farming tools:** Experiments were conducted to verify or refute the belief that CBSV can be transmitted through cutting implements or leaf picking, and the results confirmed that non-vector CBSV transmission through cutting implements or sap contact is unlikely in cassava.
- **Complex relationship between satellite molecules and severe CMD symptom:** Integrated forms of satellites were detected in CMD symptomatic and asymptomatic cassava plants and there was no specific association of these molecules with severe CMD symptoms. This observation concerns the hypothesis on the role of satellite molecules in severe symptom expression.
- **CBSVs are transmitted in a semi-persistent manner:** Studies on inoculation access period (IAP) and latent period confirmed that CBSV can be transmissible within five minutes of feeding on healthy cassava plants. The rate of transmission increased with increased IAP with the maximum transmission efficiency (72.7%) occurring at 24 h IAP. CBSV was also transmitted from viruliferous cassava whiteflies that were given 24 acquisition access period (AAP) on CBSD-infected cassava plants and subsequently allowed to feed on healthy cotton plants for periods of 1 h, 4 h and 24 h. Longer retention of virus in whiteflies suggest that a possible circulative, semi-persistent nature of CBSV transmission by whiteflies. However, further experiments are necessary to determine whether CBSVs circulate in the whitefly hemolyph. Please see IITA Appendix Ba– CBSD Inoculum Assessment TZ and IITA Appendix Bb– CBSD Inoculum Assessment Ug for more comprehensive results.
- **Disease gradients:** Vector transmission studies of CBSVs in the field at Kibaha (Tanzania) showed a clear pattern of semi-persistent mode of transmission. Plants near spreader plots are initially infected, followed by plants more distant from the initial source of inoculum. Clear and steep gradients were apparent, with spread of CBSD occurring from the spreader plots into test plots.
- **Seasonal variation in vector population and its influence on CMD and CBSD:** Whitefly abundance peaks occurred in 8th and 12th week of planting season and were followed by increases in incidence in both CMD and CBSD. Increases in both diseases were most rapid between one and two months after the initial peak in whitefly abundance. These increases were sustained for a further month, before incidences of both diseases reached a plateau. Reductions in whitefly number coincided with the main dry season. In the mid-season symptoms were less apparent as a consequence of leaf loss occurring in the dry season. The increases that followed this period were the result of the re-appearance of symptoms on newly formed leaves of already infected plants.
- **Whitefly prefers infected plants:** More whiteflies were observed in spreader plots (infected plants) than in test plots. This suggests that whiteflies prefer virus-infected plants to healthy plants.

The key findings on CBSV transmission are summarized below.

- Studies on inoculation access period (IAP) and latent period confirmed semi-persistent mode of transmission of CBSVs by whitefly, *B. tabaci.*
- Whitefly transmits both CBSV and UCBSV with equal efficiency but rate of transmission seems to be influenced by the virus concentration within the host plant and vector population.
- CBSVs are not transmitted by contact between plants, plant debris or by agricultural implements.
- Use of systemic insecticides are not effective in controlling CBSV spread as whitefly can transmit virus within short feeding time.
- Since CBSV is not persistent in the vector for long periods, the probability of long-distance spread by the whitefly is low. Based on this knowledge CBSD control practices such as maintaining separation distance between the infected and unaffected fields, establishment of buffer zones as well as community-based phytosanitation practices were devised.
- The findings from various experiments performed in the project on vector-transmission are a first of its kind and a valuable contribution to the knowledge on CBSD spread and epidemiology.
- Studies clearly demonstrated widespread occurrence of Sat molecules in cassava, but advanced biotechnological studies are needed to understand the functions of Sat molecules.

4. Increasing knowledge in CBSV epidemiology

Likewise, CBSV epidemiology studies were accumulative and conducted throughout the life of GLCI. The following summary points show the progressive results of the epidemiology studies over the life of the project.

- **Sequencing:** FERA hosted two NARS scientists to sequence CBSV samples from at least six locations. Amongst the project partners many partial sequences were available and posted on the GLCI website for use by all other partners.
- **CBSD host resistance:** Six CMD resistant clones that had been CBSD-symptom free for four years were graft inoculated at the Agricultural Research Institute (ARI)-Chambezi, Tanzania. Most plants showed symptoms on the grafted stem portion. They were harvested and roots examined for necrosis.
- **Effects of nutrients and moisture stress on disease expression:** Studies to examine the effect of water stress and fertilization on CBSD infection and symptom expression revealed that CBSD incidence was higher in both treatments that were not fertilized. By contrast, whiteflies were more abundant in fertilized plots, and particularly in plots that had both fertilizer and regular water. This suggests that vigorous plants are more resistant to CBSD infection than stressed equivalents or that infection is the same in both groups, but symptoms are more readily expressed in stressed plants which were masked in former group. This experiment highlights the fact that infection and symptom expression of CBSD involve an interaction between environmental variables and vector abundance.
- **Disease spread patterns in the epidemic simulation trial:** Records of new infections of CBSD in the epidemic simulation trial being conducted in a screenhouse at Kibaha revealed a clear directional pattern of spread from the spreader plot into adjacent plots. The pattern of whitefly abundance showed a comparable gradient with reduced numbers of plants farther from the infector source.
- **CBSD control through vector control:** Trials in Tanzania and Uganda to assess the efficacy of insecticidal sprays using local variety and improved cassava variety revealed differences in the pattern of CBSD and CMD infection between treated and untreated plots. In general, there was less CBSD in treated plots and the rate of increase during the course of the season was less. However, unlike CMD, levels of CBSD infection was relatively higher in treated plots. CMD incidence was low in treated plots and improved varieties. This result suggests treating whiteflies with insecticides is effective in reducing whitefly populations and CMD incidence, but does not stop whitefly adults

from entering treated plots and feeding on plants in those treated plots, which suggests contrasting transmission characters by whiteflies. This study also showed that the improved variety was much more resistant to CMD infection (near immune) than the local variety.

- **Experience on CBSD epidemiology documented:** A paper which compares the regional epidemiology of CBSD with that of CMD was completed and is now "in press" in *Virus Research* journal. This should provide a significant, publicly available output incorporating several of the epidemiological insights that have been generated through the GLCI project.

The key findings on CBSV transmission are summarized below.

- Patterns of whitefly population development and disease spread were similar in both Tanzania and Uganda.
- The improved variety was more readily infected by CBSD than the local variety; whereas the improved variety was much more resistant to CMD infection (near immune) than the local variety.
- Treating whiteflies with insecticides is effective in reducing populations, but does not stop whitefly adults from entering treated plots and feeding on plants in those treated plots and spread CBSD.
- Whitefly control was more effective in reducing the incidence of CMD than CBSD. These differences in the effectiveness of reducing incidences of the two diseases suggest contrasting transmission characteristics, but reconfirm the role of the whitefly *B. tabaci* as the vector of viruses causing both diseases.
- CBSD infection in farmers' plots surrounding multiplication sites was the key determinant of CBSD infection in multiplication sites.
- The pattern of whitefly abundance showed a comparable gradient with reduced numbers on plants farther from the infector source.
- Vigorous plants are more resistant to CBSD infection than stressed equivalents or that infection is the same in both groups, but symptoms are more readily expressed in stressed plants which were masked in the former group.

5. Monitoring and forecasting CBSV

Monitoring and forecasting CBSV was done by four activities, the annual disease survey being the largest, most systematic, and most informative undertaking:

1. Annual disease survey
2. Disease Early Warning Network (DEWN)
3. Global Plant Clinic (GPC)
4. Rapid assessment

5.1 Annual Disease Survey

Cassava pest and disease surveillance surveys in select districts or equivalent zones in each of the six GLCI countries were conducted in 2009, 2010 and 2011 as a regional baseline for cassava diseases against which future changes can be measured, and to generate country-level maps. Although planned for only one season, considering the value of the CBSD annual incidence data for cassava planting material distribution this survey was undertaken as annual exercise in all the project years. Survey plan and geographic coverage finalized in consultative workshop in 2009 remain the same in all years.

The annual surveillance survey protocol was developed by IITA during the last quarter of Year 1 and circulated, comments received and revised. Due to the need to prioritize the CBSV testing the first survey was delayed and eventually took place in the first half of 2009. The protocol was reviewed to

ensure a 95% probability of defining a district as a whole. The annual disease survey was conducted in three consecutive years—2009, 2010, and 2011.

The 2009 annual disease survey were conducted in Burundi, the Democratic Republic of Congo (DRC), Kenya, Tanzania and Uganda. Rwanda did not take part due to having recently completed a similar survey under the MARI project. Laboratory results were available soon for Burundi, DRC and Kenya. The National Agricultural Research Organization (NARO), Uganda, and MARI, Tanzania, took much longer to complete their analyses. No CBSD was found in DRC, root symptoms were observed in north, east and central Burundi, but laboratory test results were negative. In Kenya, CBSD was most common on the border with Uganda and leaf symptoms correlated positively with laboratory results. In coastal Tanzania, there were high incidences of both CMD and CBSD in each of the 13 provinces surveyed. In the Lake Zone, CBSD was prevalent in Migori, Kuria and Suba Districts. Please see IITA Appendix Ca– Annual Survey 2009 Maps Report for details.

Second annual cassava disease surveys in the farmers' fields of six GLCI countries were conducted from July to October in 2010. Survey plan and geographic coverage was similar to the first survey in 2009. Mapping reports for the 2010 survey are attached in the IITA final report annexes. The second annual disease surveys indicated increase in average CBSD incidence in Tanzania, Uganda and Kenya where CBSD had been well established, and very recently virus spread into Burundi had been confirmed, which was the sixth country with known incidence of CBSD. The emerging situation in Burundi warranted heightened vigilance for CBSVs in DRC and Rwanda. In CBSD-affected GLCI countries, Kenya, Tanzania and Uganda, CBSD incidence was higher (from 22% in 2009 to 37% in 2010) than in 2009 surveys, whereas CMD incidence was similar or lower in the same locations. Please see IITA Appendix Cb– Annual Survey 2010 Maps to review disease situations in maps.

Smartphones and digital pens were tested during this survey to simplify and speed up the process of data acquisition, processing, analysis and utilization when implementing cassava disease surveys. The constraints associated with each approach suggested that, at the present time, pen and paper remained a superior option to smartphones or digital pens for the GLCI disease monitoring activity.

The survey findings showed that sporadic occurrence of CBSD-like root necrosis in Rwanda, Burundi and DRC was not associated with CBSVs. In Rwanda, CBSD-like root symptoms were observed in about 16 sites in 12 districts (Bugesera, Rwamagana, Gatsibo, Nyagatare and Kirehe in the Eastern Province; Rusizi and Nyamasheke in the Western Province; Gisagara, Nyanza, Ruhango and Kamonyi in the Southern Province; and Gakenke in the Northern Province). Although, CBSD-like root necrosis was not observed during 2010 survey conducted in Burundi, but in 2009 survey such symptoms were observed in six provinces, Kayanza, Kirundo, Karuzi, Cankuzo, Ruyigi and Gitega. Similarly, in eastern DRC, CBSD-like symptoms were not observed in any of the 12 districts surveyed in 2010. However, in the 2009 survey, CBSD-like root necrosis was observed in Bulenga in Masisi district and Ngadi in Beni districts. Foliar CBSD symptoms were not observed on any of the plants that showed root necrosis. Diagnostic tests for CBSVs by conventional RT-PCR were negative.

Third annual cassava disease and pest surveys in the farmers' fields of six GLCI project countries were completed in October 2011. Survey plan and geographic coverage was similar to the first and second surveys conducted in 2009 and 2010. Please see IITA Appendix Cc – Annual Survey 2011 Maps to review disease situations in maps, and see IITA Appendix Cd – Annual Survey Differences Maps to see the changes among years, from 2006 to 2011.

Overall, the data generated during these surveys formed a key knowledge resource for developing CMD and CBSD distribution maps, the extent of adoption of improved varieties and impact of improved varieties on CMD incidence, and provided input data to planting material distribution decision matrix. These surveys also helped strengthen country capacity in conducting monitoring surveys and cassava pest and disease diagnostics, implementation of digital early warning networks and assessment of novel surveillance tools and methods. Mapping reports of these surveys are attached in the IITA final report annexes.

5.2 DEWN

DEWN, an innovative approach to monitor the spread of cassava diseases in GLCI using mobile phones, was piloted in the Lake Zone of Tanzania with 60 farmer groups from ten districts by the Tanzania Root and Tuber Crops Program (TRTCP), through the Maruku Agricultural Research and Development Institute (MARDI). DEWN was later piloted in Rwanda and DRC also. In DRC, disease surveillance network was established by combining GLCI's DEWN and FAO's alert system on food availability. Other countries received training in application of DEWN, but on-farm application was limited.

The DEWN activities were established in Lake Zone, Tanzania, but the frequency of farmer reporting declined over time. Discussions was held with the Gates Foundation supported "Voice of the Farmer" (VOF) project to develop ways to improve reporting. Linkages were sustained with the VOF project. VOF conducted SMS and phone-based interviews with individual DEWN farmers that had their own cell phones. A validation survey was carried out for DEWN in the third quarter of 2010. The primary objectives were to check on reports of both CMD and CBSD made by farmer groups involved in DEWN, and to further strengthen the supporting linkage role of VOF. DEWN has been extended to parts of Rwanda, in view of the great concern in Rwanda of the potential for new CBSD spread. This extension has been facilitated by a GLCI-supported collaboration between MARDI of Lake Zone Tanzania and project partners in Rwanda.

Synovate, in partnership with the Lake Zone Agricultural Development Institute (LZARDI), conducted two telephone-based surveys in DEWN target districts. The first set of interviews included 132 farmers in DEWN groups in all ten DEWN target districts. In both surveys, almost 90% of farmers confirmed that they had received training in CMD and CBSD. On both occasions, approximately 75% of farmers stated that CBSD was present on their farms, whilst almost 80% reported CMD. Similar numbers (ca. 40%) reported that the two diseases were getting more severe to those that reported an improvement during the January survey. By contrast, in February, there was a large majority reporting increased severity of both diseases. The National Agronomic Research Institute (INERA) piloted DEWN in GLCI districts in eastern DRC. Attempts were made to link DEWN activities to that of "Plant Clinic" of FERA at CRS' partner's level.

5.3 GPC

A novel community based Plant Pest Recognition Campaign (PPRC) for CBSD has been successfully piloted in DR Congo and provided the first confirmed country report of UCBSV. This "smart" surveillance methods have been initiated by CABI in DRC based on the "Going Public" approach of the CABI Plant Clinics to complement national surveys for CBSV where it was required to support declaration of CBSV-free area. The PPRC approach received positive acclaim from participating NGO that noted its power of outreach and engagement with cassava growers and marketers. Approaching 1700 cassava respondents were recorded from 30 markets over a 3-month period, with approximately 100 follow-up activities undertaken based on intelligence received on possible CBSD occurrence. This represented the first confirmed report of UCBSV in DR Congo, amongst confirmation of high levels of miss-diagnosis on CBSD by visual symptoms (for this country). This novel approach to community-based CBSD surveillance

demonstrated for detection of outbreaks (rare events) allowing rapid response can be done with reduced cost and time inputs.

5.4 Rapid Assessment

In June 2011, CBSD symptoms were observed in Rumonge commune and diagnostic tests for CBSVs in symptomatic leaf samples collected confirmed the virus presence. Foliar symptoms of CBSVs were recorded in all these countries and CBSUV was detected in the symptomatic plants, which were the first confirmed reports of occurrence of CBSD causal virus in Burundi, Rwanda and DRC. A special rapid assessment survey commissioned on priority basis to understand the extent of CBSD occurrence in these countries suggested limited spread of disease mainly concentrated around cassava stem multiplication sites. Please see IITA Appendix Da – Rapid Assessment CBSD Burundi and IITA Appendix Db – Rapid Assessment CBSD_DRC, Kenya, Rwanda for the full report on the assessment results.

6. Diagnostics development for CBSVs for laboratory and field use

The RT-PCR protocol for CBSV testing was developed and refined by IITA at BecA and new primer pairs designed, tested and coupled with sequencing. Accurate, large-scale diagnostics were prioritized as central to many other activities and the success of the project. On the other hand, it was decided that ELISA development would be discontinued while the project emphasized PCR technologies, LAMP-LFD and NASH, which were to be developed with participation of the NARS.

Diagnostic primers specific to the Tanzania and Uganda CBSV strains were validated by the second year using test material from Kenya, Tanzania and Uganda. In most cases the strains could be differentiated. In those instances where tests indicated both strains may be present, further investigations were being conducted to verify this, or whether cross-relativity of the primers to a particular virus strain was in play. These data provided greater assurance in the test validity and showing geographic distribution of strains and genetic diversity.

The use of FTA Classic cards for CBSV detection was also assessed. CBSV was not detectable using the recommended practice. Spotting of a leaf sample ground with denaturation buffer resulted in successful amplification. However, this procedure was considered too cumbersome for field use.

The following summary points show the progressive results of the establishment of the diagnostic tools over the life of the project:

- **CBSV sequence:** A full genome of a Kenyan strain (giving a total of three whole genomes under the project) and draft genomes for two other strains that are to be used in the Proficiency Testing Scheme were sequenced, giving a total of five genomes under GLCI. In addition, numerous other partial sequences have been generated from approximately 20 strains focusing on the coat protein and HAM1 gene (FERA Appendix Cb – GLCI Real-time PCR).
- **Validation of real-time PCR CBSVs assays (Version 3):** Diagnostic primers specific to the Tanzanian (CBSV) and Ugandan (CBSUV) strain types of CBSV developed in the previous reporting period have been validated against a test panel of plant material (CBSV positive and negative material based on visual symptoms) originating from Kenya, Tanzania and Uganda.
- **Efficient conventional RT-PCR for the detection of CBSVs:** Improved RT-PCR protocols that are twice as efficient compared to the currently available primers have been developed for the detection of CBSVs. This new test uses new primer set named CBSV-F3 and CBSV-R3 that recognizes both species of CBSVs. Validation of RT-PCR and real time RT-PCR assays for CBSVs detection suggested that careful use of standard RT-PCR using CBSV-10/11 and CBSV-UG-F/R primers can provide detection that is almost as effective as can be achieved using real-time RT-PCR.

- **Novel duplex RT-PCR protocol for discrimination of virus species:** A conventional multiplex RT-PCR protocol, which are highly efficient and cost-effective, were developed to differentiate the two CBSVs. Application of these tool revealed single as well as mixed infections of CBSV and CBSUV in experimental plots in Tanzania. Application of this tool revealed co-occurrence of CBSV and CBSUV in field collected cassava samples. This information is highly relevant for an improved understanding of the virus-vector dynamics in the field as well as for the need to develop cassava resistant to both viruses.
- **Real-time CBSV diagnostic assay widely adopted:** Real-time diagnostic assay for CBSVs have been successfully adopted by institutes in East Africa, including Kenya Plant Health Inspectorate Services KEPHIS and BecA in Kenya, IITA in Tanzania and National Crops Resources Research Institute (NaCRRI) in Uganda. Feedback reports superior level of detection than achieved by conventional PCR.
- **Field assay for the detection of CBSVs:** Proof-of-concept on the LAMP PCR field assay for CBSD was achieved for both CBSVs. An assay for CBSVs diagnosis suitable for use in the field or in a laboratory with limited equipment was developed based on isothermal LAMP technology and a lateral flow detection (LFD) system. The LAMP PCR assay for CBSVs became available for field testing as a Lateral Flow. Devise format and/ or with the real-time OptiGene Genie II instrumentOver 1000 CBSVs LFD devices were available for further validation.
- **Advances in conventional CBSV detection by PCR:** Primers for conventional RT-PCR to detect CBSV and CBSUV have been designed with varying specificity to the virus species. IITA also adopted the real-time PCR procedure developed at FERA.
- **Sap preserved on FTA cards was not suitable for CBSV detection:** The usefulness of FTA™ Classic Cards for CBSV detection by real-time PCR was analyzed. Leaf samples were pressed on FTA cards as per the recommended procedure and used in real-time PCR assay. Results indicated that CBSV was not detectable from samples collected on FTA cards.
- **Nucleic Acid Spot Hybridization (NASH):** The NASH assay is being adopted for CBSVs detection in plant tissue sap press on nylon membranes. NASH can simplify virus detection and eliminates the drudgery of sample collection and nucleic acid extra experiments are being continued to find means to reduce the latex interference. Attempts were made to use chemiluminescence detection system to improve sensitivity. NASH-based diagnostics were denatured and separated on agarose gels, however, the probes were unsuccessful in detecting CBSVs in cassava leaf or stem tissue prints. Interference of latex in cassava tissue, secondary structures or low virus titer could be contributing factors and limits field application of this assay.
- **NASH-assay for virus detection:** NASH-based diagnostics using about 300 bp probe derived from the N-terminal coat protein region or ~800 bp probe corresponding to the coat protein gene detected the virus nucleic acid that were denatured and separated on agarose gels, however, the probes were unsuccessful in detecting CBSVs in cassava leaf or stem tissue prints. We suspect that interference of latex in cassava tissue, secondary structures or low virus titer could be contributing factors and limits field application of this assay.
- **First plant health personnel proficiency testing for CBSVs developed:** The scheme was developed for stability of template and reagents, and scheduled as a FAPA Phytopas scheme. A Proficiency Testing Scheme for CBSVs was successfully developed and piloted by FAPAS across the GLCI and wider cassava laboratory community. This scheme, that allowed a measure of laboratory competence to be determined, was believed to be the first example of its kind for plant health personnel in the region. Twenty-seven individuals of 15 institutes participated in the scheme with 11 individuals of 8 institutes returning results. Results obtained are encouraging, whilst also identifying significant scope for improvement. Some institutes that requested use of the scheme stated they did not have the equipment to take part.

The major achievements of diagnostic tools development are summarized below.

- First whole genome of the emergent Uganda CBSV species (UCBSV), responsible for most new disease outbreaks and now reported in Rwanda, Burundi and DR Congo.
- First use of real-time PCR within East Africa for diagnostics of CBSVs (and any crop pest), suitable for research and high throughput testing of materials for planting.
- First use of a LAMP assay for diagnostics of CBSVs suitable for field use or use by laboratories with limited equipment.
- Diagnostic tools developed in the project have greatly aided disease surveillance surveys, evaluation of germplasm for disease resistance, production of virus-free planting materials and disease epidemiology.

7. Capacity building in CBSVs diagnostics amongst GLCI countries

Extensive training activities were conducted by IITA and FERA to build capacity of the NARS and NPPOs during the life of the project. The following are summary points of these training activities.

- **Build capacity at KEPHIS and NARS to undertake CBSV testing:** A further training secondment, from NaCCRI Uganda, was made to FERA to undertake CBSV testing. These individual trainings were followed up by a diagnostics training course for KEPHIS personnel and one IITA staff member. During this course real-time PCR was used successfully to detect CBSV for the first time in Africa. Source site material tested at FERA in March 2010 will not now be retested at KEPHIS to validate laboratory procedures as all samples tested negative. Instead, cultivars currently under clean-up at KEPHIS will be used with positive controls.
- **Regional training course:** A regional training course "Cassava Viruses: Biology Diagnostics and Management" was held in Dar es Salaam. Two trainers from each country attended, with the exception of Rwanda where technical problems precluded attendance. Two participants from KEPHIS also attended. Resource persons were from IITA, ARI-Tanzania, NRI, FERA and Dr Mike Thresh. Trainees were provided with a training manual "Laboratory Manual for the Diagnosis of Cassava Virus Diseases" and pertinent literature. These trainees are expected to train staff in their respective countries.
- **Writing workshop:** A workshop with participants from Kenya and Tanzania was held in Tanzania to prepare research outputs from the 2009 annual disease survey. Three draft papers were completed and will be reviewed before submission to scientific journals.
- **Field recognition training:** In March 2010, 26 partner staff from Burundi and DRC were trained in field recognition of virus diseases and management and planting material quality control.
- **Transferring source-site testing to KEPHIS:** Transferring CBSV testing capabilities to NARS or phytosanitary institutions of GLCI countries has continued by training two national partners of each GLCI countries in real-time PCR. The training courses held at KEPHIS are the first for real-time PCR and cassava virus diagnostics in East Africa. A training manual for real-time PCR training was developed (FERA Annex C – GLCI KEPHIS PCR Training Manual).
- **Training in cassava virus disease diagnostics and management:** The first training, "Cassava Viruses: Biology, Diagnostics and Management" was held in October/November 2009. The objective was to train the NARS scientists from GLCI project countries in cassava virus disease biology, diagnostics and management to facilitate the capacity building in cassava disease diagnostics and management.
- **Follow-on training in virus diagnostics and application of smart surveillance:** A second training, "Cassava Viruses: Application of Advanced Diagnostics and Surveillance Techniques for Cassava Virus Disease Monitoring on Advanced Diagnostics and Smart Surveillance" was held in May 2010 for 12 participants, 2 from each of the GLCI countries.

- **In-country diagnostic training:** One-week CBSV diagnostic training workshops were held in all GLCI countries.
- **Individual training:** A national scientist from the National Cassava Crop Research Institute (Uganda) was seconded to FERA for four months to assist in the development of the real-time PCR diagnostics.
- **Diagnostics lab strengthening:** PCR-based diagnostic equipment procured and delivered to all GLCI countries.
- **PhytoPas Proficiency Testing (PT):** A PhytoPas PT scheme, which allows laboratories to determine the efficacy of their practices in detecting CBSV, has been the developed as the backbone to transfer testing to KEPHIS and the region. This PT scheme will be trialed at the regional training in real-time PCR.
- **Supporting diagnostics at NARS partners:** IITA-Tanzania has continued to provide logistical support to NARS with a view to establishing basic PCR diagnostics capability. In the current quarter, support was provided to the Rwanda Agricultural Research Institute (ISAR) for CBSV diagnostics in their labs.
- **Postgraduate student on tissue culture:** An MSc student was appointed at KEPHIS to investigate the efficiency of virus cleaning protocol in cassava and develop an efficient micropropagation method for in vitro propagation of virus-free cassava.
- **Training in advanced diagnostics:** Two Ugandans participated in workshop on "Training in the use of real-time PCR for detection of CBSV and the use of proficiency testing scheme" in KEPHIS. The two Ugandan scientists are using the skills acquired to set up the real-time PCR machine at Namulonge and validating protocols for detection of various viruses.
- **Establishment of diagnostic labs:** Diagnostics labs established in ISAR-Rwanda and ISABU-Burundi are being used for the analysis of cassava mosaic geminiviruses.
  The equipping of the KEPHIS laboratory at PQS for real-time PCR CBSV testing has been completed with installation of a high throughput extraction capability. CBSV extraction and detection by real-time PCR has been achieved at KEPHIS. This is most certainly a unique facility within the region.
- **Supporting diagnostics at NARS partners:** IITA-Tanzania has continued to provide logistical support to NARS with a view to establishing basic PCR diagnostics capability. In the current quarter, support was provided to ISAR in Rwanda, ISABU in Burundi and INERA in DRC, in sourcing a final set of reagents required for the operation of PCR for CBSV diagnostics in their labs.
- **Postgraduate student on tissue culture:** An MSc student was appointed at KEPHIS to investigate the efficiency of virus cleaning protocol in cassava and develop an efficient micropropagation method for in vitro propagation of virus-free cassava.
- **Training in advanced diagnostics:** Two GLCI regional trainings and two trainings specific to KEPHIS in the use of diagnostics for CBSVs were undertaken during the reporting period.
  Two Ugandans (Mr. Emmanuel Ogwok and Mr. Phillip Abidrabo) participated in workshop on "Training in the use of real-time PCR for detection of CBSV and the use of proficiency testing scheme" in KEPHIS. The two Ugandan scientists are using the skills acquired to set up the real-time PCR machine at Namulonge and validating protocols for detection of various viruses.
- **Establishment of diagnostic labs:** Diagnostics labs established in ISAR-Rwanda and ISABU-Burundi are being used for the analysis of cassava mosaic geminiviruses.
- **Setting up regional laboratory:** The KEPHIS laboratory was equipped and commissioned for high throughput testing of cassava material for CBSVs. Parallel testing between KEPHIS and FERA of approximately 5,000 leaf samples is underway. Preliminary results suggest good agreement, however, full results are not yet available.
- **Training on elimination of CBSV through tissue culture techniques:** Training in thermotherapy, chemotherapy and meristem tip culture and virus indexing using molecular techniques was organized by KEHPIS. A total of 17 people (12 KEPHIS staff and 5 students on attachment) were

trained. Three KEPHIS staff were also trained on acclimatization of cassava tissue culture plantlets at KARI, Kakamega.

- **Awareness creating workshops:** Most notable being IITA-CRS- FAO meeting on CBSD in Bujumbura in November 2011, to update about the new spread of CBSD in the Great Lakes region. The results of the nation-wide CBSD survey conducted in Burundi were shared with the stakeholders. Participants discussed an action plan to put in place to halt the spread of the disease. This workshop was replicated in Rwanda, and DRC (Kinshasa and Goma).

The major achievements of capacity building activities are summarized below.

- First equipping and training KEPHIS in high throughput testing for CBSVs; a unique capability for Kenya and the COMESA region Parallel testing of cassava leaf material at Fera and KEPHIS achieved >90% agreement on all samples and ~50 -70% agreement on all +ve CBSV and UCBSV samples, respectively.
- First regional trainings provided for GLCI country researchers and phytosanitary personnel in diagnostics of CBSVs using real-time PCR, conventional PCR and LAMP assay methods.
- First use of a Proficiency Testing Scheme (as common for food safety) amongst GLCI countries and other countries for measuring laboratory performance in diagnostics of CBSVs.
- A training manual detailing the protocols for disease diagnostics and disease surveillance was developed and widely distributed to partners and other stakeholders.

8. Identify and distribute CBSD resistant/tolerant cassava genotypes

Nineteen of IITA's CBSD tolerant clones shortlist for sharing with GLCI partners were transferred to KEPHIS for production of virus-free stocks through in vitro approaches [MM # 06/0011; 06/0024; 06/0012; 06/0138; 06/0131; 06/0019; 06/0124; 06/0112; 06/0079; 06/0013; 06/0045; 06/0023B; 06/0076; 06/0139; 06/0143; 06/0082; 06/0083; 06/0046; and 06/0074]. The 15 CBSD-tolerant clones sent to KEPHIS in October 2008 went through two cycles of thermotherapy and meristem culture.

A select set of 8 clones (MM06/0013, MM06/0046, MM06/0074, MM06/0082, MM06/0083, MM06/0138, MM06/0139, and MM06/0143) that were found to be most tolerant in PVS trials were targeted for dissemination as tissue culture plants underwent CBSV testing by FERA. These were transferred to a commercial tissue culture laboratory, the Genetic Technologies International (GTIL) in Nairobi, for rapid multiplication. Indexing for CBSVs was undertaken at FERA for the 8 GLCI cassava clones. The indexing efforts helped identified the sub-lines of one variety tested positive for CBSV. While these sub-lined discontinued multiplication, the virus sub-lines continued. The testing provided significant confidence that CBSV, if present, would be detected and thus the phytosanitary needs of the GLCI countries were met. Plantlets tested negative were multiplied and distributed to participating NARS of GLCI project countries in September 2011 for adoption by hardening and further multiplication.

Pest and disease-free (clean) cassava multiplication sites (3.2 ha in total) have been established in the mid-altitude location in the Usambara Mountains region of Tanga Region, north-eastern Tanzania to multiply and disseminate improved varieties identified in GLCI that ensure production of healthy planting material along the pipeline. The site was specifically selected to be in an area with sparse cassava cultivation, low virus disease incidence and isolated from other cassava plantings. The clean site was planted with 50 cuttings each of seven new cassava clones on one side of the Holding Site field. These sites are being used for the multiplication and dissemination of virus-free planting materials (stems) of improved varieties identified in GLCI. This model is being replicated in other CBSD affected countries in eastern and southern Africa. Please see IITA Appendix E – Clean Seed Site Establishment for comprehensive details on this subject.

The IITA breeding program in Tanzania identified seven promising clones, viz., KBH # 2001/110, 2002/363, 2002/066, 2006/12, 2006/18, 2006/26 and 2006/98 that showed field tolerance to CBSD during the evaluation trials in CBSD-sick plot in Kibaha, Tanzania. Subsequent evaluation by graft inoculation identified KBH 2002/066 and KBH 2006/18 as most tolerant to CBSD and plants despite virus infection (confirmed by diagnostic assay) remained asymptomatic. These seven clones are being evaluated under multi-locational trials for further validation and release.

9. Assessing benefits

A statistical tool for analyzing the benefit of receiving GLCI material to an area was developed. The M&E tool took account of the prevalence of CBSD and other pests, existing rates of improved variety adoption and the variability of these data to assign a probability on the numbers of farmers likely to benefit from receiving GLCI material. Overlaying other social and socio-economic parameters to these assessments allowed a sense of how the yield benefit links to benefits in food security, income and reduced poverty.

A model that enabled the impact of the GLCI material to be evaluated under varying parameters of the receiving environment, including existing levels of improved variety adoption, CBSD prevalence and cassava field density, was produced. The model allowed for additional scenarios to be investigated such as varying volumes of cassava distribution, targeted distribution to CBSD affected fields, effect of NGO-distribution with and without CBSVs testing and the impact of releasing tolerant or resistant CBSD varieties.

This model formed the basis for a case study on the consequence of the GLCI testing for CBSVs and in distributing planting material in scaling-up of material with beneficiaries. The case study analyzed and reported on the following impacts of GLCI disease mitigating activities. For full report, please see FERA Appendix H_GLCI Case Study.

- Review on the efficacy of the testing protocols in timeliness of action and reporting.
- Estimate on the volume of CBSV infected material prevented from reaching farmers.
- Estimate of cassava yield change with beneficiaries one season on from receiving GLCI material, allowing for existing improved cultivar use and prevalence of CMD and CBSD.
- Projection on benefit if CBSD infection occurs during first season of multiplication.

Chapter 3. Training

The Great Lakes Cassava Initiative (GLCI) used a combination of face to face and e-learning to train the partner staff. CRS and National Agricultural Research System (NARS) staff generally facilitated the face to face training of partner staff. Topics in which face to face training only was provided included: 1) varietal identification; 2) Participatory Variety Selection (PVS); 3) Integrated Crop Management (ICM); 3) cassava storage, preparation, planting and harvesting; 4) Quality Management Protocol (QMP); 5) introduction to Information and Communication Technology (ICT); and 6) forming Savings and Internal Lending Communities (SILC).

To complement face to face training and, in an effort to reduce costs of training and re-training and to improve the quality and consistency of messaging in training, GLCI piloted e-learning using the Agilix BrainHoney (formerly known as GoCourse) platform. A consulting professor from the Cornell International Institute for Food, Agriculture and Development (CIIFAD) collaborated with technical experts to produce e-learning courses including: 1) cassava pests and diseases, 2) cassava multiplication, 3) cassava dissemination, 4) farmer group management[1], and 5) working with adult learners. An expert consultant developed an additional course on Introduction to Global Positioning Systems (GPS). All of the courses included reading, images (photos and drawings), practical assignments and quizzes, while a few also incorporated video clips. Each course was also translated into French.

Following the same structure as Chapter 1 on partnerships and planning, this chapter is also presented in two parts. The first part of the chapter provides an overview of the process of the training component was implemented during the life of the project. Part 2 of the chapter presents the assessment of the training program to draw lessons from GLCI partner staff training to determine what might be the ideal model for building their knowledge and skills to facilitate farmer learning and behavior change.

Part 1. The Process of Implementing the Training Component

Partner staffing

GLCI training program was targeted for the partner staff, with the aim that these staff would become the training delivery channel to the farmer groups. As the number of multiplication sites and farmer groups participating in going to scale increased, FY2010 saw a sharp increase in the number of partner paid field agents (PFAs) and particularly voluntary field agents (VFAs), all of whom were in need of training in order to carry out the field activities and to train the farmer groups to implement their activities. By then, the average partner had one full time GLCI supervisor, three PFAs, and ten VFAs. Table 1 below summarizes the number and breakdown by gender of partner staff and VFAs supporting GLCI. Of note is the varying degree of women's participation in project implementation. Reasons for low participation of women (21%) included: 1) a limited number of women who met job qualifications and often those who were qualified were already employed with competing organizations, 2) a limited number of women showing interest in the positions, and 3) perhaps an increased exposure to danger due to insecurity (particularly in the Democratic Republic of Congo - DRC). Since then, project staff levels remained relatively stable; however the turnover of supervisors and field agents continued to be significant and increasing toward the end of the project.

[1] This course was put together in collaboration with Cornell University by graduate students Miguel G. Escassi, Maria Salamanca, Ariel Bleth, Thomas Archibald under the supervision of Dr. Beth Medvecky.

Table 1. Partner staffing levels by December 2010

Country	Supervisors		PFAs		VFAs		All Partner Staff		
	Total	Women	Total	Women	Total	Women	Total	Women	% Women
Burundi	12	1	21	0	40	8	73	9	12
DRC	17	0	40	1	77	15	134	16	12
Kenya	3	2	10	3	120	29	133	34	26
Rwanda	5	1	22	8	68	16	95	25	26
Tanzania	14	2	40	9	106	18	160	29	18
Uganda	6	1	20	7	134	35	161	43	27
TOTAL	**57**	**7**	**153**	**28**	**545**	**121**	**756**	**156**	**20**

Some partners were dropped during the latter part of the project, bringing the total partner staff to a lower level than the peak time in 2010. At the last count at the end of August 2011, three months prior to the end of the project, the number of VFAs were markedly higher than before. The most significant difference is the increase in female VFAs in the mix. In compliance with the GLCI grant agreement with the foundation, 30% of positions were filled by women.

Table 2. Partner staffing levels as of August 2011.

Country	Supervisors		PFAs		VFAs		All Partner Staff		
	Total	Women	Total	Women	Total	Women	Total	Women	% Women
Burundi	7	0	11	2	43	10	61	12	20
DRC	15	1	45	3	131	60	191	64	33
Kenya	3	3	14	3	128	46	145	52	36
Rwanda	5	1	22	9	77	21	104	31	30
Tanzania	13	1	39	6	107	19	159	26	16
Uganda	6	2	20	5	135	55	161	62	38
TOTAL	**49**	**8**	**151**	**28**	**621**	**211**	**821**	**247**	**30**

Partners indicated that there had been an overall 20-25% turnover with reasons cited including: the end of project approaching, new opportunities, low salaries, natural attrition and incompetence.

Development of training modules to train partners

To meet the need of training materials for the partner staff, CRS collaborated with the Cornell University (CU) International Institute for Food, Agriculture and Development (CIIFAD) to develop training modules for the CRS/CIAT identified "5 skill sets of successful farmer groups." This included modules on sustainable production/natural resources management, innovation, farmer group strengthening, and agricultural marketing. Draft modules were then tested and improved by Cornell graduate school students, in collaboration with CRS and two local GLCI partners in Western Kenya. GLCI then adapted these modules for use in GLCI training of farmer groups. The farmer group strengthening and agricultural marketing modules were used to train all GLCI groups. Sustainable production/natural resources management accompanied the training of GLCI farmer groups in how to produce cassava roots and stems. The innovation module proved to be useful in orienting those groups involved in PVS and ICM trials. These 5 skill sets became the compass to guide the GLCI farmer group development over the life of the project, and the bases for monitoring the growth and development of these groups.

CU graduate students later worked to improve and ensure consistency of the approach for four of the five farmer group skill set modules: group management, marketing basics, natural resource management and innovations. They also developed a module on nutrition. GLCI also contracted CU to work with the Seed and Disease Objectives to develop modules on cutting production basics, cutting dissemination and disease recognition and management.

In collaboration with CU, CRS refined the farmer group training modules, developed new modules, and loaded them on to computer-based training via Agilix GoCourse. Partner supervisors and field agents then adapted and used the modules to train farmer groups.

For each module, GLCI formed working groups of interested stakeholders linking with the CU students to ensure a grounded, two-way process. CIIFAD worked in Kenya, Rwanda and Uganda to provide practical training to the CRS country program managers (CPMs) and to select partners (supervisors and field agents) in adult learning principles and practices, adaptation of training materials to local contexts, and the use of GoCourse. The lead partners, with backstopping from the students, then worked with the CPM to either organize a centralized training of partners or on-site training with each partner.

Partner supervisors and PFAs were later trained through a combination of face to face and GoCourse trainings in basic computer use, GoCourse use, data collection, adult learning, cassava pests and diseases, seed multiplication, seed dissemination, GPS use, group strengthening, and SILC.

The subsequent mini-laptop roll-out and associated trainings enabled partner staff to complete GoCourse courses and use them to strengthen farmer groups. The initial feedback from partners indicated that the technology was a significant motivating force and many who had never used a computer were now empowered to do so. Further, they find the GoCourse content useful in increasing their knowledge, skills and confidence to train farmers.

Five GoCourses available were: 1) Working with Adult Learners, 2) Cassava Pests and Diseases, 3) Cassava Seed Multiplication, 4) Group Management and 5) Global Positioning Systems. Participants were able to access these courses with GLCI regional staff reviewing, analyzing and giving feedback. Interest in the first two courses was particularly strong.

The Marketing Basics training module (developed by CIIFAD with CRS/Kenya) was developed in late 2008 for rollout in early 2009. Later, the CRS agro-enterprise resource person led a thematic working group tasked with liaising with the CU team to guide and provide feedback on the on-going revision of these modules. In the end, it was deemed not contributing directing to the core of the GLCI seed system and was not rolled out to the GLCI farmer groups.

Training partner staff and farmer groups with training modules

GLCI won a $100,000 Intel Inspire grant to support a pilot phase of the mini-laptop roll-out. Sixty-eight mini-laptops distributed and 69 partner staff received basic information technology, GoCourse and electronic data collection training. Training in GoCourse for CPMs, supervisors and paid field agents were to be completed in early 2010. At a workshop in August 2009, stakeholders reflected on lessons learnt from the pilot laptop roll out and discussed the way forward for training and the management of GoCourse during roll out, resulting in GoCourse and training management guidelines.

GLCI loaded the laptops with six courses (please see the training objective below) and users could take courses on or off line. Partner supervisors and field agents were expected to take all six courses and then apply the knowledge or skills in their work with farmers in the field. The courses ensure consistency of messaging and reduce the frequency of required face-to-face trainings thus lowering costs. However, a cascade of face-to-face training of trainers were stilled maintained to reinforce the GoCourse curriculum as well as to cover themes for which GLCI does not have GoCourses (e.g., SILC and QMP).

Many first time users successfully learned to use the laptops and participated in computer based training. These users felt they understood the project strategies better, were more knowledgeable in course content and more confident in facilitating adult learning and sharing their knowledge. Users appreciated that they can refer back to course content as needed. Field agents also used the laptop video function to capture training sessions, farmer testimony and cassava disease symptoms to share with others.

Partner staff were trained using both the GoCourse curriculum and face-to-face training of trainer methods. Cumulatively all partner staff (supervisors and PFAs) were trained in: 1) Basic Computer Use, 2) Working with Adult Learners, 3) Farmer Group Management, 4) GPS Use, 5) Multiplication of Cassava Stems, 6) Dissemination of Cassava Stems, 7) Cassava Pests and Diseases, and 8) QMP.

A significant number of partner staff were also trained in some or all of the following: PVS, ICM, SILC and financial management. Partner supervisors and PFAs, with assistance from VFAs and government agencies, trained farmer groups in Multiplication of Cassava Stems, Cassava Pests and Diseases, Dissemination of Cassava Stems, SILC, and Farmer Group Management. On average each farmer group participated in two to four trainings. The effectiveness of these trainings was part of the impact evaluation/case studies and the findings are included in Part 2 of this chapter.

PFAs played a pivotal role in taking GoCourses, training on average 15 farmer group multipliers (and an additional five individual multiplication sites) each in five topics, monitoring each farmer group and individual site, implementing QMP twice prior to planning and actual dissemination. The monitoring and evaluation (M&E) system required each PFA to submit six datasheets for each multiplication site in addition to monthly management information system datasheets for each SILC group. A way of reducing workloads for PFAs that some partners were adopting was to increase the number of VFAs, whose main role was to monitor and reinforce training given by the PFAs. Unfortunately, with the large number of VFAs, who were not given the mini-laptops, the training for them was not nearly as adequate as it was for the PFAs, even though they took on a large share of training for the farmer groups.

Over the life of project 7,000+ farmer group training events (approximately three per farmer group) were conducted, focusing primarily on Seed Multiplication and Dissemination and Cassava Pests and Diseases which combined comprised 75% of all training events (Table 3). Group Strengthening and SILC training comprised the remaining 25%. Training in business basics and agro-enterprise development (AED) has been delayed due to the prioritization of planting material and seed. Most training were facilitated by partner supervisors and PFAs with Tanzania and DRC reporting also that VFAs were training farmer groups, highlighting the depth of training within the system.

Table 3: Farmer group training events summary

Country	N° partners	Training activity							Total training events	% of total events
		Seed mult'	Seed dissem'	Pests & disease	Group strength'	SILC	Business basics	AED		
Burundi	13	154	154	149	143	19	0	0	619	8
DRC	15	725	578	581	156	225	0	0	2,265	31
Kenya	3	164	75	50	44	0	0	0	333	5
Rwanda	5	245	240	240	198	417	4	1	1,345	18
Tz (CZ)	6	358	169	354	125	0	0	0	1,112	15
Tz (LZ)	8	246	148	260	125	58	0	0	837	11
Uganda	6	205	177	182	154	156	0	0	874	12
Total	**56**	**2,097**	**1,541**	**1,816**	**1,051**	**875**	**4**	**1**	**7,385**	**100**

Awareness materials development

In addition to the more formal training events, each country employed different strategies and tools to raise the awareness of cassava farming communities and service providers of Cassava Mosaic Disease (CMD) and Cassava Brown Streak Disease (CBSD). Strategies included producing and disseminating posters, leaflets, T-shirts and hats, radio spots and community field days. Further materials were developed on improved varieties.

Each country implemented awareness raising activities to increase public awareness of CMD and CBSD and how to manage them by producing and dissemination mass media. These activities included: community field days (Burundi, Kenya, Uganda), public display of CBSD posters at partner and government offices (DRC, Rwanda, Tanzania, Uganda), distribution of brochures on CMD (DRC, Rwanda, Tanzania, Uganda) and CBSD (Rwanda, Tanzania), use of radio spots (DRC, Rwanda, Uganda), organization of stakeholder and public awareness meetings (DRC, Kenya, Rwanda, Uganda), and the use of songs (DRC). Key activities included disseminating 9,980 posters, 20,370 CMD brochures, 27,170 CBSD brochures, 242 radio spots, 1 CMD song (in Lingala and Swahili), and 2,600 guides for non-governmental organization (NGO) and government extension staff, as well as holding 94 field days.

Unfortunately, the plan of launching a collective mass awareness campaign by GLCI and Food and Agriculture Organization (FAO) using Association for Strengthening Agriculture Research in Eastern and Central Africa (ASARECA)-developed material and gaps identified by GLCI were not realized.

Bolstering partner staff capacity for training

GLCI did the following to bolster partner staff capacity to train and facilitate farmer group learning.

Lesson plan competition

GLCI completed a project-wide partner staff competition for the best lesson plans for facilitating farmer learning sessions. Participation was excellent with 57 entries from 52 partner staff. Three grand prizes were awarded, 8 second prize, and 20 third prizes. GLCI regional staff reviewed and evaluated each lesson plan for completeness and quality and shared feedback with CRS country program staff and partners to help strengthen lesson planning for facilitating farmer learning. Please see Training Appendix 1_Lesson Plan for details.

Country training

To further enhance partner staff and farmer learning, GLCI held a two-day training in each country between for CRS, partner supervisors and field agents. Key outputs included: mapping out progress on completion of GoCourse training curriculum and the use of lesson planning to prepare farmer trainings, identification of advantages and constraints of the GoCourse approach, discussion of best practices in facilitating farmer learning sessions, review of the project recommended template for planning of farmer learning sessions, elaboration of new lesson plans, field testing and critiquing, and forward planning. It was concluded that most partner staff had taken the GoCourses and were training farmers in the key topics. Very few, however, had developed lesson plans prior to training farmers. As a result of the workshop, partner staff understanding, commitment and capacity to plan quality farmer learning sessions was greatly enhanced. GLCI later developed and disseminated a comprehensive set of lesson plans for key project topics. At the close of each country meeting, winners and participants in the regional lesson plan competition were recognized, and those completing the GoCourse curriculum were issued certificates. Please see Training Appendix 2_GoCourses Feedback for details.

Course evaluation

Course takers evaluated each course and GLCI then consolidated their feedback to inform design of future courses for similar audiences. Generally, the feedback on the courses was very positive: they were relevant, appropriate in content, helpful as source of reference and trouble shooting, and were useful in increasing partner staff knowledge and capacity to facilitate farmer learning. Key findings were that courses should: be concise without too much text; be interesting/engaging with audio-video; use simple (non-technical) language; include quizzes, tests and practical assignments; have sample lesson plans and accompanying visual aids for facilitating farmer learning sessions; be available in soft and hard copy; be available in local languages; include access to additional reading materials; and be interactive with administration by a teacher. Please see Training Appendix 3_Course Evaluation for details.

To complement training and bolster awareness raising efforts, the regional office developed information, education and communication (IEC) materials. These include laminated handouts on CBSD and CMD to be disseminated to planting material beneficiaries as well as participating farmer groups and individual multipliers, brochures on CBSD and CMD, A2- and A0-sized posters on CBSD, and hard copies of visual aids and guidance for cassava field workers. All materials were produced in English and French as well as local languages including Swahili (both Tanzanian and DRC versions), Luganda, Kirundi, and Kinyarwanda, seven languages in total. Those destined for farmer use consisted mostly of drawings and photos with minimal writing and were laminated to protect them from the environment (Table 4).

The sample lesson plans for facilitating farmer learning and the GoCourses were converted to PDF and offline HTML-based formats so they can be made more widely available within and beyond the project. Partners were given hard and soft copies while other stakeholders were also provided with soft copies of all of the IEC and training materials.

Table 4. Training and awareness material developed to bolster partner staff's capacity to do training

	English	French	Kinyar-wanda	Kirundi	Luganda	Swahili	Swahili	All
	Kenya	DRC	Rwanda	Burundi	Uganda	DRC	Tanzania	Total
CBSD flyer	375	500	375	375	375	1,000	750	3,750
CBSD handout	5,000	10,000	10,000	10,000	5,000	50,000	5,000	95,000
CBSD poster	375	500	375	375	375	1,000	750	3,750
CBSD poster	50	35	50	50	50	35	50	320
CMD flyer	375	500	375	375	375	1,000	375	3,375
CMD handout	2,500	5,000	2,500	2,500	2,500	10,000	2,500	27,500
CMD poster	375	500	375	375	375	1,000	750	3,750
Visual aids	200	150	125	70	185	150	180	1,060
Total	**9,250**	**17,185**	**14,175**	**14,120**	**9,235**	**64,185**	**10,355**	**138,505**

Additional technical training

PVS Training

The first PVS planning and training was held in Bukavu, DRC in March 2008 for the Institut des Sciences Agronomiques du Burundi (ISABU), the Institut National pour l'Etude et la Recherche Agronomique (INERA-DRC), as well as two local NGOs and the CPM from DRC. Similar trainings were then held for Kenyan and Ugandan NARS in Kampala and for Tanzanian NARS in Mwanza. Subsequently, PVS trials were established in five out of the six participating countries. PVS was planned to start in Uganda in 2009 as the National Agricultural Research Organization (NARO) had indicated that was when they would have tolerant or resistant varieties ready for PVS.

ICM Training

The ICM resource person and the objective team leader for training visited all GLCI countries in July and August 2008 to meet partners and visit research stations, cassava multiplication sites and PVS sites. During the PVS training in Mwanza mentioned above, each country team brainstormed and ranked critical agronomic constraints to increasing cassava productivity. Trial designs were drafted based on these constraints for NARS to set up on-station and on-farm trials between September and December, 2008. Key issues included soil fertility management (determining organic and inorganic fertilizer recommendations per agro-ecological zone), appropriate intercropping associations, number and timing of weeding and timing of planting. Efforts were also made to liaise with and learn from the Tropical Soil Biology and Fertility Institute (TSBF) - International Center for Tropical Agriculture (CIAT) work in the region, notably the Consortium for Improving Agriculture-based Livelihoods in Central Africa (CIALCA).

Twenty-three on-farm trials were subsequently established: 21 in DRC and 2 in Tanzania. Local partners and the NARS continue to manage the existing on-station trials in Rwanda and DRC established in year 1. Trial topics included intercropping with grain legumes, timing and frequency of weeding, and use of small amounts of fertilizers.

Meanwhile, CRS and TSBF-CIAT funded the CIALCA project agreed to collaborate on ICM in Burundi, DRC, and Rwanda. CIALCA had extensive on-farm research experience in DRC and would share with CRS its results on best bet options for farmers in the eastern DRC. CRS would benefit from accessing proven technologies and CIALCA in turn would benefit from scaling-out of their results. To reach this mutual benefits, CIALCA agreed to work on cassava in the same sites as CRS Burundi and Rwanda in the September 2009 planting season to evaluate options for productivity improvement. This covered 20-30 locations in each country. In East Africa, CIALCA then conducted similar on-farm research in the

September 2009 planting season. The synergies with CIALCA were meant to, and did, enable GLCI to integrate simple farmer participatory research trials in many GLCI tertiary multiplication sites.

By FY2010, 126 trials were being conducted in Burundi, DRC, Kenya and Rwanda. 68 of which harvested in October-December 2010 while the rest of the 58 trials in February-June 2011. The trials mainly measured the effects of spacing in cassava and intercropping with tropical legumes. These trials were implemented by the partners and farmer groups in the field while guided and supervised the NARS in each country and CIALCA.

The Kenya Agricultural Research Institute (KARI) in Kakamega conducted a trial harvested in May 2010 and the results indicated an additional net benefit of $201 and $255/ha with the recommended spacing and intercropping. Additional important benefits for that treatment over the traditional practice of mono-cropping and spacing are that the farmer had: 1) a more nutrient-rich cropping system with cassava and the beans; and 2) an improved cash flow because of the intermediate harvest of beans potentially twice before the cassava is harvested after 12 months.

Part 2. The Assessment of the GLCI Training Program

This part of the chapter reports on the assessment and analysis of the GLCI training program, mainly from the partners' perspectives on their views on face to face and e-learning training approaches, the impact of partner staff training on their knowledge and training methods; and the downstream impact of partner staff training – knowledge and behavior changes at farmer group member level and beneficiary level. These findings and conclusions were extracted from the case study on training. To view the full report, please refer to Case Study Appendix – Training.

I. Assessment findings

This section reports on the general profile of the partner staff respondents as well as:

- **Training, knowledge and behavior change of partner staff:** importance of subjects, training received and number required for subject mastery, knowledge acquisition, views of training methodologies and changes in their own training method.
- **Training, knowledge and behavior change of farmer group members:** most important subject, training received, passing on information to non group members, and behavioral changes in cassava production practices. (from the GLCI Farmer Group case study by Dai Peters)
- **Beneficiary sensitization and behavior:** examines the sensitization messages received, behavior changes, and passing on of messages to others.

A. Partner profile and general information

GLCI interviewed 93 partner staff: 3 partner coordinators, 14 partner supervisors, 31 PFAs and 45 VFAs. 30 of the 93 were women (32%), with the highest proportion at the VFA level (48%) and becoming progressively less at each level above: 33% at PFA, 15% at supervisor and no women partner coordinators. On average, partner staff had been working with the project for 3.3 seasons with average caseloads of farmer groups and multiplication sites presented in Figure 1 below.

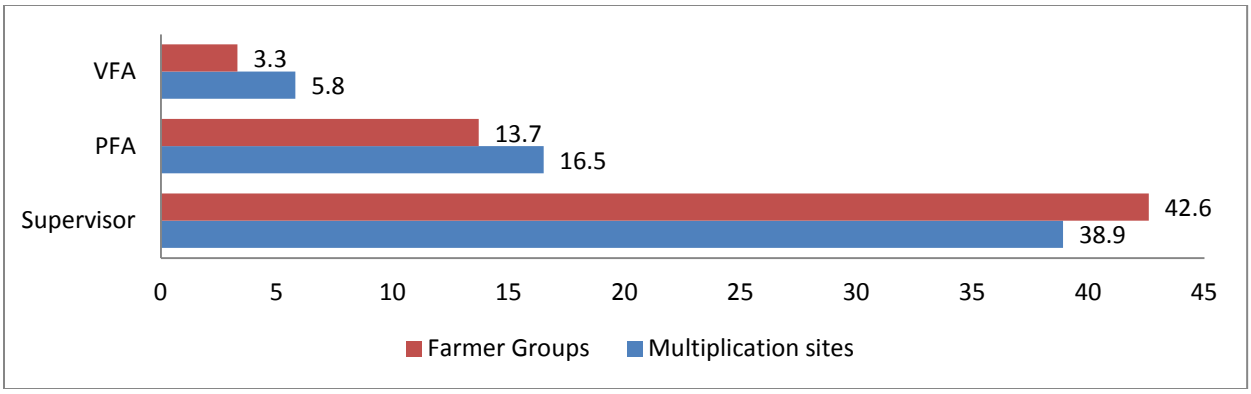


Figure 1. Average caseloads of multiplication sites and farmer groups by partner staff position (no.)

B. Training, knowledge and behavior change of partner staff

1. Importance of topics, training received and knowledge change

Generally, respondents considered all training subjects either important or very important. Partner staff may have ranked PVS and ICM lower largely because not all staff were trained in those topics as PVS was not implemented at the same scale as the other activities (Figure 2). Further, only one partner implemented SILC in Kenya, while no partners implemented ICM and SILC in Tanzania.

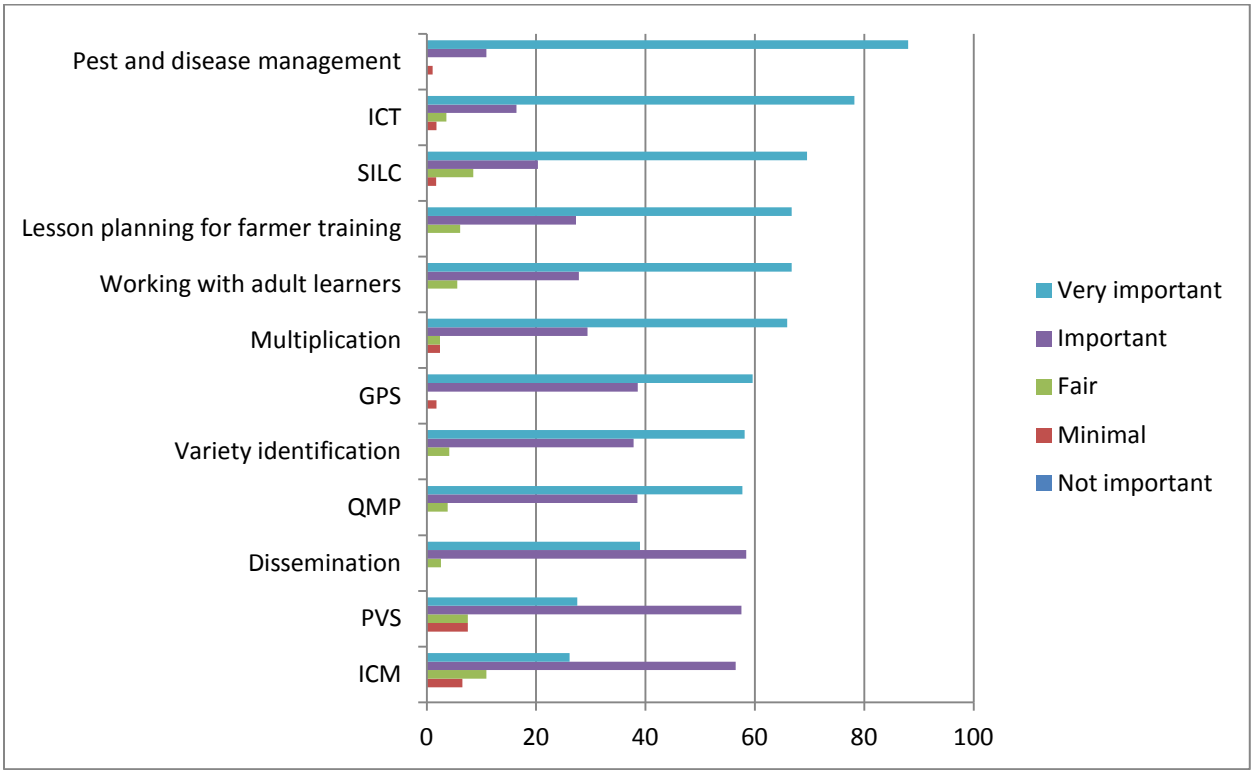


Figure 2. Partner staff respondents (coordinators, supervisors, PFAs and VFAs) ranking of the importance of each training subject (in %)

On average, partner coordinators, supervisors and PFAs responded that their knowledge had increased from being minimal prior to GLCI training to between good and very good post training (Figure 3). Subjects for which results indicated further training is required (i.e. none to fair knowledge) include SILC

(44%), farmer group management (28%) and GPS (20%). Similarly, while there was an e-learning course on farmer group management, this was generally not complemented by face to face training.

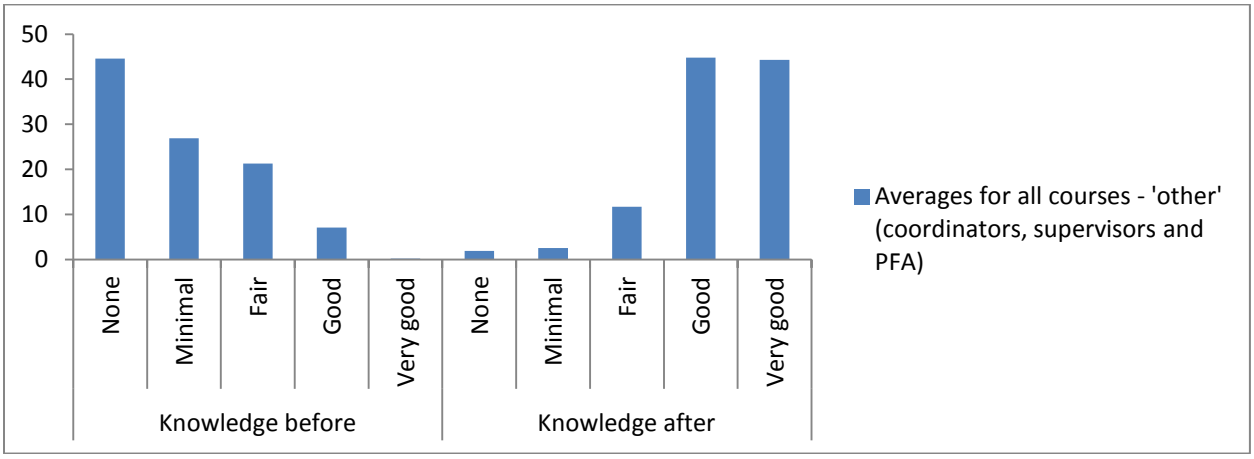


Figure 3. Aggregate valuation of knowledge change by paid project staff before and after GLCI training (in % of respondents)

VFAs reckoned their knowledge increased from none/minimal to good (Figure 4). Subjects for which results indicated further training is required (i.e. none to fair knowledge) included QMP (51%), dissemination (40%), SILC (40%), working with adult learners (33%), farmer group management (28%) and multiplication (24%).

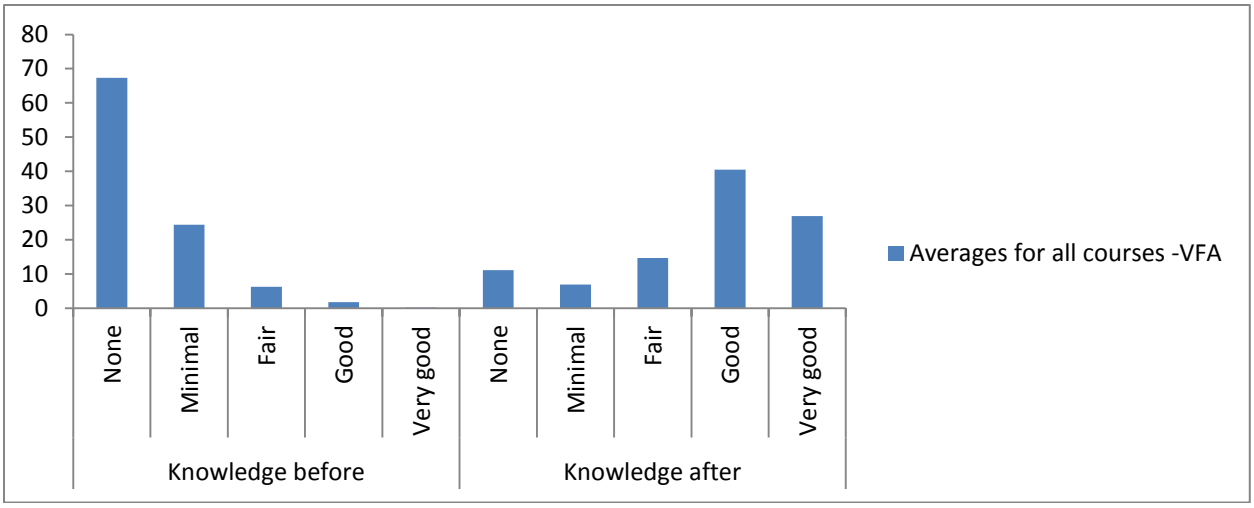


Figure 4. Aggregate valuation of knowledge change by VFAs before and after GLCI training (in % of respondents)

The disaggregated data shows that partner staff and VFAs feel that they know the most about group management, working with adult learners, cassava storage, preparation, planting and harvesting, multiplication and cassava pests and diseases. They felt they knew the least about GPS, QMP and SILC.

Figure 5 below shows that partner staff (supervisors and PFAs) felt they have been adequately trained in cassava pests and diseases, multiplication, QMP, variety identification, dissemination and SILC. Four of these subjects were covered in the e-learning curriculum. Supervisors and PFAs felt they could use additional training in ICM, PVS, working with adult learners, lesson planning for farmer training, GPS and information technology (basic computer use). Since GLCI partners did not implement ICM in Tanzania and because not all partners implemented PVS, the results may be skewed for these topics.

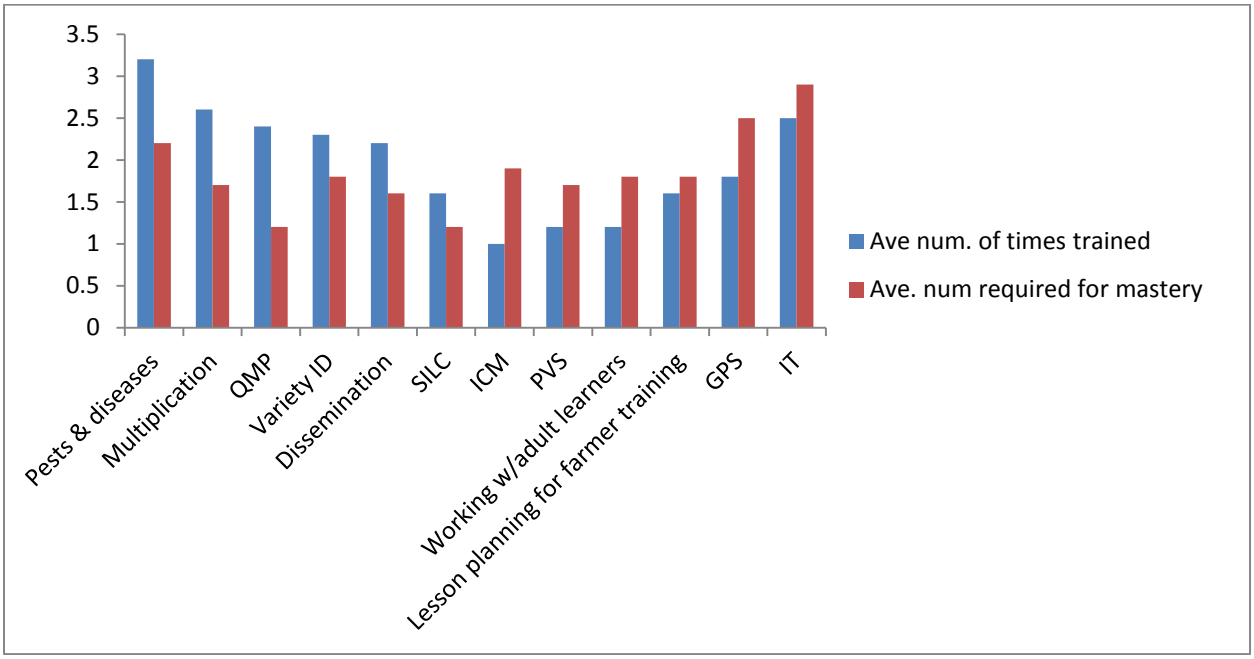


Figure 5. Actual training of partner supervisors and PFAs (average number of times trained in each subject) vs. average number of trainings required for mastery of the subject

On average, GLCI trained VFAs at least once on all topics (Figure 6), though they generally indicated that more training is required for mastery with the exception of dissemination. Again, this is due in part to the fact that GLCI brought VFAs on later and their role continued to evolve over the course of the project. Further, Tanzania partners did not implement SILC, so the results are likely skewed downward.

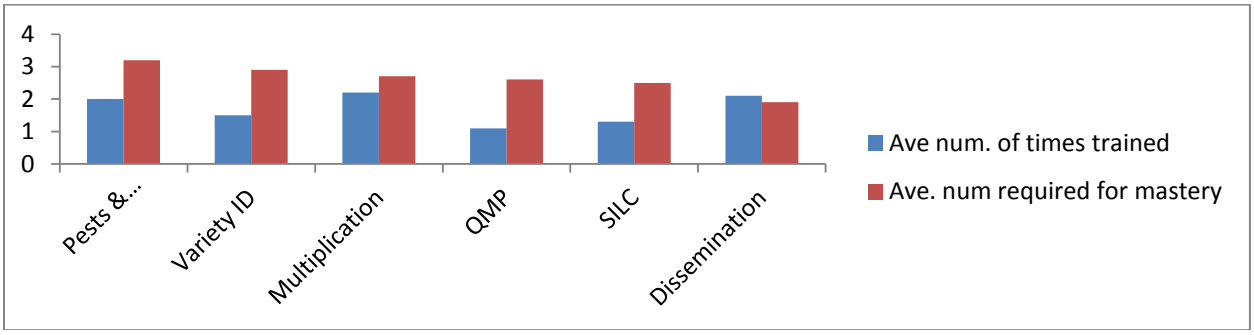


Figure 6. Actual training (average number of times trained) of VFAs against the average number of trainings required for mastery

The responses clearly indicate that a one-off training is not enough – refresher trainings are required for mastery, and even more so as the trainees are less formally educated (i.e. VFAs need to be trained more frequently than PFAs).

2. Face to face training of partner staff by CRS, NARS or others

All respondents felt face-to-face training is essential and provides opportunity for questions and answers and immediate feedback. Few respondents indicated problems with face to face training (Figure 7) though 30-35% felt that not enough time was allotted for pests and diseases, IT, and GPS, while 19-32% indicated that not enough materials (visual aids) and equipment (computers and GPS units) were availed for the same subjects. Other categories were not selected or minimally selected (<0.5%) including "too many trainees," "trainer not competent," and "other."

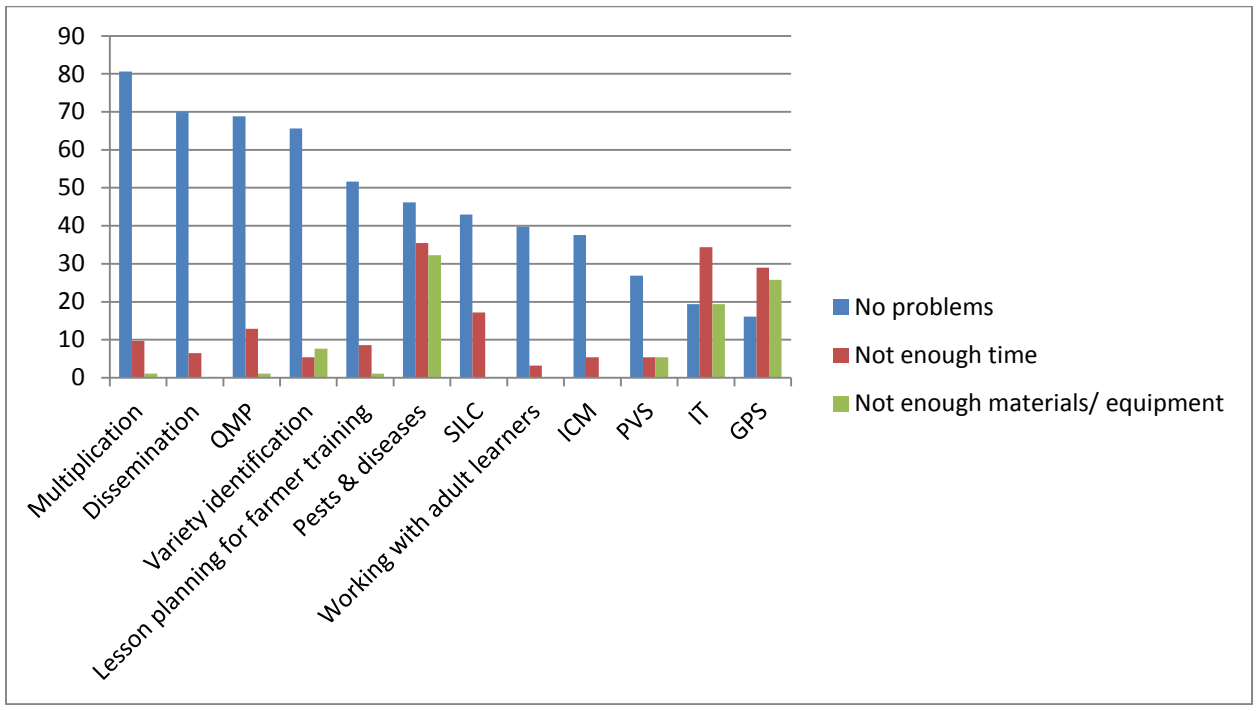


Figure 7. Problems with face to face trainings by subject (percent of respondents selecting)

The most frequent recommendations to improve face-to-face training were: increase the frequency of training (78%), provide more supporting materials such as reference materials and visual aids (67%), provide more practical, hands-on work (41%), and provide more examples and demonstrations (27%).

Partner staff were asked how face to face training complements the GoCourses (Figure 8).

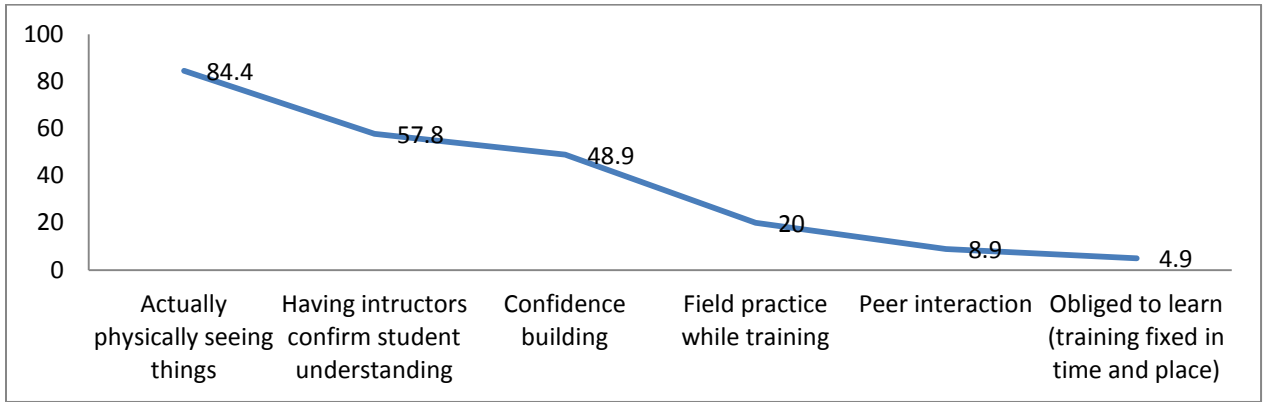


Figure 8. Advantages of face to face training over GLCI GoCourses (supervisors and PFAs only, by percentage of respondents)

3. GoCourse training of partner staff

All PFAs and 13 of 14 supervisors affirmed having taken or used the GoCourses (Figure 9). Not all coordinators and no VFAs took the GoCourses, but they were not the intended audience.

Figure 9. Percentages of partner staff by position that took GoCourses

Respondents felt the courses to be useful: for reference (84%), because they can be taken when and where desired by course taker (44%), to refresh one's memory (44%), because the tests and quizzes help one to assess their knowledge (31%), and finally because the practical assignments enabled them to apply their knowledge and skills (18%). The majority of respondents (>87%) felt that all of the e-learning should be associated with face-to-face sessions, 89% also wanted them in hard copy and 29% felt that the courses should be complemented by exchange visits (though more so in Rwanda with 73%). Only 2.2% indicated that the courses were useful in orienting and training new staff or for training farmer groups directly. Respondents did not indicate that either of the following was important – "sample lesson plans for facilitating farmer learning sessions" or "that the courses were good introductory material so that one can be ready for face to face training."

GoCourse user feedback[2] collected from 145 course takers in a separate study, revealed the following: 83% suggested including visual aids for use in facilitating farmer learning sessions, 73% recommended providing lesson plans to facilitate farmer learning sessions, 61% suggested including a dialogue of people discussion various subjects in the field (i.e. on video in the courses), 52% suggested incorporating story telling of subjects to learn, 46% felt it would be useful to include video of an African CRS or partner supervisor talking about specific subjects in the field (i.e. on video in the courses), 17% suggested reducing the amount of reading and 13% recommend including music and songs.

Other common suggestions from the users included: improve the quality of the French translations, translate into Swahili and Kirundi, provide the courses in soft and hard copy, reduce the use of technical terms, and enable partner staff to take and review each course collectively (as a group) rather than insist that each partner staff take the course individually. While respondents indicated that they most liked the use of text, slideshows and quizzes in the courses, this may be because these were predominant whereas video was hardly incorporated. Further, in lieu of having a "teacher" reviewing and responding to submitted assignments and exercises, the next level supervisor was supposed to complete this task

[2] Schofield, J. Preliminary Summary Report: GoCourse User Feedback. June, 2011. (see Appendix I)

but this generally seems not to have been the case which again may have led to the low ranking of assignments and exercises.[3]

4. Changes in the training methods of partner staff

Partner staff were asked "how the training they received has influenced how they train others" to which 67% of respondents indicated that the training has influenced them to plan more carefully and better manage their time (e.g., one topic per session), 49% indicated that they now have the technical knowledge required, 42% indicated increased confidence, 33% said that they know better how to facilitate farmer learning, 25% indicated that their sessions are now more participatory, and 7% said they now better understand how farmer groups work and how to help them become stronger.

C. Training, knowledge and behavior change by farmer groups

This section looks at training received and behavior change among participating farmer group members.

1. Training received by farmer groups

The survey results show that most of the farmer groups have received most of the training offered by GLCI, though variations exist among countries (Table 8). Of these, farmer group members ranked disease awareness, identification and management as the most important (70%). The rest of the training courses received 0-12% of vote as being the "most important." The core training subjects in the curriculum were identified by the management team, additional subjects were addressed on an ad hoc basis including gender and diversity, value addition and marketing courses.

Table 5. Training courses received by the farmer groups[4]

Country	Clean seed handling	ICM practices	Disease awareness & management	Variety ID	QMP	Dissemin-ation planning	Inter-cropping	Average
Kenya	88.9	83.3	77.8	83.3	66.7	72.2	77.8	78.6
Rwanda	100	100	92.9	100	92.9	100	50	90.8
Tanzania	100	100	100	83.3	100	72.2	61.3	88.1
Average	**96**	**94**	**90**	**88**	**86**	**80**	**64**	**85.4**

Farmer group members found observing demonstration plots and practices in the field to be the best part of the training (72%), particularly farmer group members in Tanzania (100%). Meeting and making connections with resource people is a distant second (30%) in terms of importance to farmers, followed by meeting other farmers or groups (22%). Receiving handouts from the training is the least important to farmer group members (12%).

Respondents confirmed that 82% have shared their training information with other individual farmers, while only 38% have shared it with the other groups they belong to, even though many belong to more than one group. This shows that working with farmer groups is an effective and efficient way to share training information with the rest of the community. Half of the respondents shared the training information by showing their demonstration plots to other farmers. This suggests that most farmers pass on information on an informal individual level rather than by training members of the other groups to which they belong.

[3] Ibid
[4] Ibid

2. Behavior changes and changes in practices by farmer group members

For each category of the questions, only the answers with >50% of respondents are considered significant enough to be listed in Table 9. For example, of the various ways diseases are managed, while 100% of respondents now manage them by removing diseased plants (roguing), only a small percentage plant only improved varieties (28%), and fewer yet manage by roguing off types or isolating the improved varieties from the local ones. Given that, over time, most varieties showing high tolerance to CBSD and/or CMD have later succumbed, it is logical that farmers continue to hedge their bets by using a diversity of varieties. The answers in Table 9 reflect only the behavioral changes that the majority ore respondents reported undertaking. While roguing diseased plants is the most consistent change of behavior, farmers have also recognized the importance of sourcing clean planting material, and better spacing, weeding and planting practices.

Table 6. Changes in practices and behavior regarding cassava planting material and production as result of training[5]

Country	Sourcing practices		General management within disease context			Planting practices			Disease mgmt
	From known person & inst only	Confirm quality of planting material	Distance from diseased fields	More weeding	Rogue diseased plants	Shorter cutting	Better spacing	Plant at angle	Rogue diseased plants
Kenya	83.3	66.7	88.9	100	72.2	94.4	72.2	94.4	100
Rwanda	100	78.6	85.7	85.7	85.7	78.6	85.7	71.4	100
Tanzania	94.5	55.6	100	88.9	66.7	77.8	83.3	33.3	100
Average	**92**	**66**	**92**	**92**	**74**	**84**	**80**	**66**	**100**

D. Sensitization of and behavior change by beneficiaries

As mentioned in the introduction, partner staff sensitized direct beneficiary recipients on a number of topics just prior to disseminating improved planting material. During these sessions, key messages included how to recognize and manage diseases and to plant and manage cassava. This section examines the messages that beneficiaries recalled having received, their understanding of them, related practices and whether they shared the messages with others.

1. Sensitization messages received

Figure 10 below shows that beneficiary respondents from Kenya recalled receiving the most sensitization messages, followed by Rwanda and lastly Tanzania. This may reflect both the messages communicated, but also the capacity of beneficiaries to understand and recall. On average, Kenyan farmers have had the most education, followed by Rwanda and Tanzania. Generally, the messages recalled varied between countries though generally crop management and plant spacing were the most recalled. Crop management and spacing was the most recalled, followed by variety identification, use of mini-stem cuttings, disease symptom and management, and finally cassava leaf consumption. Disease symptoms and management may have been difficult to recall due to the relative complexity of the topic as distinguishing the diseases is not always straightforward (particularly CBSD). Cassava leaf consumption was the least recalled, though this message may not have been systematically disseminated, particularly in Tanzania and to a lesser extent in Rwanda, perhaps because consumption of cassava leaves is already widely practiced in these countries.

[5] Ibid

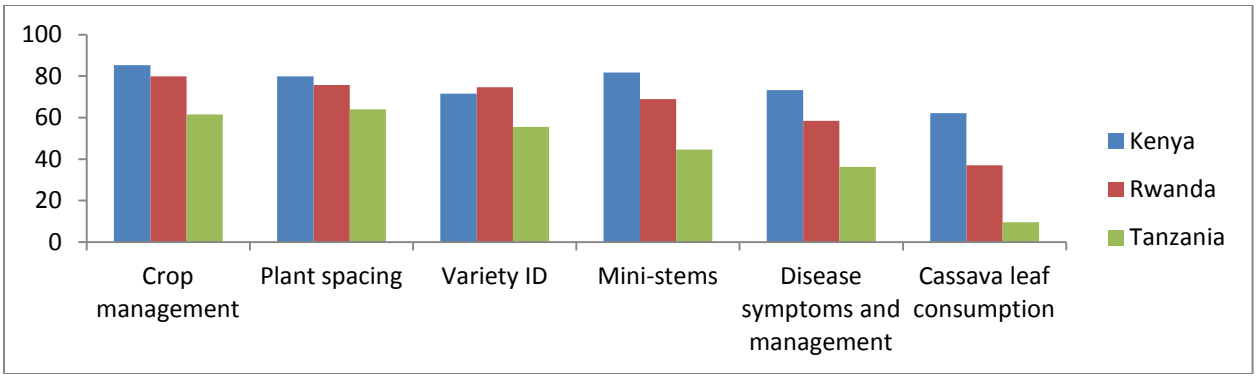


Figure 10. Percentage of respondent beneficiaries recalling sensitization messages received at dissemination

Beneficiaries' primary suggestions for improving sensitization included: providing more training (91%), distributing hand outs or printed reminders (82%), and demonstrating with samples (24%). It is interesting that so many beneficiaries insisted on receiving reminders, while few farmer group members requested the same. This may be explained however by the specific questions they were asked. Beneficiaries were asked "what could be done to help you remember key messages" while farmer group members were asked "what actions do you recommend to strengthen the training you received." Somewhat surprisingly, beneficiary respondents did not indicate that it was important to focus on only one topic or theme per training session.

Figure 11 indicates the percentages of respondents that felt that they understand CBSD and CMD. CMD is well known in Rwanda (97%) and lesser known in Tanzania (80%), while only half (51%) of respondents in Kenya indicated that they understand CMD. This might be related to the fact that cassava is of lower importance in Kenya as opposed to the other countries, so even those that grow it may give it less attention. CBSD is best known by beneficiary respondents (81%) in Tanzania where the disease is the most prevalent; it is understood by 46% in Kenya (lower prevalence) and by 17% in Rwanda where its presence had not been confirmed at the time of this study.

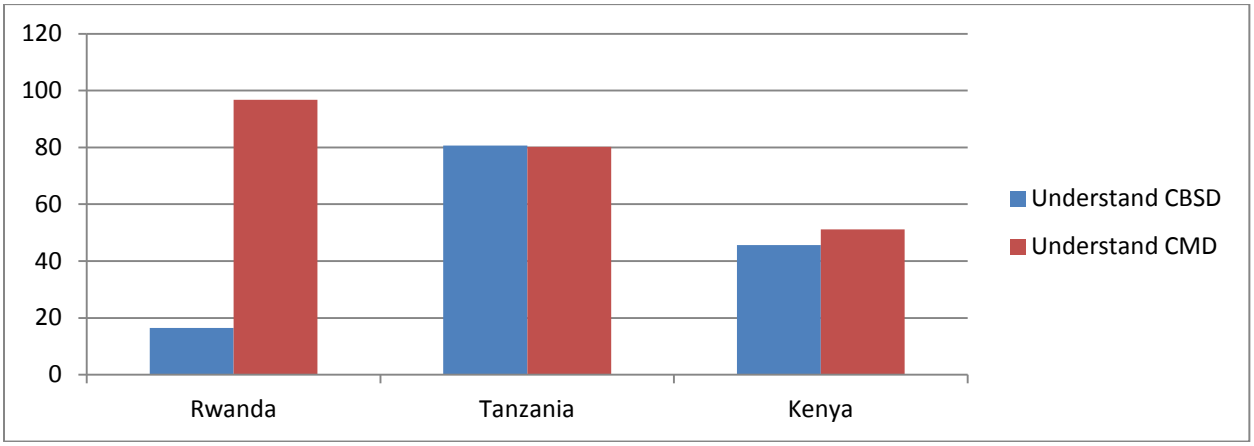


Figure 11. Percentage of respondent beneficiaries that feel that they understand CBSD and CMD

2. Knowledge

Beneficiaries were also asked questions to assess their knowledge of the causes of the two diseases. GLCI sensitizations have indicated that both viruses can be transmitted by white flies (pests) and can also be spread by use of already infected planting material. In correlation with above, Figure 12 shows that the large majority (93%) of beneficiaries in Rwanda associated CMD with pests, followed by 67% in Tanzania and 38% in Kenya. When comparing the percentage of respondents that indicated that they understood CMD with their actual knowledge of the cause, it is apparent that in each country fewer actually knew that CMD is caused by pests.

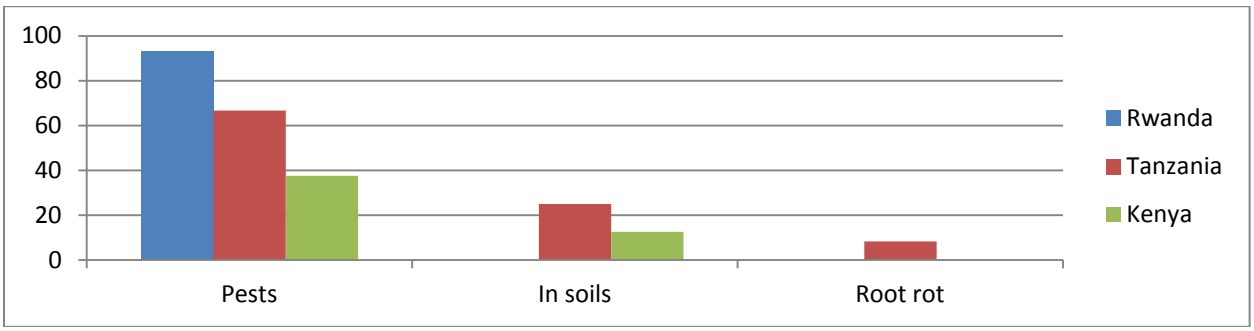


Figure 12. Percentage of respondent beneficiaries indicating their understanding of the causes of CMD

Figure 13 below shows that a large proportion of beneficiary respondents in each country associated CBSD with soils. This was particularly true in Tanzania with 58% linking the cause of CBSD to soils against 50% indicating pests. In Kenya, 25% of respondents linked CBSD with soils and 25% with pests. In Rwanda, most respondents indicated that they do not know CBSD with only 7% indicating CBSD is caused by pests. It is not surprising that more Tanzanian beneficiaries responded to this question as it, along with Uganda, is the country with the highest incidence and severity. While the sensitization provided indicated that CBSD is caused by a virus spread by white flies and that it is also spread through the use of already infected cuttings, the very concept of a "virus" is difficult to comprehend as it cannot be seen by the naked eye. The perception of CBSD being soil borne is understandable as, once the inoculums exist, it keeps getting passed around by white flies and the planting material. The way the disease then persists looks very much like the disease actually is in the soil because it does not seem to go away with new crops (e.g., new planting material), or absence of white flies. Further, research is on-going on CBSD epidemiology and it will take time and resources for research findings to reach farmers. In contrast, the epidemiology of CMD transmission has been known and disseminated for many years.

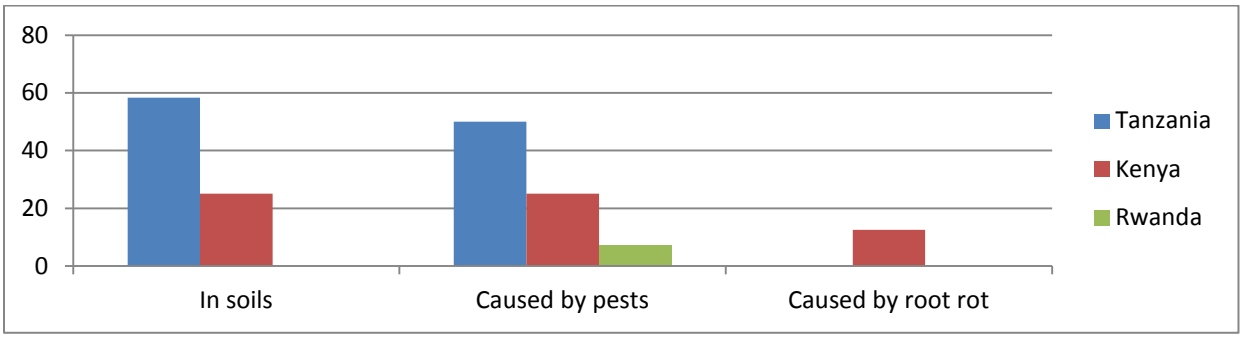


Figure 13. Percentage of respondent beneficiaries indicating their understanding of causes of CBSD

3. Beneficiary practices

During this survey, beneficiary respondents were asked about their current practices. As shown in Figure 14 below, many beneficiaries indicated that they use improved practices.

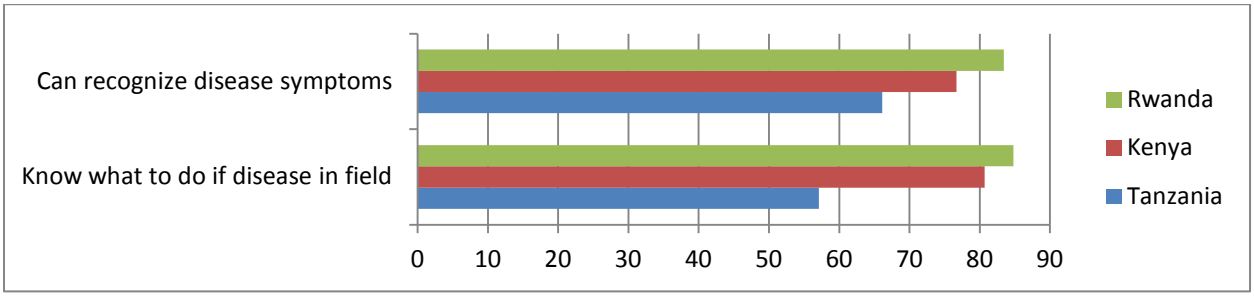


Figure 14. Percentage of respondent beneficiaries reporting changed practices

In Tanzania, only 57% of respondents indicated that they knew what to do if disease is in their field – this may be due to the high incidence of CBSD, that leaf symptoms do not necessarily mean high root severity and because all varieties have eventually shown susceptibility. However, it is important to note that even scientists are just learning what can be done in the face of CBSD, so it should come as no surprise that farmers do not know. Encouragingly, a mean of 76% of all respondents indicated that they can recognize disease symptoms and 98% in Kenya and Tanzania and 99.5% of beneficiaries in Rwanda indicated that they remove diseased plants. This represents a significant increase in this practice as the GLCI baseline study showed that 82% of farmers in Rwanda removed CMD diseased plants, 63% in Kenya and 62% in Tanzania.[6]

4. Sharing of training

The project encouraged beneficiary farmers to share the messages they received during sensitization with other farmers. To gauge the extent to which this actually happened, beneficiary respondents were asked whether they shared the messages and which messages. 64% of respondents in Rwanda said they shared training messages against 60% in Kenya and 47% in Tanzania. From Figure 15 below, the most commonly shared messages were on spacing and the benefits of cassava, while the messages on variety identification, preparation of mini-stem cuttings and disease identification and management were less frequently passed, on probably because these topics are more complex.

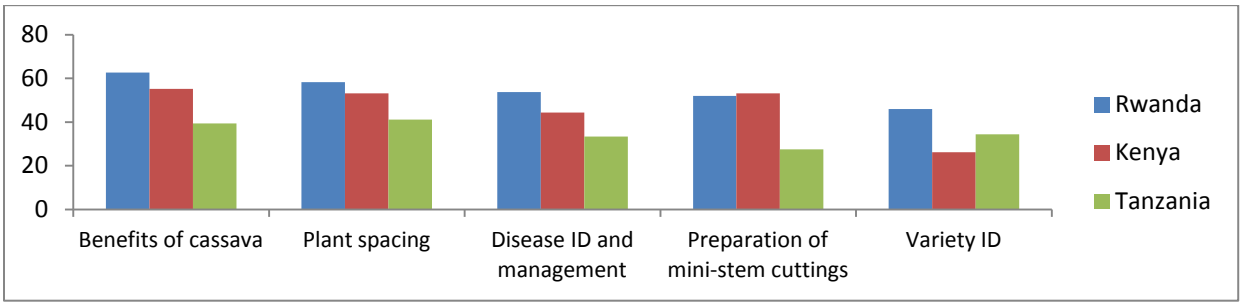


Figure 15. Percentage of respondent beneficiaries indicating that they pass on sensitization information (by topic)

[6] Kimetrica International Limited, Baseline Study: CRS Great Lakes Cassava Initiative and FAO Regional Cassava Program. 18 November 2008

II. Discussion and Conclusions

A. Partner staff – training, knowledge and behavior change

The study concluded that the combination of face to face and e-learning courses was most effective in increasing the knowledge, skills and confidence of GLCI partner staff (Figure 1) and, in turn, strengthening farmer groups and planting material beneficiaries and making them more effective in producing improved planting material, sharing knowledge and mitigating against cassava diseases.

The large majority of partner supervisor, PFA and VFA respondents indicated that each of the training subjects was either very important or important (Figure 2). The conclusion is that partner staff felt that all of the subjects in which they were trained in GLCI were relevant to their activities.

Partner coordinators, supervisors and PFAs felt that after GLCI training they had good to very good knowledge and skills in project topics (Figure 3), compared to their initial level of none to fair knowledge and skills.

VFAs felt that they had fair to very good knowledge and skills in many of the GLCI topics following training, while they came into the project with none to minimal knowledge and skills (Figure 4). It is concluded that, VFAs, starting with a lower level of skills, require more training. Though they were sufficiently trained to mobilize communities, monitor field work, and support dissemination of planting material, further training would have increased their confidence and competence. More efforts in direct training for VFAs would be a worthwhile investment.

Needs assessments and monitoring are crucial so that the right amount and frequency of training is provided to the right level of learner. The findings show that supervisors and PFAs received multiple trainings in most topics and were able to master the content (Figure 5), and areas of over and under training were identified. VFAs were also able to understand most topics, although more training is required for them to master content and be confident in facilitating farmer learning. The newer and more complex the topic, the more repetition of training required.

Face to face training is critically important to partner staff, as it enables hands-on practice and provides immediate feedback through question and answer (Figure 8). The emphasis must be on providing more practical, hands-on work and providing examples and demonstrations. Further, sufficient equipment or other supporting materials should be provided for all participants. Face to face training should be scheduled at regular intervals based on the needs of the partner, while supporting materials should be provided for trainees to refer back to and to use to train others.

The e-learning courses are particularly useful as reference materials and to refresh one's knowledge. For the foreseeable future though, it is important to continue to combine e-learning with face to face training. Quizzes help a course taker assess their knowledge and the practical assignments enable application of new knowledge and skills. This study was not able to discern the results and impact of the e-learning specifically as participants also received face to face training. E-learning courses must be complemented by face to face sessions with supporting visual aids and hard copy training materials. GoCourse user feedback from a separate study provided more comprehensive feedback and recommendations on the courses and revealed that visual aids, lesson plans, dialogues, storytelling, African-appropriate video with dialogues, and even music and songs should be incorporated into the course material. In the future, e-learning courses should be considered for projects at such scale and, to

the extent possible, should respond to learners' interest in seeing and hearing (audio-visual), doing (practical assignments) and interacting with a facilitator (blog, feedback, etc)[7]. It is important to note however that enough time and funds must be allocated to develop, manage and maintain courses[8].

Training in how to work with adult learners and plan lessons were integrated into each course[9] and were critical in making partner supervisors and PFAs more effective in facilitating farmer learning through pre-planning, providing more focused trainings, and feeling increased confidence with greater technical knowledge. Partner staff now also know how to structure and manage farmer learning sessions, facilitate sessions that are more participatory and practical in nature, and know the farmer groups better. Working with adult learners and lesson planning should be integrated into the training of extension staff regardless of the program focus.

B. Farmer group members – training, knowledge acquisition and behavior change

The most appreciated training method cited was demonstration and practice in the field, which should be the principal method used in such projects. Participating farmer group members were trained in most if not all key subjects (Table 8), most important of which was cassava diseases awareness, identification and management. Few respondents suggested that information brochures or hand outs be provided, though this may be an indication that the practical training that they received was adequate and that they had mastered the content, though this might also be attributed to the way the questions were structured.

Working with farmer groups is an effective way of disseminating information well beyond the group. The stronger groups had received more training, were applying more of the knowledge and skills and were sharing or passing this training on to more community members outside of their group[10]. Group members most commonly shared training messages on an individual basis, by showing their farms to others, and, to a lesser extent by sharing with other groups to which they belong.

Farmer group members indicated quite a significant number of behavior changes regarding cassava multiplication and production as a result of training (Table 9). This suggests that the training and monitoring visits by partner staff and VFAs was effective and that caseloads (Figure 1) were reasonable.

C. Beneficiaries – sensitization and behavior change

Beneficiary recollection of sensitization messages varied by country and topic. It is hypothesized that this is due more to the relative levels of education and awareness of the farmers (highest in Kenya and lowest in Tanzania) than to the sensitization provided, though this could also be a cause. This would suggest, though it did not emerge from respondent suggestions for improving sensitization, that the dissemination sensitization should be carefully tailored to the audience and focused on the few most important messages that can be reasonably understood and remembered from a brief session.

[7] For more detail on the e-learning courses, user feed was collected and analyzed and is available in a separate report.
[8] For more on this refer to Davies, S. CRS ICT4D Portfolio Great Lakes Cassava Initiative (GLCI) – Data Collection and Remote Learning. For CRS by Accenture in 2010.
[9] The content of "Working with Adult Learners" and the lesson planning integrated into the courses is based on the work of Dr. Jane Vella.
[10] Peters, Dai. Farmer groups, strengthened by Savings and Internal Lending Community, as a delivery channel in the cassava seed system in East and Central Africa. A CRS/ GLCI case study, December 2011.

Beneficiaries indicated significant changes in their practices in dealing with diseases (Figure 14) **and more than half of respondent beneficiaries had passed on the training messages to others** (Figure 15). Tanzanian respondents' lower percentages of adoption may be attributed to high incidence of CBSD and the lack of tolerant varieties.

Beneficiary respondents insisted that more training is required and that handouts and reminders would be useful to them for reference and to facilitate sharing the messages with others. These may be particularly useful in reinforcing messages with lower adoption rates. Consequently, brochures and informational handouts have been designed, printed, and to be distributed (discussed below). Increasing the use of examples and demonstrations was also encouraged, but to a much lesser extent, probably because these are already the standard practice.

D. Actions underway

With the six month extension, the GLCI project continues to pursue a number of actions to complement and bolster training and sensitization. These efforts respond specifically to partner staff demand for hard copies of training courses and visual aids as well as farmer beneficiaries' request for informational handouts and reminders. This has involved working with a local artist to develop information, education and communication (IEC) materials, including:

- Laminated handouts on CBSD and CMD to disseminate to planting material beneficiaries as well as participating farmer groups and individual multipliers. All of these materials are being produced in English and French as well as Swahili (both Tanzanian and DRC versions), Luganda, Kirundi, and Kinyarwanda. Materials destined for farmer use consist mostly of drawings and photos with minimal writing and are being laminated to make them more durable.
- Brochures on CBSD and CMD, A2- and A0-sized posters on CBSD for government and NGO staff, and hard copies of visual aids and guidance for cassava field workers. The sample lesson plans for facilitating farmer learning and the GoCourses have been converted to PDF and HTML formats so they can be made more widely available within and beyond the project. Partners will receive hard and soft copies while other stakeholders will also be provided with soft copies of all of the IEC and training materials. Low resolution versions will also be available for download at http://iglci.crs.org/.

III. Summary

Increased knowledge and more effective partner staff

- The GLCI combined approach of face to face (repeated) training and e-learning courses was complementary, enabling partner supervisors and PFAs to acquire the knowledge and skills to effectively facilitate farmer group learning and beneficiary sensitization sessions.
- All partner staff require repeat training to master a subject. VFAs require more repetition than PFAs and supervisors. The more complex and foreign the topic (i.e. use of IT, causes of diseases, etc), the more repetitions required. Further, the lower the level of formal education, the more repetition required. It is important to assess progress and re-train as necessary.
- Adult learning and lesson planning should be included in any training program for extension staff.

Value of face to face training

- Repeated, face to face training sessions remain essential to facilitate partner staff learning and must include hands-on practice and allow for immediate feedback through question and answer.
- Face to face training can be strengthened by increasing the frequency and providing more supporting materials, more hands-on work and more examples and demonstrations.

Supportive role of GoCourses

- E-learning complements face to face training, but cannot replace it.
- E-learning courses were valued primarily as reference materials and to refresh one's knowledge.
- Hard copies and visual aids should accompany the courses.
- Future courses should build in more audio-visual of the local context and people that learners can relate to and who are actually demonstrating the concepts in the field.
- Practical assignments and quizzes should continue to be incorporated so that course takers can apply their knowledge and skills.
- A course facilitator should be available and responsive in person and/ or via the intranet and provide feedback on assignments.

Increased knowledge of and improved practices by farmer group members

- Training farmer group members was effective.
- Farmer groups participating in GLCI were trained in key topics related to diseases management.
- Group members are implementing all improved disease mitigation and management practices they learned from the training.
- Group members appreciate direct observation in the field and then applying or practicing the new knowledge and skills.
- To a lesser extent they appreciate interacting with resource people and also meeting members of other groups and seeing their work.
- 80% of farmer group members share their knowledge with others.
- The more training received the stronger the farmer group and the more likely they are to share the information with others.[11]

Increased knowledge of and improved cassava disease management by beneficiary farmers

- Sensitization of beneficiary farmers during planting material dissemination was effective.
- The majority of beneficiaries can now recognize disease symptoms and know what to do if they see them in their fields – principally removing diseased plants.
- About half of beneficiaries also share the information with other farmers.
- To enhance sensitization and sharing information with others, further training and handouts and reminders should be provided with relevant photos or images and minimal text in local language.

[11] Peters, Dai. Farmer groups, strengthened by Savings and Internal Lending Community, as a delivery channel in the cassava seed system in East and Central Africa. A CRS/ GLCI case study, December 2011.

Chapter 4. Seed System

Setting up a seed system was the core component of the Great Lakes Cassava Initiative (GLCI). Dealing with the two diseases—Cassava Mosaic Disease (CMD) and Cassava Brown Streak Disease (CBSD)—made it particularly important to prepare for pipeline material. Since CMD-resistant varieties had firmly been established and were already available, the pipeline materials were mainly selected to withstand CBSD, at least for a few years, and all the better if they last longer before succumbing to the disease.

Multiplication and dissemination clean seeds of the disease-tolerant/resistant varieties was the core activities of the seed system. The major challenges of these activities were to: 1) identify disease-tolerant/resistant varieties, 2) ensure the disease-free quality of the seeds, 3) establish a strategy on multiplication site selection, 4) manage the magnitude of the diverse multipliers of each step of the multiplication process, and 5) integrate the relevant knowledge and information gained from the disease component of the project, to both ensure the quality of seeds and to keep the costs of quality assurance to a reasonable level.

Part 1 of this chapter reports on the process the project underwent to manage the pipeline material, multiplication and dissemination, ensure quality, and integrate the relevant knowledge on disease into multiplication over the life of the project. Part 2 presents the assessment of the GLCI seed system, which examines the four innovative approaches used in the GLCI seed system which allowed GLCI to achieve its target while dealing with the diseases. The case study explains the rationale of each of these four approaches, examines how well they worked or not, explores the challenges faced, and provides suggestions and recommendations to improve such a system.

Part 1. The Process of Establishing the GLCI Seed System

Pipeline materials

Participatory Variety Selection (PVS) and tissue culture (TC) multiplication of the "best bets" from the International Institute of Tropical Agriculture (IITA) were the venue through which GLCI selected and prepared pipeline material.

1. PVS

To get the PVS established, the PVS resource person, with support from the GLCI regional team, organized a workshop in Tanzania in July 2008 to train and share experiences with National Agricultural Research Systems (NARS), extensionists and non-governmental organization (NGO) representatives. Integrated Crop Management (ICM) trials and SILC were also introduced at this meeting.

Country planning meetings of the first year of project served as a venue to sensitize participating country level stakeholders as to the content of preparing for pipeline material, to verify the availability of varieties to establish PVS trials and to establish a timeline for PVS, along with ICM start up.

The first year, PVS trials were established at 135 sites versus 90 planned, to be harvested in 2009. The National Agricultural Research Organization (NARO) in Uganda did not have any new varieties ready to enter PVS, but anticipated that they would have at least 12 varieties to enter into trials during the major growing season in February to March of 2009 (Table 1). The overachievements in Rwanda were due in part to the incorporation of pre-existing trials established at the end of the East African Root Crops Research Network (EARRNET). Overachievement in Tanzania that year was justified because the number

of sites targeted was based on an underestimation of the agro-ecologies. During this first year more sites were established with individuals rather than farmer groups.

Table 1. PVS trial establishment (comparing new varieties against best local variety) in 2008

Country	Sites (#)		Agro-Ecological Zones (#)		No. of varieties
	Targeted	Established	Targeted	Established	
Burundi	10	10	4	3	7
DRC	30	20	3	3	8
Kenya	10	10	5	-	15
Rwanda	10	50	4	4	15
Tanzania	20	45	6	3	6
Uganda	10	-	-	-	-

During six months of the trials, monitoring and training visits were made to all countries implementing PVS. During this period, a number of these varieties have already shown symptoms of CBSD, including 9 of 15 in Western Kenya, 6 of 10 in the coastal zone of Tanzania, and 1 of 8 in Lake Zone, Tanzania. This indicated the difficulty of identifying viable varieties during the rest of the time of the project.

By the end of 2009, PVS trials have been established in each GLCI country for the third consecutive year, except for Uganda which waited to plant 12 trials in the following season of April/May, 2010. (Table 2) By this time 13 agro-ecological zones have been covered with nine to 18 trails in each zone to give statistically reliable data. Most zones had five to seven varieties, except Kenya where only three varieties were available after many succumbed to CBSD last season, and Tanzania Coast with nine as new varieties came online.

Table 2. Summary of PVS trial establishment in 2010

Country	Clones selected for multiplication from FY 2009 trials & criteria	Varieties in PVS	# groups and AEZ
Burundi	8 varieties (from FY08 trials, none in FY09); CMD tolerance, yield, taste, piecemeal harvesting	MH 97/1744, M/964463, MM 97/5006, MM 96/1666, MM96/1961, MM96/2961, MM96 /3920	31 groups; 3 agro-ecological zones (AEZ);
DRC	2 varieties; CMD tolerance, yield, taste, appearance of leaves, early maturing, piecemeal harvesting	MM 96//0730, MM 97/1735, MM 96/4653, MM 97/2206, MM 97/2015, TME 419	46 groups, 6 AEZ
Kenya	Still working with 2 varieties selected in FY09; disease tolerance, yield, drought tolerance	MM98/3567, M96/3972, MM96/2335	4 groups; 2 AEZ
Rwanda	Still working with 3 varieties selected in FY09; CMD tolerance, yield, piecemeal harvesting	MM96/1068, M96/2480, and MM97/1948	17 groups; 3 AEZ
TZ Lake Zone	No varieties yet selected, trials have been repeated		20 groups; 5 AEZ; 5 varieties
TZ Coast	None, two promising varieties from FY08 trials included in FY10 trials		15 groups; 5 AEZ; 13 varieties
Uganda	N/A	266-BAM, 349-KAK, 72-TME 14, 28-TME-14, 109-TME-14, and MM 4271	12 groups; 3 AEZ

The PVS trials became more organized and better structured by the last year of the trials. All countries established trials during this year (Table 3).

Table 3. Summary of PVS trial establishment in 2011

Country	No. clones	No. sites	Best performing clone		Local check Fresh yield (T/ha)	Observations
			Name	Fresh yield (T/ha)		
Burundi	7	8	MH97/1744	24.8	--	Significant productivity difference among the 8 sites; 2 sites mean yields over 30 T/ha; 3 sites mean yield under 16 T/ha.
DRC	6	16	TME419	24.8	17.3	50% of sites recorded mean yields for all clones above 20 T/ha.
Kenya	3	18	MM96/3972	26.6	18.1	MM96/3972 had significantly lower mean maximum severity score (2.0) for CBSD than other two clones.
Rwanda	7	17	MM96/1068	23.9	16.4	Yield from 2010/2011. 2011 has no repeat clones so no potential to compare with the previous trial.
TZ Lake	4	--	None	--	--	All the clones performed poorly as they succumbed to CBSD
TZ Coast	6	6	KBH02/482	32.4	9.7	CBSD root necrosis severity not significantly different among clones, score 1-2.
Uganda	12	12	28-TME-14	20.7	14.9	CBSD root necrosis incidence varied variety considerably among the clones and among the sites.

*-- signifies missing data

Below are the summary of the results of these PVS trials in each of the countries. For detailed information, please see the PVS Final Report Appendix attached to this chapter.

Burundi

- 2008/2009 season. Burundi established 32 trials in April 2008 across eight sites with six improved genotypes (MM 96/3920, MH 97/2961, MH 97/1744, MM 96/1961, MM 96/1666, and MM 96/4463). The rainfall was inadequate and most clones yielded very poorly. Clones MM96/3920 (6.4 t/ha) and MM96/1961 (3.7 t/ha) were the most promising in terms of fresh root yield.
- 2009/2010 season. Seven clones were evaluated across eight sites. Significant differences were detected among the clones in yielding ability. The highest yielding clone was MH97/1744 which yielded 24.8 t/ha of fresh roots while the lowest yielder was MH96/1666 (18.9 t/ha). The eight sites differed significantly in their productivity. Rumonge and Cibitoke (both in Imbo AEZ) were the most productive followed by Giteranyi (Bugesera) and Cihonda (Buyenzi). Cankuzo (Buyogoma AEZ) was the worst site where the average yield of the clones was below 10 t/ha.
- No trials were planted during the 2010/2011 and 2011/2012.

Democratic Republic of Congo (DRC)

- 2008/2009 season. In this season 15 PVS trials were established in DRC using six clones (MM 96/4653, MM 96/2023, MM 96/4463, MM 97/2015, TME 419, and MM 96/5529). They were evaluated in three AEZs in the two provinces of North Kivu and South Kivu. Fresh root yield of the clones ranged from 6.7 to 17.6 t/ha for MM 96/2023 and MM 96/4653, respectively, with a mean of 10.9 t/ha. In comparison to checks used, four test genotypes (MM 96/4653, MM 97/2015, TME 419, and MM 96/5529) gave superior yields compared to the checks.
- 2009/2010 season. Six varieties (TME 419, MM 97/1735, MM 96/5272, MM 96/3055, MM 96/0730, and MM 96/6040) were evaluated across 16 sites. Statistical significant differences were found among the clones in fresh root yield. TME 419 yielded the best (24.8 t/ha), followed by MM 97/1735 (24 t/ha) and MM 96/5272 (23.6 t/ha). The yields of these three varieties were significantly higher than the local checks which gave average yields of 17.3 t/ha. Statistical significant differences were also detected among the sites in fresh root yield. The highest productive site was Irango (lowland AEZ) where the clones recorded the highest mean fresh root yield of 61.5 t/ha. The least productive site was Bisembe (lowland AEZ) where the clones had average yields of 8.9 t/ha.
- 2010/2011 season. Three clones were evaluated. Significant differences were detected in fresh root yield among the clones. The three improved clones, on the average, significantly out-yielded the local checks. The highest fresh root yield was recorded from clone MM 96/3972 (26.6 t/ha). The average root yield of the local checks was 18.1 t/ha. CBSD mean root severity scores detected no significant differences among the clones. However, highly significant differences were detected for CBSD root necrosis maximum scores. Significant differences were detected among the districts for CBSD maximum root necrosis scores. Highest scores were recorded in Busia (3.3) followed by Kisumu (2.8). Lowest scores were recorded in Bondo (1.7).
- 2011/2012 season. Five clones were evaluated in DRC. No statistical significant differences were detected among the clones with regards to fresh root yield. Yield ranged from 10.54 to 15.08 t/ha for clones Mu 2007/090 and MM 96/5272, respectively. However, the sites varied significantly in fresh root yield. The most productive district was Kalemie (18.39 t/ha) while the least productive was Bukeye which had 3.57 t/ha. CBSD-like root symptoms were recorded on clones MM 96/3378, MM96/5272, Mv 2004, and on the local check in Fizi district.2 In Western Kenya, 150 trials were established in May and June 2008 in 10 sites. Each site had 15 PVS trials hosted by farmer groups. Fifteen improved genotypes developed on-station by KARI Kakamega were used (MH 95/0198, Migyera, MM 96/0814, MM 96/1872, MM 96/4605, MM 96/6966, MM 96/7688, MM 97/0022, MM 97/0293, MM 97/0442, MM 97/0807, MM 97/0881, MM 97/1403, MM 97/1735, and MM 98/0602). The yield of these clones ranged from 2.2 to 25.2 t/ha, many out-yielding the local checks. Farmers were very excited by the yielding ability of these new clones. However, farmers were disappointment when they succumbed to CBSD.

Kenya

- All three improved clones in the Kenyan showed severe root necrosis from all of the six fields in Kisumu where CBSD pressure was the highest. This had the serious implications that GLCI had no CBSD-tolerant clone to recommend for cultivation in high pressure areas.

Rwanda

- 2008-2009 season. 21 trials were established in season A of 2008 with a total of seven genotypes, namely: MM 96/0287, MM 96/3920, MM 96/4618, MM 96/1961, MH 95/0414B, MM 96/7204, and MM 96/5280. The second set was planted in season B (February-March 2009) with a total of eight genotypes, namely: MM 96/2546, MM 96/8299, I96/1632, MH 97/1948, M94/0461HS/3, I94/0263HS/1, MM97/2480, and MM97/1068.

- No CBSD foliar symptom was observed during biotic data collection; however, at harvest, root symptoms of CBSD were noted in four clones (MM 96/4618, MH 95/0414B, MM 96/3920, and MM 96/5280) at Mareba site in Bugesera District. For season A, the clone MM 96/0287 significantly yielded higher than the rest of the improved clones. For season B, all test clones yields were higher than the two most used local checks (Gatamisi and Crealinha). The mean yield for seasons A and B was 16.3 t/ha and 14.2 t/ha, respectively. From the PVS evaluation of season A, ISAR released three genotypes (MM 96/0287, MM 96/3920, and MM 96/7204).
- 2010/2011 season. Statistical analysis of the yield data from Rwanda revealed significant differences among the eight clones evaluated. The highest yielding clone across sites was MM 96/1068 with an average root yield of 23.85 t/ha. The lowest yielding clone was MM 96/7459 with an average root yield of 9.60 t/ha. Only two clones (MM 96/1068 and MM 96/2546) gave significantly higher root yields than the local checks, which had average root yields of 16.42 t/ha.

Tanzania

- 2008-/2009 season. Twelve trials were established in the southern coastal region of Mtwara in January 2008 with ten improved genotypes, namely: KBH 2002/1056, KBH 2002/477, KBH 2002/482, KBH 2002/494, KBH 2002/517, KBH 2002/554, NDL 2003/031, NDL 2003/067, NDL 2003/111, and NDL 90/034. The root yield ranged from 1.7 to 38.3 ton/ha with a mean of 9.8 t/ha ± 2.0. The two most promising clones were NDL 2003/111 and KBH 2002/1056, which had moderate resistance to CMD and CBSD, and had good yield potentials of 19.4 t/ha and 10.9 t/ha, respectively.
- For the Lake Zone, two sets of trials were set in two growing seasons of 2008/2009 and 2009/2010 across seven districts. The districts were Bukoba, Misenyi, Misungwi, Sengerema, Geita, Musoma, and Bunda. The first set of clones included: MM 96/0876, MM 96/7487, UKG/98/343, UKG 2001/150, Ex Uganda 15 (Ex Ug 15), and MM 96/4570. TMS 4(2)1425 was used as the improved check. The second set was comprised of Mkombozi, MM 97/2966, UKG 2001/151, UKG 2001/165, and UKG 2001/166.
- 2009/2010 season. Results obtained during this season indicated that most of the tested varieties had good performance in Kagera region (high to medium altitude and high to medium rainfall areas) as compared to the local checks in terms of pests and disease tolerance. Some of the tested varieties succumbed to CBSD in the high CBSD areas. Leaf and root necrosis were recorded in both sets with low incidences and mild symptoms.
- Statistical analysis of the data revealed no significant differences in fresh root yield among the clones evaluated in Misungwi, Bunda, and Ukerewe districts. Fresh root yield ranged from 17.15 to 21. 46 t/ha recorded from clones UKG 2001/166 and 2001/165, respectively. The local checks recorded 19.60. Statistical analysis of CBSD root necrosis severity revealed no significant differences among the clones. All the clones had mean scores above Class 2, indicating that they were susceptible to CBSD. The most severely damaged clones were UKG 2001/165 and MM 97/2966, followed by the local checks. Mkombozi had the least severe root necrosis damage.
- Significant differences in CBSD root necrosis severity were detected among the three districts. Ukerewe had the highest CBSD root necrosis severity (4.33) followed by Bunda (3.33) while Misungwi had the lowest (1.03). The CBSD pressure in Ukerewe was so high that the roots of all the four improved clones were rendered unmarketable.
- Combined analysis of the data for the first set of clones evaluated during the 2008/2009 and 2009/2010 seasons in the Lake Zone, Tanzania, revealed no significant differences among clones for fresh root yield and CBSD root necrosis severity. However, significant differences were detected between districts for both fresh root yield and CBSD root necrosis severity. Bukoba district (Kagera region) was the best in terms of fresh root yield (17.8 t/ha) and Bunda (Mara region) was the worst (1.1 t/ha). Bunda district had the highest CBSD root necrosis severity (1.2); whereas, Bukoba,

Misenyi and Misungwi had the lowest (1.0). No significant differences were detected among the seasons in both fresh root yield and CBSD root necrosis severity.

- 2010/2011 season. Six clones were evaluated across six sites in the three coastal districts of Bagamoyo, Rufiji, and Muheza, Tanzania. Highly significant differences were detected among the clones in fresh root yield. The highest yielding was KBH 02/482 (32.4 t/ha). The second highest yielder was KBH 02/066 (23 t/ha). The top four high yielding improved clones significantly gave higher yields compared to the local checks which yielded only 9.7 t/ha. Statistical significant differences could not be detected for CBSD root necrosis severity among the clones. This is so, because in coastal Tanzania where CBSD has been endemic for many decades, farmers mostly cultivate tolerant varieties. These varieties mostly score class 1-2 for necrosis.
- Combined analysis of the data for the second set of clones evaluated during the 2009/2010 and 2010/2011 seasons revealed significant differences among clones for fresh root yield but not for CBSD root necrosis severity. The highest yielding cultivar was Mkombozi (10.1 t/ha) and the lowest yielder was TMS 4 (2) 1425, which had an average yield of 1.2 t/ha.
- The districts differed significantly in both fresh root yield and CBSD root necrosis severity. Bukoba district again proved to be the most productive in fresh root yield (9.3 t/ha) whereas, Geita district was the least productive (1.2 t/ha). Ukerewe district (Mwanza region) was the most severely CBSD affected district with most of the roots having a mean severity score of 4.3. Bukoba and Muleba districts were not affected at all (1.0). Significant season differences were detected for both fresh root yield and CBSD root necrosis severity.

Uganda

- For the first time under GLCI, Uganda implemented PVS trials using seven clones that have shown promise for dual CBSD and CMD resistance (266-BAM, 72-TME 14, 52-TME 14, 109-TME 14, 28-TME 14, MM 96/4271, and 349-KAK). Statistical significant differences were detected among the clones in yielding ability. Three clones (28-TME-14, 52-TME 14, and 109-TME 14), significantly gave higher fresh root yields (20.7, 20.1, and 19.1 t/ha, respectively) than the local checks which gave average yields of 14.9 t/ha.
- The most CBSD-tolerant clone was 28-TME-14, which showed the lowest severity (1.7) followed by MM 96/4271 (1.8). The most susceptible clone was 349-KAK (3.3) followed by the checks (2.7). Although these scores were statistically not significant, roots with severity score of Class 3 and above are not marketable.
- CBSD root necrosis analyzed across sites showed that Kamuli 2 (3.5), Mukono 2 (3.3), and Nakasongola 3 (3.2) had the highest CBSD root damage. These scores indicated that most of the roots were too severely damaged to be marketable. Palisa 3 had the lowest CBSD damage (1.1).

Summary

After four seasons of evaluation, no single clone was identified to have promising CBSD resistance or tolerance in Burundi, DRC, Lake Zone of Tanzania, and Western Kenya. New clones with proven dual resistance to CBSD and CMD need to be introduced into these areas/countries to mitigate the increasing CBSD threat.

The data on fresh root yield from all the countries clearly showed that most of the improved clones had a significant yield advantage over the local checks and also had acceptable eating qualities. The NARS cassava research programs should use these clones in their breeding programs to generate new recombinants that have high-yielding ability along with dual resistance to CMD and CBSD and acceptable end-user characteristics.

2. TC multiplication of the "best bets"

During previous years IITA had selected some CMD-resistant and potentially CBSD-tolerant varieties which were tested for a few seasons at the Namulonge Research station under the severe pressure of CBSD. These varieties were also supposed to possess the characteristics of high-yielding and early maturity (Table 4). They were then sent to KEPHIS for cleaning and preservation, followed by a contract to have them proceed to multiply 120 cassava plantlets for selected eight "best-bet" clones resistant to Cassava Brown Streak Virus (CBSV) for six countries. These clones include MM06/0138, MM06/0013/ MM06/0139, MM06/0143, MM06/0083, MM06/0046, MM06/0082, MM06/0074. The material multiplied was planned to be supplied in TC to all six GLCI countries. The first batch of these nine clones is expected to be delivered to East African GLCI countries in tissue culture plantlets in 2010.

Table 4. The agronomic characteristics of the eight best bet material

Clone	Fresh Root Yield (t/ha)				DMC (%)
	Mukono	Namulonge	Serere	Mean	
MM06/0013	3.6	5.9	22.3	10.7	47.7
MM06/0046	2.5	5.4	24.4	10.8	37.6
MM06/0074	2.9	2.2	23.8	9.6	34.5
MM06/0082	10.9	11.1	10	10.7	43.1
MM06/0083	2.4	4.7	11.6	8.4	37.9
MM06/0138	4.6	6.2	16.1	8.4	40.7
MM06/0139	6.4	10.5	16.4	11.1	43.1
MM06/0143	3.8	0.69	10.1	4.9	
TME 204 (Check)	3.1	5.8	16.2	8.4	
TME 14 (Check)	11.5	8.6	21.4	13.7	

By February 2011, it became clear that Kenya Plant Health Inspectorate Services (KEPHIS) Muguga could not deliver the plantlets and most of the material was then moved to GTIL, a private commercial lab in Nairobi, as they could more quickly multiply the material and have worked with cassava previously. These eight clones were then rescheduled to be delivered to GLCI countries in August/September 2011 following a Kenya Agricultural Research Institute (KARI) Kakamega led hands-on training on handling tissue culture material for NARS technicians. Since arriving at GTIL, the best growth media for each clone were identified and they were now growing very well. As of early June, three additional propagations were expected for each clone before the end of August and the minimal amount of plantlets for each clone was 2,500. It was clear that KEPHIS, though the appropriate institution to clean and certify the seed quality; did not have the experience or capacity in multiplying TC material and this was best done by private labs which specialized in such activities.

In August 2011, GLCI supported a TC hardening training at KARI- Kakamega for national program staff receiving TC materials. KARI scientists provided the training. The training was attended by Burundi, DRC, Rwanda and Tanzania. Uganda did not did not attend the training but received the materials later. Training was on handling receipt and transfer of material for hardening. Table 5 below shows the number of each clone that was given to each of the countries. More was allocated to Burundi, DRC and Rwanda in the anticipation of the need for CBSD-tolerant materials in the face of the disease outbreaks.

Burundi lost all of the material for reasons not clearly known. DRC had a 58% survival rate when first hardened, but an additional 30+% died subsequently during the heavy rains and excessive moisture and heat. One of the reasons for the low hardening rate is the loss during transport on the plane when the

plantlets were turned upside down. Uganda re-established fresh plantlets as some had overgrown which will be hardened in March 2012.

Table 5. Tissue culture plantlets distributed to the GLCI countries in August 2011

Variety	Kenya	Burundi	DRC	Rwanda	Tanzania	Uganda
MM06/0013	200	200	400	200	150	250
MM06/0074	800	1,600	1,400	1,600	800	900
MM06/0082	200	400	600	400	200	400
MM06/0138	1,200	2,200	2,569	2,200	1,600	1,600
MM06/0083	100	150	300	150	100	140
MM06/0139	400	730	600	600	400	1,400
MM06/0143	100	100	100	100	100	100
MM06/0146	150	750	600	870	150	350
TOTAL	**3,150**	**6,130**	**6,569**	**6,120**	**3,500**	**5,140**
Survival rate	26	0	20	72	20	Re-established

Due to the low survival rates, the second batch of plantlets was distributed to Burundi, Kenya, DRC, and Tanzania between December and January 2011 (Table 6). The number of plantlets distributed depended on the materials available at the time of delivery. Most reported high survival rates than the plantlets previously received and lower losses. Rwanda achieved high survival rate the first thus did not need more; Uganda had always been fairly independent in its breeding program and was content with the first batch received. The breeders of each country had been looking after this material and, in the absence of the definitely CBSD-resistant material, these were the best bets of the pipeline material.

Table 6. Second batch of tissue culture plantlets distributed to the countries

Variety	Burundi	DRC	Kenya	Tanzania
MM06/0013	0	0	100	500
MM06/0074	800	800	400	500
MM06/0082	200	200	200	500
MM06/0138	1,200	1,200	900	500
MM06/0083	83	0	50	500
MM06/0139	800	800	400	500
MM06/0143	0	100	100	500
MM06/0146	600	600	350	500
TOTAL	**3,683**	**3,700**	**2,500**	**4,000**

Seed Quality

In the context of two diseases, seed quality was of the greatest concern and GLCI exercised extreme caution to make sure that no infected material was put to onward multiplication or disseminated. As mentioned in Chapter 2, lab-testing by Real Time PCR was used to ensure the virus-free quality. But due to the magnitude of GLCI, this expensive and time-consuming lab-testing had to be complemented by field Quality Management Protocol (QMP).

At the onset of GLCI, the QMP drafted and piloted during C3P was discussed at a two-day meeting with partners, NARS, and country National Plant Protection Organization (NPPOs) officials, and IITA to produce a new draft to include CBSD by June 30th, 2008. NARS, partners and plant health inspectors then reviewed and tested the QMP at the Learning Alliance meeting in January 2009 and used it for the March 2009 plantings. It was revised further after the March plantings when appropriate diagnostics for CBSV became available. The revised QMP was being applied in all countries by 2010. Rigorous control

using QMP in CBSD endemic regions resulted in a marked improvement in quality and reduced waste as evidenced by the source site testing. Uganda took the application of QMP seriously and applied it to all primary and secondary multiplication sites to weed out obviously infected fields. This practice saved significant amount of time and cost in conducting unnecessary lab-testing for a great number of fields.

Such decentralized quality control and phyto-sanitary processes were slowly but being appreciated, instituted and documented across GLCI partners, sites and countries. A QMP French training manual was developed in 2010 and used as part of a training in Rwanda facilitated by GLCI Rwanda partners with Rwandan Ministry of Agriculture and plant health support. GLCI staff from Burundi, DRC and Rwanda travelled to Musoma, Tanzania in June 2010 to see CBSD in the field, talked to Tanzanian plant health staff, government officials, CRS partners, and participate in field and focus group meetings with affected farmers. All participants noted a renewed understanding of the importance of QMP after having participated in this GLCI sponsored event.

By 2011, the dissemination activities indicated that partners had fully instituted and implemented the approach. This showed QMP as a contextually relevant, low cost and decentralized quality control process, though there was difficulty to draw analytical insights from QMP data which were not always accurately entered.

Seed multiplication and dissemination

1. Multiplication site selection strategy

In the planning of the multiplication site selection, geographic (location-based) information was seen as especially important in the context of a project operating in six countries covering a range of climatic and topographic zones. A close integration of geo-referencing of all project activities using global positioning system (GPS) technology, and incorporation and analysis of all this data within a geographic information system was seen as the key to flexible and adaptive project management and to effective monitoring of project impact and effectiveness. To this end, it was decided that large numbers of GPS units would be supplied to all field operatives, both project staff and partners, and that training should be given in field use of GPS and in data transfer techniques. It was also proposed that geographic information system (GIS) software should be selected and disseminated within the project so that mapping and analysis of field data could be undertaken as a routine activity at all levels of the project

It was also agreed that innovative techniques should be developed for field data collection, combining GPS, digital collection of field (for example cassava disease) data, and transmission of data from field to central office through mobile telephone networks. It was envisaged that this would assist in standardization of data collection, minimize transcription errors, and speed data flow.

Thus, during the GLCI planning workshop in October 2007, GIS was considered an important tool in defining target areas in the six project countries. Maps and tables of population, cassava dependency and CMD and CBSD incidence were prepared and refined as more data was provided by project staff.

It was decided that target areas should be selected on the basis of cassava production, cassava dependency (proportional contribution of cassava to total starch intake), numbers of farming households, and the incidence of CMD as indicated by the most recent available surveys. And these variables will then be mapped out by GIS to help determine the appropriate locations for multiplication. In the end, the final selections of the multiplication sites ultimately were based on the technological consideration as well as the considerations of the field situations, namely, accessibility, partners'

infrastructure in the area (whether they have history working there), security (as there were many areas were too insecure for the project to engage), and the expenses of operating in these areas.

For example, In the case of DRC, there are huge amounts of areas in the country is all but inaccessible. Even the "accessible" areas are tough enough and incur extremely high costs to travel there, the "inaccessible" areas are all but impossible to reach, regardless the population and cassava production. In the case of Tanzania, the disease situation resulted in serious loss of multiplication sites, thus seeds and multiplication sites. Tanzania coast faced the following constraints: it is a different ecological zone that cannot use the same varieties as the rest of the project areas, it is a totally new area of working for CRS thus lack of human and physical infrastructure, and drought during the first season of the project that destroyed most of the multiplication sites. All of these factors limited the reach of the project, and the complete application of GIS to determine the locations of the project sites. For a comprehensive understanding of the GIS application in GLCI, please refer to GPS_GIS Case Study Appendix.

2. Multiplication and dissemination process over the life of project

First country planning meetings of GLCI verified the availability of material, identified seed multiplication partners and sites and ensured synergy with other stakeholders. The first GLCI plantings during the February-March 2008 season were at 65% of the annual target (Table 7). And the 2008 September to November planting was expected to achieve or surpass these targets. Sites were not yet tested for CBSD as the diagnostic tools were not yet available, so multiplication was limited to the immediate administrative district in Kenya and Tanzania. In Uganda, due to the high infection of CBSD, Crop Crisis Control (C3P) project sites were maintained but not multiplied.

Table 7. Year 1 multiplication sites target vs. actual and varieties

Country	Country Total	Plantings per site (target/actual)			Varieties
		Primary	Secondary	Tertiary	
Burundi	303	11/11	73/36	131/90	MM96/0287; MM96/7204; MM96/ 1961
DRC	235	8/2	70/46	150/96	MM96/ 0287; MM96/ 3920; MM96/ 7422; MV99/ 0395; I95/ 0211; I196/ 0160; I196/ 0528; Zizila
Kenya	55	6/2	24/30	-	Mygera; SS4; MH95/ 0183
Rwanda	155	8/7	41/24	68/38	MH96/ 0287; MM96/ 7204; MM96/ 5280; MM96/ 0414; MM96/ 3920
Tanzania	398	38/14	22/4	99/143	MM96/ 8450; MM96/ 3075B; MM96/ 5725; MM96/ 4686; I91/ 0063; Kiroba
Uganda	145	64/54	-	-	MH96/ 2961; TMS 192/ 0067

Having learned much from a close scrutiny of C3P activities, GLCI adjusted activities accordingly. Among the major findings which GLCI considered included the following:

- Small multiplication plots, usually less than a half hectare, were cheaper than larger sites.
- The quality of material produced at small multiplication sites was usually higher.
- Losses during harvesting and transporting cuttings could be 50%.
- Dispersed multiplication sites served as better centers to create awareness and demand.
- Rigorous supply chain monitoring was essential to trace seeds and for quality control.
- While the GLCI proposal suggested 400 cuttings, most farmers could cover their whole cassava cropping area with 200 improved varieties within 18 months.

In addition to the above, a preliminary analysis of C3P plantings indicated that sites tended to be "clumped" around larger villages or partner offices, irrespective of disease incidence, population, cassava production or poverty and food security indicators. Through the use of GIS and grids, GLCI developed a methodology to improve targeting at the administrative district level. This would greatly enhance geographical coverage and speed with which cuttings were available.

Due to the availability of planting material and training from the C3P project, most countries emphasized planting material production and exceeded targets by the beginning of 2009. Distribution from year 1 plantings is shown in Table 8 below. Low distribution in Burundi was due to a focus on establishing secondary sites prior to large-scale distribution in years 2 and 3. In Tanzania, where many source sites were found to be infected by CBSV, all material was retained for further multiplication.

Table 8. Targets versus performance for year 1 planting material

Country	Target Farmers	Actual Farmers	Achievement Rate	Comment
Burundi	12,000	4,109	34%	Emphasis on secondary multiplication in year 1
DRC	36,963	74,991	203%	
Rwanda	5,288	6,984	132%	
Kenya	738	5,349	725%	
Tanzania	68,563	0	-	Due to CBSD all material were put to secondary multiplication to maximize production later
Uganda	6,600	980	15%	Distribution restricted due to a high incidence of CBSD in multiplication plots
Total	**130,152**	**92,413**	**71%**	

The first harvest in March 2009 already showed the potential effects of CBSD as indicated in Tanzania's seed production (Table 9).

Table 9. Seed production statistics of March 2009 harvest/planting

Country	N° cuttings produced (million)	N° farmer groups receiving cuttings	N° individual multipliers receiving cuttings	Total N° hectares multiplied in farmers' fields	N° beneficiaries outside FGs receiving cuttings
Burundi	3.2	185	16	95	4,109
DRC	40.0	190	20	137	74,991
Kenya	3.4	89	170	109	5,349
Rwanda	4.8	39	194	107	6,984
Tanzania	1.7*	315	437	252	0
Uganda	3.8	228	1,560	275	980
Total	**56.9**	**1,046**	**2,397**	**975**	**92,413**

* Production was low due to approx 50% of the first year crop being destroyed due to CBSD.

During the FY2010 all countries prioritized planting material production using the revised practices adopted from the previous year: smaller plot size, reduced planting material received per farmer, increased voucher targets, decentralized quality management and monetization of production. This resulted not only in many targets being surpassed, but introduced transparency, and thus partner and farmer confidence, and laid the basis for a more robust seed system. The seed production and distribution increased significantly by May 2010 (Table 10).

Table 10. Cumulative production/distribution by May 2010

Country	N° cuttings produced (million)	N° FG receiving cuttings	N° individual multipliers receiving cuttings	Multiplied in farmers' fields (ha)*	N° recipients outside FGs	Cumulative actual beneficiaries
Burundi	11	372	66	129	57,408	74,889
DRC	53	810	34	358	318,280	355,770
Kenya	6	277	212	77	23,506	39,155
Rwanda	9	295	351	219	54,550	58,938
TZ (Coast)	1.4	174	372	199	6,455	10,283
TZ (Lakes)	3.6	487	276	131	14,371	25,085
Uganda	11	270	16	337	67,339	75,637
Total	**95**	**2,685**	**1,327**	**1,450**	**541,909**	**639,757**

* Included all secondary and tertiary sites.

In Burundi and DRC, where planting material production was prioritized and CBSD was not present, targets have been exceeded. In countries where CBSD, which was not an issue at the proposal stage, was now present were targets not being met. Through improved targeting, planting material production and health monitoring, the end of project targets could still be met.

All GLCI countries prioritized planting material production during year 3 using revised practices introduced in 2009, such as smaller plot size, an average of 100 cuttings of planting material provided to recipients, and decentralized QMP. Year 3 saw increased use of and adherence to the multiplication and dissemination processes which were now also embedded in the M&E system. The main outcome of these processes was increased transparency, participation, and documentation of seed activities and setting a solid foundation for process execution and data capture on seed. By October 2010, more than 344,145 new farmers had received seeds from GLCI and were using disease tolerant and higher yielding varieties (Table 11).

Table 11. Seed production and dissemination status by Oct 2010

Country	Seed multiplication and dissemination				Farmer Groups	
	Beneficiaries (no.)		Multiplication in ha (FY10)			
	Result	Target	Result	Target	Result	Target
Burundi	38,847	116,000	158	175	293	385
Kenya	47,243	246,849	78	243	317	158
DRC	285,397	41,529	200	1,169	816	452
Tanzania	9,264	100,416	104	498	400	353
Rwanda	33,602	390,818	197	433	456	392
Uganda	9,920	82,605	118	599	267	215
Total	**424,273**	**978,217**	**853**	**1,410**	**2,549**	**2,309**

By the third year, countries and partners demonstrated a far greater appreciation and understanding of dissemination planning and have made good progress in ensuring this key process occurs two to four weeks before actual field harvest. Unfortunately, the dissemination planning was not rigorously documented across all partners and all countries. Most critically, government authorities – typically at district level – by now were supporting and applauding GLCI partners for the effort to make dissemination a well-planned, transparent, participatory, and documented approach.

By this year, GLCI put in a massive effort to underline the important of documenting every farmer that received planting material – across all six countries and 56 partners – using standard processes. This presented a real paradigm shift for anyone who has ever worked with vegetative crops at scale in sub-Saharan Africa.

During the last year, GLCI partners continued to make excellent progress in carrying out and documenting important seed processes such as field registration, QMP, and dissemination. With the spread of CBSD into Burundi, Rwanda, and possibly Eastern DRC, the seed system transparency and traceability which GLCI had fostered could prove their utility in the coming years.

The performance of promoted GLCI varieties in Lake Zone Tanzania since the start of 2011 suggested the need to revisit the end of open quarantine in the region, notably between Tanzania and Kenya where excellent performing GLCI promoted varieties in Western Kenya were not available in Tanzania and the NARS only wanted the material be made available via TC and under best case available to farmers after two to three years bulking after TC.

In addition, best bet CMD varieties used in Burundi, DRC and Rwanda need to be tested under high field based CBSD pressure to determine their suitability to CBSD. To date, varieties had been declassified by GLCI in non-CBSD countries based on performance to CBSD, hence varieties such as MM96/5280 had never been promoted under GLCI due to reports of high physical CBSD incidence on roots and leaves in Uganda. GLCI recommended revisiting the end of open quarantine and field testing under CBSD pressure the best bet materials in Burundi, DRC and Rwanda to IITA and to Tanzania Root Crop authorities. Discussion went underway but the Tanzania authorities decided to take the cautious path and did not wish to test out non-TC material. The issue of open quarantine to promote the more rapid exchanges of materials remained controversial and needed to be taken up by the national programs and the broader cassava communities.

GLCI exceeded its target of 1.15 million beneficiaries by the end of the project by January 31, 2012 when the last annual report was submitted (Table 12), with one more season of dissemination remaining. When GLCI closed at the end of May 2012, it exceeded the target by 0.2 million as it reached 1.35 million direct beneficiaries.

Table 12. GLCI end-of-project direct beneficiaries served with clean seeds by January 31, 2012

Country	Number of fields disseminated to date	Beneficiaries served outside multiplication groups	Beneficiaries served within multiplication groups	Total beneficiaries served
Burundi	349	118,440	13,500	131,940
DRC	1,747	705,075	59,237	764,312
Kenya	238	63,904	8,981	72,885
Rwanda	530	109,934	11,378	121,312
Tanzania	384	44,104	8,595	52,699
Uganda	92*	39,701	7,381	47,082
Summary	**3,340**	**1,081,158**	**109,072**	**1,190,230**

3. GLCI multiplication and dissemination system

GLCI established an rigorous seed system within the context of diseases that had not been attempted by other projects. The system included some unique features: 1) the well-defined multiplication stages, 2) multiplication and dissemination protocol with multipliers, 3) small is beautiful, 4) traceability of

planting material, and 5) quality seed at scale. This part of the report provides the overall description of this system, while the assessment and evaluation of this system is reported in Part 2 of this chapter.

Well-defined multiplication stages

The GLCI seed system consists of primary, secondary, and tertiary multiplication stages and it was essential that there was a clear understanding of who are in charge of each, where they are to be established, where the material came from, the purpose of this stage of the multiplication, remuneration for the site, where the seeds were distributed to, and the size of the site. Table 13 below summarizes the definition of the features of each of the multiplication stages.

Table 13. The definitions of each of the multiplication stages

Multiplication level	Who	Where	Material from where	Purpose	Monetary ($/ha)	Stem arrangement	Size (ha)
Primary	NARS	NARS site	Pipeline Primary	Bulking new GP	1-2,500	100% to primary or secondary	Varied
Secondary	Institution Partner	Int land Partner land	Primary Secondary	Strategic multipli-cation	500-800	100% to secondary or tertiary	0.5 – 5
	FGs Farmers	Private land	Primary Secondary	Strategic multipli-cation	200 – 500	80% to secondary or tertiary	0.5 – 5
Tertiary	FGs Farmers	Farmers' fields	Secondary Tertiary Commercial	Dissemi-nation Tertiary		100% Dissemination	0.2 – 1

Multiplication level	Number 9per country)	Distance to destinations (km)	QMP	CMD QMP pass value	CBSD QMP pass value
Primary	1- 5	Within country	Twice	95%	100%
Secondary	10 – 60	30	Twice	90%	100% (C1-4); 90 (C5)
Tertiary	100 – 500	10	Twice	80%	100% (C1-3); 80% (C4-5)

Setting up these definitions was necessary because the countries and partners had randomly decided practices which were not uniform throughout the project (Table 14).

Table 14. Partners' practices of payment and stem allocations of tertiary sites

Country	Payment	Stem allocations
Burundi	0	All different, up to 30% (dissemination), 70 (multiplier)
DRC	$200/ha	All different, up to 20% (dissemination), 80 (multiplier)
Kenya	$1 for 35 stems	However much multipliers wish to sell
Rwanda	$300/ha	2/3 (dissemination), 1/3 (multiplier)
TZ coast	0	50% (dissemination), 50% (multiplier)
Uganda	0	50% (dissemination), 40% (multiplier)

Many factors could disrupt the strict adherence to these rules, particularly diseases. For example, we have used tertiary material to reestablish tertiary fields in countries where there was severe shortage of seeds, and this happened in Kenya and Tanzania. Uganda did not resort to such practice because CBSD wiped out almost all the multiplication sites and the project was just finally able to identify a new variety during the last year of the project.

Multiplication and dissemination protocol

GLCI set up the following protocol with farmer groups for tertiary multiplication to ensure uniformity and quality of practices in multiplication and dissemination.

- Select farmer groups.
- Make a contract in which the payment for the stems will be given when the dissemination record has been turned over.
- Provide planting material.
- Provide technical backup.
- Partners monitor the field four times a season, of which two are QMP at months 5 and 11.
- Dissemination plan prepared by partner and approved by the local authorities, and beneficiaries selected by a selection committee consisting of local authorities, farmer group representatives, paid field agent and civil society.
- Each beneficiary receives a voucher.
- If the site fails QMP, GLCI does not buy the material.
- If the site passes, partner and local authorities identify beneficiaries who are informed where they can go and get clean material.
- Announced to the beneficiaries the dissemination date.
- The beneficiaries walk to the harvested field to get planting material and turns in the voucher.
- Dissemination monitored and facilitated by the partner, voluntary field agent completes dissemination record, based on the vouchers received.
- Dissemination record validated by the selection committee and submitted to partner or CRS country program manager along with the vouchers as proofs of dissemination.
- GLCI pays 2 Kenyan shillings per stem (Kenya).
- Country program manager calls beneficiaries for feedback on quality of planting material.

Small is beautiful

The seed projects normally have large sites as that seems like a more efficient way of multiplying. GLCI started out with these standard large fields, but came to realize the merits of smaller fields, particularly for the tertiary sites. Thus, GLCI established, over the life of the project, nearly 6,000 tertiary sites, on average of .31 ha per site (Table 14) for the following benefits.

- Beneficiaries had a short distance to walk to and from the dissemination sites.
- Seeds did not travel far which meant less chance of them drying and dying during travelling.
- Less risk—in case of infection, only small plots of multiplication sites would be lost.
- Each beneficiary received 100-125 cuttings, which was almost enough to plant the .25 acre of average cassava fields by the following year, and more farmers could benefit.

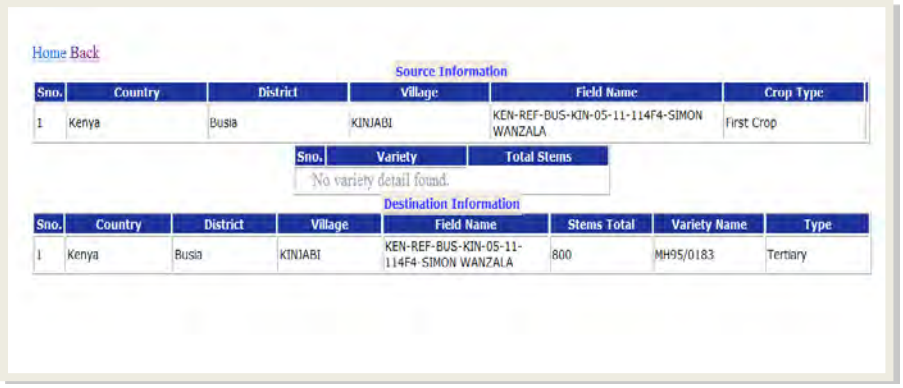
Table 14. The average sizes of the secondary and tertiary multiplication sites

Country	Secondary sites		Tertiary sites	
	Total # sites	Avg size (ha)	Total # sites	Avg size (ha)
Burundi	107	0.50	739	0.35
DRC	124	1.02	2,161	0.21
Kenya	81	0.73	611	0.33
Rwanda	82	1.10	927	0.43
Tanzania	105	0.63	725	0.30
Uganda	78	0.88	375	0.47
Summary	577	0.80	5,538	0.31

Traceability of the planting material

Along with establishing the monitoring and evaluation (M&E) system, GLCI set up traceability of the planting material in order to track disease situation. All of the multiplication sites--primary, secondary, and tertiary--were coded to reflect the country, partner, district, planting season, and the source site from which the seeds came, and the destination to which site the seeds went. These data were recorded in the onward multiplication forms, and this form was submitted for all primary and secondary sites at the time of harvest and seed distribution (Figure 1). The tertiary sites were disseminated, rather than multiplied further, and they showed from which primary or secondary sites the seeds were received.

Tracing the source and destination of the seeds was essential within the context of diseases as part of the management tool for disease surveillance and seed quality. When infection was detected, this information allowed the project to trace back the source material for disease surveillance purpose and to make decision on the downstream further distribution or dissemination of the material.


Home Back

Source Information

Sno.	Country	District	Village	Field Name	Crop Type
1	Kenya	Busia	KINJABI	KEN-REF-BUS-KIN-05-11-114F4-SIMON WANZALA	First Crop

Sno.	Variety	Total Stems
No variety detail found.		

Destination Information

Sno.	Country	District	Village	Field Name	Stems Total	Variety Name	Type
1	Kenya	Busia	KINJABI	KEN-REF-BUS-KIN-05-11-114F4-SIMON WANZALA	800	MH95/0183	Tertiary

Figure 1. Example of an onward multiplication form

Quality seeds at scale

To ensure the disease-free quality of the seeds at the large scale GLCI operated on, the project integrated a combination of lab testing, field-based QMP, and disease survey into the multiplication strategy. The combination allowed the project to do it at scale, as lab-testing was too costly to draw on for all 6,000+ of sites. The following integrated strategies were employed by GLCI:

- All primary sites were lab-tested. No compromise was allowed at the level of the foundation seeds, and it was too costly to test the small number of these sites.
- Secondary site testing was determined by the disease survey results. Where there was no CBSD detected during the disease survey, it was not necessary to test the secondary sites.
- Secondary site testing was not necessary if the QMP had rendered it infected with CBSD. This greatly reduced the number of testing sites, particularly in Uganda and Tanzania where CBSD was endemic.
- Tertiary sites were tested if some or all stems would be distributed for onward multiplication.
- Whether tertiary sites were allowed to be disseminated depends on the incident rate of the multiplication site versus the level of the disease incident rate in the district, indicated by the disease survey data.

For the QMP results, a set of guidance was provided to determine whether the field passed or failed. This decision-making process took into consideration of the CBSD incidence, CMD incidence, and the level of CBSD incidence in the district to derive at the conclusion of pass or fail (Table 15). In this case, C1

referred to districts free of CBSD, C2 referred to district with < 10% CBSD incidence, C3 10-20%, C4 20-50%, and C% >50%, all based on annual disease survey.

Table 15. Planting material movement decisions based on seed quality and disease situation

Multiplication level	Pass	Slight failure (< 10%)	Somewhat failure (< 20%)	Moderate failure (20-50%)	Miserable failure (>50%)
Primary	Move to primary or secondary	Official Dissemination to C4-C5	Official Dissemination to C5	Destroy	Destroy
Secondary	Move to secondary or tertiary	Official Dissemination to C4-C5	Official Dissemination to C5	Abandon	Destroy
Tertiary	Dissemination or move to tertiary	Official Dissemination to C4-C5	Official Dissemination to C5	Abandon	Abandon

GLCI followed these guidelines wherever possible. But the disease survey data invariably were not available until the following year, thus the disease situation was not up-to-date to make this decision-making matrix totally meaningful. Entry of the huge amount of data collected for the disease survey was a daunting task and various information and communication technology (ICT) solutions were tried but to no avail. Identifying the appropriate ICT solutions to this task in the future would solve the problem of delayed data availability.

Part 2. The Assessment of the GLCI Seed System

This part of the chapter reports on the assessment and analysis of the GLCI seed system, largely based on the data from the GLCI database. The case study explains the rationale of each of these four approaches, examines how well they worked or not, explores the challenges faced, and provides suggestions and recommendations to improve such a system. These findings and conclusions were extracted from the Results section of the case study on seed system. To view the full report, please refer to Case Study Appendix – Seed system.

I. GLCI seed system

The four innovative approaches used in the GLCI seed system: 1) decentralized production and dissemination, 2) quality management protocols, 3) targeted dissemination and traceability in the seed system, and 4) mitigation against CBSD through surveillance, sampling and testing, are also the cornerstones of the GLCI seed system. Given the context at the start of GLCI these four approaches were also inter-dependent. Scale could not be attained without decentralization. Decentralization could not be managed without field level quality control mechanisms and traceability in the seed system. Field level quality control mechanisms could not be justified without a testing and diagnostic framework.

A. Decentralized production and dissemination

Rationale

This approach involved establishing many small multiplication plots, as opposed to fewer larger plots, spatially allocated in target areas. The approach involved allocating small amounts of planting material – 100 cuttings per farmer – enough to have a demonstration effect at farm level and enable the farmer to meet their own planting material needs for the variety within three years. The main benefits of this "small is beautiful" approach include: making access easier for farmers, raising the demonstration or

"look see" effect of planting material, reducing the loss of planting material which occurs between harvest and planting, and reducing production costs at multiplication sites through paying back for land and labor costs through allocation of all roots and % stems as compensation to producers.

Cassava planting material under GLCI was euphemistically called "self propagating medicine" because nearly all cassava planting material produced and disseminated at start of GLCI was CMD resistant. CBSD was not yet a major constraint nor was its epidemiology well understood. To maximize sharing of material and geographical coverage within intervention zones, GLCI recommended that the average amount of planting material per farmer beneficiary was 20-25 full stems (100-125 cuttings each having 3 to 5 nodes). This approach would also reinforce the use of the cassava multiplication field for learning with respect to seed sourcing and planting as well as field and disease management.

The term, approach, modeling and implications of small is beautiful was presented and discussed by GLCI seed objective team leader during a GLCI planning meeting in Mukono, Uganda in June 2008. The reaction from CRS staff when this was first suggested was that partners would not accept smaller more numerous fields and farmers would not accept smaller volumes of cassava planting material.
The modus operandi from previous and on-going cassava stem multiplication and dissemination efforts in GLCI countries was more centralization, larger fields, greater focus on primary and secondary sites, large quantities of planting material received by individual farmers and out-growers, and no systematic effort to disseminate material in small quantities to farmers[1]. Under the CRS managed, USAID-funded Crop Crisis Control project, which included multiplication and dissemination of cassava planting material across the same six countries as GLCI and with many of the same partners, the average number of cuttings received per recipient was over 500 (See Table 16: Crop Crisis Control Project Cassava Dissemination in 2007-2008 Across All GLCI Countries).

Table 16: C3P cassava dissemination in 2007-2008 across all GLCI countries

Beneficiary category	% of total material	Number of beneficiaries	Cuttings received by individuals in each category	Cuttings allocated to entire category
Vulnerable	50%	70,153	254	17,818,862
Individual farmer	14%	5,516	1,338	7,380,408
Farmer group/ association	23%	1,883	7,698	14,495,334
Used as GLCI source material	12%	n/a	n/a	n/a
Other	1%	n/a	n/a	n/a
Total	**100%**	**77,552**	**512**	**n/a**

Source: CRS Final Crop Crisis Control Report to USAID

Easier access to smaller plots of land and lower labor and management challenges with smaller multiplication plots encouraged GLCI to recommend bulking sites be a maximum of 1 ha and a minimum of ¼ ha. This necessitated greater decentralization which would increase the perceived demonstration effect, i.e. farmers will more readily seek to access and adopt improved disease tolerant varieties when they witness the materials performance, but also resulted in GLCI making concerted effort to spatially allocate fields 10 km apart in intervention zones.

[1] See Bonnard, "An Evaluation of USAID/OFDA Efforts against Cassava Mosaic Disease 1997-2004", in which she suggests a focus on reducing response time to the CMD pandemic.

Smaller more decentralized fields promote the transport of planting material in full stems on farmers heads in a single bundle as opposed to cuttings or mini-stems in bags loaded on vehicles, the former have a shelf life of several weeks versus several days for the latter.

Results

The cumulative seed achievements at the end of GLCI show how each country contributed to project seed targets, the amount of stems disseminated, and the total female and total vulnerable stem recipients (See Table 17: Total Farmers Served with GLCI Planting Material).

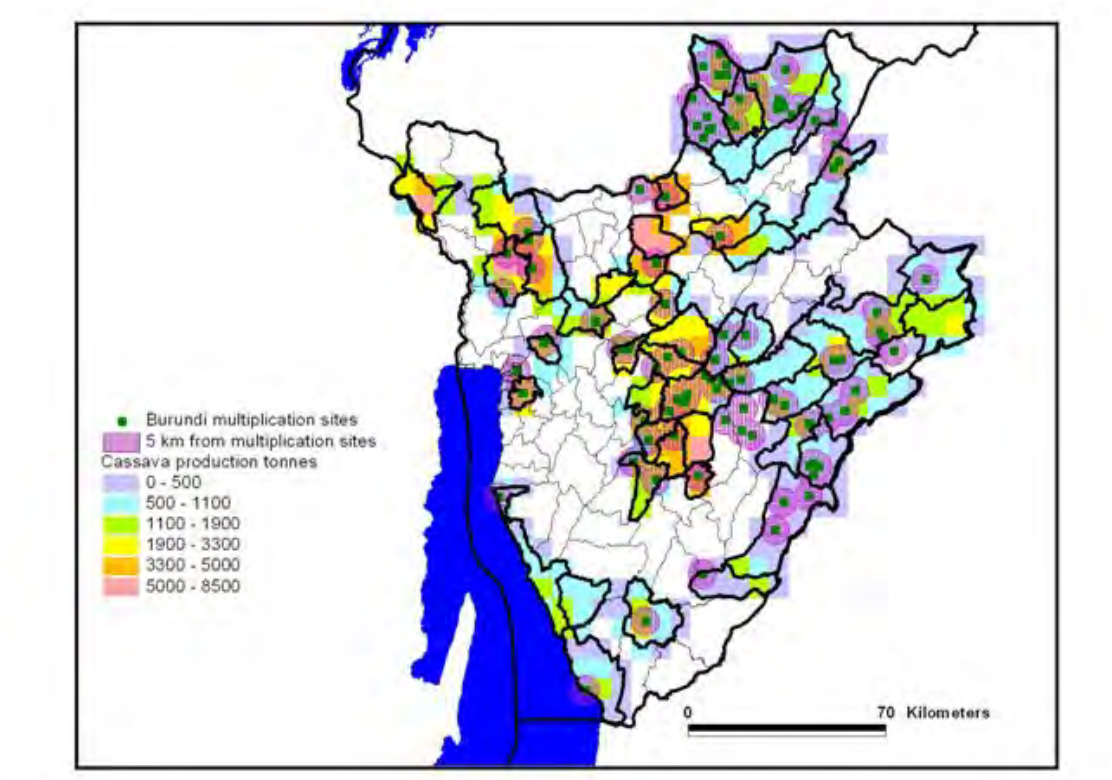
Table 17: Total farmers served with GLCI planting material

Country	Total beneficiaries served	Total stems disseminated	Total Female Stem Recipients	Total vulnerable beneficiaries
Burundi	138,891	4,626,287	61,615	45,212
DRC	837,125	17,097,335	347,067	473,546
Kenya	83,992	1,955,492	40,534	51,369
Rwanda	160,035	6,012,078	58,786	60,664
Tanzania	72,556	2,369,103	24,229	23,638
Uganda	50,831	1,557,592	19,655	27,850
Total	**1,343,430**	**33,617,887**	**55,887**	**682,279**

Source: GLCI Database/Project Reports and Impact. Reports. Dissemination

The map of Burundi illustrates geo-referencing of multiplication plots (See Figure 2: GLCI Burundi Multiplication Sites and Cassava Production). GLCI multiplication plots are green circles while cassava production is represented by green, light blue and light purple. This shows a visual demonstration of the spatial allocation of cassava fields established by GLCI partners and an indication of the variance in cassava production in areas where GLCI had multiplication sites.

Figure 2: GLCI Burundi Multiplication Sites and Cassava Production



Source: Burundian Agricultural Statistics Office, 2009

The extent of decentralization in production of planting material under GLCI is impressive in both scale and scope and the degree to which it is documented (See Table 18: Decentralization - GLCI Production Sites). GLCI partners established more than 6,500 multiplication sites over the course of the project and the average GLCI multiplication site measured under 1/3 ha.

Table 18: Decentralization - GLCI production sites

Country	Avg. size (ha)	Total # of sites
Burundi	0.36	875
DRC	0.21	2,333
Kenya	0.33	715
Rwanda	0.43	1,082
Tanzania	0.3	1,016
Uganda	0.47	492
Summary	0.31	6,513

Source: GLCI Database/Project Reports and Impact. Reports. Dissemination

The small is beautiful approach resulted in significant decentralization in the number of farmers served per GLCI production site. Across all GLCI countries, the average GLCI-disseminated field served 348 farmers, the average number of stems received per recipient farmer within the GLCI project was 25, and the average distance travelled per farmer to access stems at a GLCI multiplication site was 2.35 km (See Table 19: Decentralization – GLCI Dissemination Results).

Table 19: Decentralization – GLCI dissemination results

Country	Average beneficiaries per field	Average stems per beneficiary	Average km travelled to access stems
Burundi	363	30	1.52
DRC	443	21	2.59
Kenya	260	23	1.72
Rwanda	246	39	1.34
Tanzania	111	23	3.29
Uganda	486	30	4.11
Summary	**348**	**25**	**2.35**

Source: GLCI Database/Project Reports and Impact. Reports. Dissemination

The small is beautiful approach was instrumental in having low loss of planting material. Analysis of GLCI beneficiary data indicates low loss rate and high use rate of GLCI planting material. More than 90% of recipients planted within three days of receipt of material and reported germination rates of over 90% and very high plant survival rates (See Table 20: Decentralization – Evidence of Low Loss Rates in GLCI).

Table 20: Decentralization – evidence of low loss rates in GLCI

Country	Recipients who planted within 3 days of receipt of material	Recipients reporting high (+80%) germination rates	Recipients reporting high (+80%) plant survival rates
Kenya	97.5%	87.5%	87.5%
Rwanda	96.1%	97.9%	96.1%
Tanzania	97.8%	90.9%	76.3%

Source: 420 beneficiary respondents from GLCI Case Study/ Beneficiary Data

While decentralization increased costs of monitoring production sites, evidence from GLCI suggests real and significant benefits from a small is beautiful approach. GLCI was able to support a robust field management structure of 55 partner supervisors, 210 paid field agents, more than 750 voluntary field agents, and approximately 3,000 farmer groups who were the dominant cassava multipliers under GLCI. Considering all costs of GLCI and dividing by direct recipient farmers (that is not including the two to three farmers that direct recipients report sharing planting material with), the cost per direct stem recipient is $16.80. Considering all costs and dividing by all production sites established, not discounting for fields eliminated for disease, the cost per production site is $3,448 (See Table 21: Decentralization – Cost per Production Site and Recipient Farmer in GLCI).

Table 21: Decentralization – cost per production site and recipient farmer in GLCI

Country	Total budget ($)	Total # of sites	Unit cost ($) per site	Total # of farmers	Cost ($) per farmer
Burundi	1,448,070	875	1,655	138,891	10.4
DRC	4,400,111	2,333	1,886	837,125	5.3
Kenya	952,551	715	1,332	83,992	11.3
Rwanda	1,563,021	1,082	1,445	160,035	9.8
Tanzania	2,334,185	1,016	2,297	72,556	32.2
Uganda	1,470,001	492	2,988	50,831	28.9
Region	10,353,665	n/a	n/a	n/a	n/a
Summary	**22,521,604**	**6,513**	**3,458**	**1,343,430**	**16.8**

Source: GLCI Phase One Financial Report and GLCI Database/Project Reports/Dissemination

GLCI beneficiaries and farmer groups sharing cassava planting material is discussed under 4.4 Transparent and Participatory Dissemination Processes.

Challenges and Suggestions

The GLCI decentralization approach of small is beautiful with many small fields and a small amount of planting material per recipient farmer was effective strategy in moving planting material quickly in target zones and to gain geo-spatial saturation. However, this highly decentralized approach in GLCI was predicated on most material being disease resistant.

Where germplasm performance is unclear to disease pressure, such as in CBSD endemic zones, small is beautiful is not an appropriate approach. The results from TZ and Uganda speak to this. With hindsight from the knowledge gained in CBSD epidemiology during the course of GLCI, field isolation and quarantine for multiplication sites would be a better approach to serve CBSD endemic areas. However, the ultimate utility of this approach in a CBSD endemic zone is a function of how fast disease free material offers farmers better yields in a CBSD endemic zone.

Small is beautiful was effective at supporting training and having the production site serve as a classroom. While it is difficult to quantify the benefit of thousands of classrooms managed by thousands of trained farmer groups, a key theory of change underpinning GLCI was that farmer groups would change behavior and socialize knowledge gained on cassava.

B. Quality Management Protocol (QMP)

Rationale

"There are a variety of reasons why current public seed regulation is unsatisfactory. It is not efficiently organized, often uses inappropriate standards, does not offer opportunities for farmer and seed producer participation, and is not sufficiently transparent. In seed quality control, standards should be re-examined for their relevance to particular farming conditions, and much of the responsibility for monitoring seed quality should be passed to seed producers and merchants, accompanied by well-defined public oversight and enforcement mechanisms."

Tripp, Louwaars, et al. (1997)

A QMP for cassava was first developed under C3P (2006-2008) and then simplified and used at greater scale under GLCI. The aim of QMP was to apply a seed quality standard for cassava which was relevant to farmer conditions could be conducted at field level visually and at low cost, and provided an opportunity for public sector (national cassava research and/or national plant protection and/or national seed agency) engagement in setting of standards and vetting protocols.

Based on visual assessment, QMP provides a simple method that takes a few hours to execute at field level. These visual inspections assessed for varietal purity, scored for pest and disease, and estimated total stems to be harvested. The QMP methodology under GLCI involved visually inspecting 100 plants per field and taking a sub-sample of 10% of plants inspected for root inspection. QMP was done at scale in GLCI, was used to screen source fields before lab testing, was instrumental in raising cassava stem producer knowledge on cassava pest & disease, and improved knowledge on quality cassava planting material (See Table 22: QMP – Tertiary Site Field Criteria).

Table 22: QMP – tertiary site field criteria

Pest & disease incidence	Cassava mosaic	Cassava brown streak	Cassava mealy bug
0 %	Take	Take	Take
0-20%	Select and take	Reject in CBSD non-epidemic or unaffected areas. Select and take in CBSD endemic areas.	Select and take, uproot and bury infested plants.
+ 20%	Reject, advise to rogue and reassess after one month.	Reject the field in all areas.	Select and take, uproot and bury infested plants.

Source: QMP Lite, adapted for GLCI in 2008

IITA and CRS staff first carried out QMP assessments in July and August 2007, assessing 165 fields across six countries, during C3P (2006-2008). Fields were visually assessed and scored for cassava pest and diseases (mealy bug, CMD and CBSD) and other quality parameters (varietal purity, plant age, plant population, plant height, number of stems per plant, and weeding frequency.

Out of 165 fields assessed, only 4 were proposed for rejection due to suspicious CBSD symptoms and no field was rejected due to CM or CMD in any of the six countries. Among the key recommendations were increased training in cassava pest and disease, efforts to institutionalize QMP by cassava stakeholders within the region, an explicit acknowledgement that CBSD symptom are not reliable to predict CBSV infection and hence the need for simpler CBSV field based diagnostics, and a call to governments to include cassava in national seed policy to facilitate control and management of disease[2].

"QMP lite", a shorter and simpler protocol aimed at stem producers, was drafted by IITA (Boni and Legg) at the end of 2008. By the end of 2009, QMP lite was being conducted in Kenya, Tanzania and Uganda at some tertiary sites. The first QMP training in Burundi and Rwanda occurred at the end of 2010.
While knowledge gaps in the epidemiology of CBSD limited the utility of QMP, a big impact of QMP at tertiary level under GLCI was to reinforce phyto-sanitation with an actual protocol. Challenges to doing QMP at scale included multipliers not wanting to sacrifice ten plants for CBSD assessment, GLCI partners not being trained in QMP, GLCI multipliers not being required to do QMP, and a general low level of sensitization and buy-in from local government.

[2] Crop Crisis Control Project Cassava Planting Material Quality Management in the Multiplication sites. Technical report for Burundi, DR Congo, Kenya, Rwanda, Tanzania, and Uganda. April 2008.

GLCI Multiplication Field in Rwanda

Results

QMP was done at scale within GLCI following a significant effort at communicating the value of QMP and then training in the methodology. QMP was not effectively scaled within GLCI until the third year of the project, when partners and extension staff were both acquainted with QMP and aware of the effects of CBSD and the value of field based vigilance. QMP assessments were made at least eight months after planting and prior to harvesting on each cassava variety separately with data recorded in a field scoring sheet. QMP was done systematically at GLCI source sites. Of 204 source sites where QMP was conducted during GLCI, only one site failed QMP (See Table 23: QMP - GLCI Source Sites).

Table 23: QMP - GLCI source sites

Country	Primary Sites				
	No. fields	Fields passed QMP	% passed QMP	Fields passed lab test	% passed lab test
Burundi	15	15	100	15	100
DRC	16	16	100	16	100
Kenya	12	12	100	12	100
Rwanda	13	13	100	13	100
Tanzania	127	123	97	126	99
Uganda	21	17	81	21	100
Summary	**204**	**196**	**96.08**	**203**	**99.51**

Source: GLCI Database / Project Reports and Impact. Reports. QMP

QMP was done at 2,639 tertiary and the associated field scoring sheet was uploaded into the GLCI database. This represents about 50% of all tertiary sites. The reason for this was that QMP as a quality control protocol and the associated concerns about CBSD were not drivers across all of GLCI until year three of the project (See Table 24: QMP – GLCI Tertiary Sites).

Table 24: QMP – GLCI Tertiary Sites

Country	Total fields	True to type	True to type (%)	CMD (avg. of %)	CBSD leaf (avg. of %)	CBSD root (avg. of %)	Avg. of % passed
Burundi	210	210	100	0	0	0	100
DRC	854	764	89	0	0	0	100
Kenya	262	201	77	0	0	0	100
Rwanda	697	682	98	1	0	0	97
Tanzania	359	313	87	0	0	0	100
Uganda	257	170	66	0	2	0	99
Summary	**2,639**	**2340**	**88.67**	**0**	**0**	**0**	**99**

Source: GLCI Database / Project Reports and Impact. Reports. QMP

The extremely low recorded percentages for CMD and CBSD, and the 99% pass rate are attributed to the fact that fields which failed QMP were not entered into the system. In Tanzania and Uganda, nearly half of GLCI tertiary sites were not disseminated due to CBSD and many of these fields were so visually diseased as to not warrant the time and effort of carrying out the QMP process.

Across all of GLCI, farmer groups managed more than 80% of multiplication sites. While there were many individually managed tertiary sites, GLCI favored group sites because to use the fields as a class room and the group as a means to socialize knowledge on cassava. Farmer group members questioned as part of the GLCI farmer group study demonstrated an excellent understanding of what part of the plant required inspection as part of the QMP (See Table 25: QMP - Farmer Group Understanding).

Table 25: QMP – farmer group understanding

Country	Leaves were checked to be sure plants were not diseased before harvesting	Roots were checked to be sure plants were not diseased before harvesting	Stems were checked to be sure plants were not diseased before harvesting
Kenya	61%	61%	61%
Rwanda	100%	100%	93%
Tanzania	100%	100%	94%

Source: 50 farmer groups (420 members). GLCI Farmer Group Member Questionnaires. September2011

The vast majority of farmer group members who were sampled under the GLCI farmer group study indicated that they changed their behavior on seed sourcing. While this change in behavior cannot be attributed solely to QMP, the QMP process occurred widely and provided participants with a regular opportunity to put into practice training they received on disease identification (See Table 26: QMP – Changes in Practice Among Farmer Groups).

Table 26: QMP – changes in practice among farmer groups

Country	Farmer group members whose change in practice on seed sourcing is to source from only known people or organizations	Farmer group members whose change in practices on seed sourcing is to confirm variety before acquiring
Kenya	83%	67%
Rwanda	100%	79%
Tanzania	94%	56%

Source: 50 farmer groups (420 members). GLCI Farmer Group Member Questionnaires. September2011

Participation in QMP inspection was dominated by GLCI staff with farmer group interviewees noting good participation of local government extension and village officials, notably in Kenya and Tanzania. It

is not surprising, considering the sheer scale of tertiary site, that national cassava research program staff played a minor role in QMP of these tertiary sites (See Table 27: QMP - Who inspected the field?).

Table 27: QMP - Who inspected the field?

Country	Local government extension	National cassava research program	GLCI partner staff	Village officials
Kenya	28%	17%	61%	17%
Rwanda	14%	0%	100%	21%
Tanzania	56%	17%	100%	33%

Source: 50 farmer groups (420 members). GLCI Farmer Group Member Questionnaires. September2011

Nearly 65% of farmer group members interviewed (n=420) cited training as the most frequent suggestion to improve QMP where financial incentives to inspectors was cited by 6% of farmer group respondents. However, training on QMP in GLCI was a big effort with impressive results considering that QMP was not part of the original project design (See Table 28: QMP – Extent of Training).

Table 28: QMP – extent of training

Country	# partners QMP trained	# CRS & partner staff QMP trained	# NARS & extension staff QMP trained
Burundi	19	150	5
DRC	11	35	2
Kenya	5	25	32
Rwanda	6	30	5
Tanzania	16	53	21
Uganda	6	22	5
Summary	**63**	**315**	**70**

Source: GLCI country program managers

Challenges and suggestions

Decentralized field quality control through visual assessment – QMP – was increasingly institutionalized across GLCI countries and partners and became a critical GLCI activity which was not envisioned at project inception. While QMP was effective at screening source fields before testing, the biggest impact was the application of learning opportunity which this phyto-sanitary protocol presented at thousands of field sites, hundreds of partner staff, and dozens of national cassava program staff.

At the conclusion of GLCI, it is uncertain to what extent some form of QMP will continue at any scale in any country. A central challenge in all GLCI countries is the capacity of National Plant Protection Organizations to promote and coordinate the application of minimal phyto-sanitary standards. In all GLCI countries, these structures lack the resources, staff and capacity to support even a rudimentary framework to oversee cassava stems production field inspections[3].

A functioning system to promote stem quality standard must have the farmer and the stem producer at the center with field criteria reexamined for its relevance to farmers. In the context of GLCI, the QMP protocol should have been updated in line with new knowledge on CBSD. For example high correlation between CBSD and white fly populations may call for having a white fly score on QMP.

[3]Global review of phytosanitary surveillance in the context of the IPPC Standard (ISPM6) – identification of best practices. Regional Workshop for the review of ISPM 6. February, 2012. Accra, Ghana.

Arguments for investment (public or private) into certification protocols and processes are strengthened by a solid understanding of the economic costs of no standard and the benefits of functioning standards.

C. Targeted Dissemination and Traceability

Rationale

Disease tolerant cassava planting material is highly sought after in areas impacted by disease. Given that the multiplication rate of cassava is low (one mature cassava plant at 12 months can provide on average 5-8 cuttings for future cassava plants), efficient and well targeted dissemination of disease tolerant planting material is crucial. Given the importance of cassava as a food crop for vulnerable farmers, GLCI made explicit efforts to reach disease-affected vulnerable farmers with tolerant planting material.

Throughout the GLCI project areas there was very little systematic effort to ensure that planting material reached the most diseased impacted communities and farmers. While all of the GLCI countries had functioning national cassava coordination committees which discussed and coordinated nationally, and at times regionally, the level of coordination and targeting at the district and field level was low. A key innovation of GLCI was developing systematic processes for identifying communities and farmers to be served with planting material and having a seed supply chain that recorded the origin of material.

Happy farmer in DRC carrying planting material from a GLCI site

Three values underpinning GLCI dissemination are accountability, transparency and participation. Accountability refers to being able to demonstrate to partners, governments and donors who receives GLCI planting material, when it is received, how much is received, from where is the material received, and how far the recipients travel to receive the material. Transparency refers to having clear and documented processes for allocating material and ensuring that the processes are well understood and practiced at partner level and with all sites of multiplication. Participation refers to having strong community engagement in decisions on allocating planting material and involving local government, civil society leaders and the multipliers in discussions on who is targeted to receive planting material.

GLCI used dissemination plans and reports to target and document dissemination. Dissemination plans were aimed to promote a transparent discussion with local authorities on the amount of planting material to be disseminated, the target villages, and criteria for beneficiary selection. Dissemination reports had a specific aim to document the extent to which marginal groups were served by GLCI.

GLCI commonly used vouchers during dissemination. Households identified in advance were provided a voucher which was redeemable for 25 full stems. The voucher made the dissemination process more orderly. The use of vouchers for cassava stems was well documented by C3P[4].

GLCI recipient of planting material shows her voucher

Results

Targeted dissemination and traceability enable scale that was well transparent and documented (See Table 29: Total Farmers Served with GLCI Planting Material).

Table 29: Total farmers served with GLCI planting material

Country	Total beneficiaries served	Total stems disseminated	Total female beneficiaries	Total vulnerable beneficiaries
Burundi	138,891	4,626,287	61,615	45,212
DRC	837,125	17,097,335	347,067	473,546
Kenya	83,992	1,955,492	40,534	51,369
Rwanda	160,035	6,012,078	58,786	60,664
Tanzania	72,556	2,369,103	24,229	23,638
Uganda	50,831	1,557,592	19,655	27,850
Summary	**1,343,430**	**33,617,887**	**55,887**	**682,279**

[4] On Farm Voucher and Pilot Use of On-Farm Vouchers to Disseminate Cassava Planting Material in Western Kenya. Walsh, S, Odero -Onyango, B and Obiero, H. Crop Crisis Control Project Brief No. 5. Copyright 2006 by IITA and Catholic Relief Services. http://www.crsprogramquality.org/storage/pubs/agenv/5%20CASSAVA%20OVF.pdf

Source: GLCI Database/Project Reports and Impact. Reports. Dissemination

Dissemination planning under GLCI involved a transparent and open discussion among local partners, government authorities, and the farmer group or individual managing the production site on the allocation of planting material for each production site. A format and guide for dissemination planning was incorporated in training materials. Dissemination planning has become increasingly institutionalized as more than 50% of all GLCI fields disseminated were following this process by the end of 2010. Local authorities appreciated the efforts undertaken to plan dissemination in a participatory and transparent manner (See Table 30: Percentage of Disseminated Fields with Field Dissemination Plans).

Table 30: Percentage of Disseminated Fields with Field Dissemination Plans

Season	Dissemination plans completed	Fields disseminated	Percentage of disseminated fields with dissemination plans completed
Jan- July 2009	15	266	6%
Jan-July 2010	145	764	19%
Aug- Dec 2010	629	800	79%
Jan- July 2011	333	645	52%

Source: GLCI Database / Project Reports and Impact. Reports. Dissemination

Sharing cassava stems among project recipients was reported very low. This is normal when farmers first access a small quantity of a variety, such as in GLCI where recipient farmers got 25 stems or roughly 125 cuttings. At a multiplication rate of 10 to 1, a farmer receiving and planting 125 cuttings would have roughly 1,250 plants at the end of 12 months and 12,500 plants after 24 months. This multiplication rate depends on multiple factors: the number of plants actually harvested and used for planting material, the number of cuttings per stem, the germination rate of cuttings planted, and the number of germinated plants achieving maturity / suitable for use as planting material.

Challenges and suggestions

The GLCI project succeeded in using many tools to promote seed system transparency and targeting but the extent to which these tools will be adapted in the future is uncertain. To replicate them, donors and governments that fund cassava projects need to be aware of some best practices and approaches.

D. Mitigating against CBSD – Surveillance, Sampling and Testing

Rationale

The GLCI multiplication and dissemination system was organized in a hierarchical manner, small number of primary sites feeding a larger number district level secondary sites provide planting material for thousands of community level multiplication sites, referred to as tertiary sites. The main threat for the GLCI multiplication system was the spread of viruses that cause CBSD. Two species of CBSVs are now recognized: CBSV and CBSV Uganda virus (CBSUV).

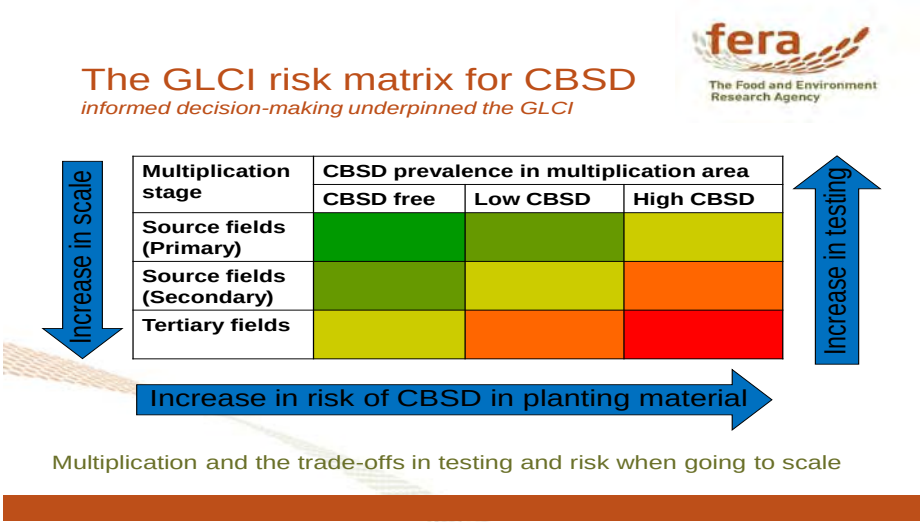
CBSD risk assessment mitigation in GLCI involved surveillance and testing which was donor mandated and not based on farmer cost-benefit analysis. Neither the epidemiology of CBSD nor the economic impact of CBSD on farmers was well enough understood at the start or end of GLCI for this cost-benefit analysis to be credible. From the standpoint of the donor, GLCI could do more harm than good if the project spread CBSD and this was the justification for an investment into CBSD mitigation.

To minimize the risk of spreading CBSVs through the GLCI multiplication scheme, primary sites and most secondary sites in CBSD threatened areas were tested using virus laboratory diagnostic methods (Real-

time PCR) for the presence of CBSVs. CBSD threatened areas were determined by surveillance activities undertaken by IITA, notably annual disease surveys.

Only GLCI source sites having no positive virus test results were used as source sites for secondary or tertiary sites – the zero tolerance approach. The sampling frame of 300 plant leafs per field (tested in ten batched of 30 plants) was determined in order to detect with 95% confidence 1% CBSD incidence. The GLCI approach to CBSD in terms of sampling frames for testing and diagnostics emphasized source fields and high CBSD areas while focusing significantly less on tertiary sites and CBSD disease free zones (See Figure 3: GLCI Risk Matrix for CBSD).

Figure 3: GLCI Risk Matrix for CBSD



Source: Dr. Julian Smith, the Food and Environmental Research Agency

Results

During the life of GLCI, 450 fields (150,000 leaves) were tested through 45,000 PCR reactions. A total of 32 fields (7%) which passed QMP were confirmed as CBSD positive by this testing. The estimated total cost of this testing was $300-400,000 or roughly 1.5% of the total value of GLCI.

The following tables from GLCI reports show the number of source fields tested in 2010 and 2011. Fields identified as CBSD positive are in brackets. CBSD positive fields were eliminated from the multiplication system and hence not used to feed secondary or tertiary sites. If not identified, these fields would have certainly spread CBSD within one season into every field established from planting material originating from these sites (See Table 31: GLCI Source Fields Tested in 2010 using Real Time PCR).

Table 31: GLCI source fields tested in 2010 using Real Time PCR

Country	Fields received (March 2010)	Fields received (Sept 2010)	Fields received (Oct 2010)	Total fields received (2010)
Burundi	0	0	0	0
DRC	27	32	0	59
Kenya	3	7 (1)	0	10
Rwanda	0	2	0	2
Tanzania	9	5 (1)	7 (5)	21
Uganda	0	0	0	0
Total	**39**	**46**	**7**	**92**

Source: GLCI 2011 Six Month Report

Presence and absence of CBSD was determined from annual GLCI disease surveys, which were conducted across all six GLCI countries and most GLCI target zones within each country. These surveys were conducted from July to August under IITA leadership and with participation of GLCI partners at country level. Preliminary survey results were made available by the end of the calendar year, in time to inform testing decisions for the following season.

As Uganda GLCI target areas and coastal Tanzania were CBSD endemic, no GLCI field testing was done there in 2010 or 2011. No testing was done in Burundi in 2010 or 2011 as Burundi was presumed CBSD free based on the annual surveys. Likewise, Rwanda was presumed CBSD free based on annual disease surveys but two fields were tested in 2010. Despite no CBSD detected in DRC during annual GLCI disease surveys in 2009 or 2010, DRC's GLCI source sites were tested in both 2010 and 2011. The testing in DRC focused on fields in north Kivu and this was due to eastern DRC's higher reliance on cassava as a food crop and significant population movement between DRC and Uganda resulting from an upsurge in conflict and population movement in Rutshuru and Masisi Territories (North Kivu) in 2009 and 2010.

Beyond identifying diseased source sites, the testing and its associated human and financial costs forced project actors to work collaboratively to lower throughput and develop useable decision making frameworks. GLCI provided a platform for a CBSD risk mitigation process to be developed, tested in the field and critiqued. Nothing of this sort had even been attempted with cassava.

Challenges and suggestions

While the process of linking surveillance to testing was unique and had a number of benefits, the investment cost of the GLCI CBSD risk mitigation process is not linked to any demonstrable economic benefits. To the extent that the economic benefits of testing regimes is understood, trade-offs can be made on sampling frames and confidence levels.

GLCI annual disease surveys did not provide results fast enough. These surveys were conducted in July-August and would provide information on CBSD threatened or epidemic zones. The results of the surveys would not be used to effect testing decisions until – at best – the following February and in some cases these surveys did not affect testing decisions until 12 months later.

The advent of cheap and accurate diagnostic testing suitable for field application does not supplant the necessity of having a systematic process to apply these diagnostics. This system would combine some surveillance or disease reconnaissance to justify the scope of testing, some analysis of the economic cost-benefit to ensure that seed producers and seed consumers have economic incentives to support the system, and some buy in and backstopping from public sector actors in each country such as National Plant Protection Organizations and National Seed Certification Associations.

II. Conclusion

The four innovative approaches used in the GLCI seed system – 1) decentralized production and dissemination, 2) quality management protocols, 3) targeted dissemination and traceability in the seed system, and 4) mitigation against CBSD through surveillance, sampling and testing – were the cornerstones of the GLCI seed system. Scale could not be attained without decentralization, which could not be managed without field level quality control mechanisms and traceability in the seed system, and these were justified through a testing and diagnostic framework.

A. Decentralized production and dissemination

Decentralization through thousands of multiplication sites averaging under 1/3 ha and with recipient farmers accessing only 100 cuttings was very effective in achieving scale in the GLCI. However, this approach was predicated on CMD resistant materials which were prevalent in all GLCI countries at the start of the project. This approach is not appropriate in CBSD endemic zones because there are currently no CBSD resistant varieties.

Varietal dispersion data from GLCI dissemination sites, combined with post-GLCI varietal adoption studies, could provide important information on the effective "inoculation rate" of new varieties, i.e. how much multiplication and dissemination is needed in a zone before a variety is easily available to all. Given the low multiplication rate of cassava, this would be useful to maximize returns on future public sector cassava seed system investments.

B. Quality management protocols

GLCI effectively employed visual field inspection protocols, known as QMP, to screen source sites to avert costly laboratory testing and to provide an opportunity to apply cassava phyto-sanitary knowledge across thousands of multiplication sites while training hundreds of field staff.

Certification and quality control must have an economic basis and the costs to implement must be significantly lower than the cost of no standard and the benefits of functioning standards. Under GLCI, the economic benefits of doing QMP, even in CBSD endemic zones, were not well understood.

Even with a strong economic argument to justify public sector investment in QMP, it remains highly unlikely for QMP to continue in any form in any GLCI country without significant donor funding because the national plant protection organizations lack the capacity to promote, coordinate and backstop the application of minimal phyto-sanitary standards for cassava stem production fields.

C. Targeted dissemination and traceability

Transparency in the GLCI seed system – understanding and documenting the origin and destination of all fields – was an important innovation but it is unclear to what extent other donor or government funded cassava seed system projects will employ such tools and more generally how much accountability and transparency are actually considered to be valuable characteristics for public sector seed investments.

D. Disease Mitigation via Surveillance, Sampling and Testing

The use of a risk mitigation framework through combining surveillance, visual field inspections, and testing was unique to GLCI. The application of this framework has not yet been linked to any demonstrable economic benefits. The learning from GLCI will facilitate smarter use of low cost and accurate diagnostic testing in a systematic framework where surveillance justifies the scope of testing where seed producers and seed consumers have economic incentives to support the system.

In the Great Lakes region of East and Central Africa, cassava and cassava seed systems will continue to attract public sector investment given the importance of the crop to food security and farm family livelihoods. However, in the absence of effective coordination among donors and a multitude of cassava partners, it is unclear how effective ad hoc, one-off, and unilateral public sector investments can be. The GLCI network of 50 plus partners – compromising civil society organizations, local governments, plant protection organizations, and agricultural research – was an ideal platform for promoting collaboration, learning, mutual accountability and innovation at scale across six countries.

Chapter 5. Farmer Groups

Like partnership and planning, training, and seed system which are components of Great Lakes Cassava Initiative (GLCI) activities, farmer groups here refers to the GLCI's component to organize, establish, and train farmer groups to implement multiply and disseminate cassava. Establishing farmer groups required registration and characterization, these groups then underwent extensive training in order to build up their capacity to conduct multiplication and dissemination activities. Savings and Internal Lending Community (SILC) was incorporated into the farmer group component to increase the cohesion and solidarity of the group; while agro-enterprise development (AED) was introduced as a small component to address the issue of cassava products and markets.

Part 1 of this chapter reports on the process the project underwent to: 1) register and characterize farmer groups as they were established, 2) provide training to build capacity of the groups, 3) engage farmer groups in multiplication and dissemination activities, 4) establish SILC groups, and 5) engage farmer groups in AED activities. Integrated Crop Management (ICM) was also included as part of the farmer group activity. As it was not conducted in a systematic manner, thus yield little coordinate results. Neither did it fit into the overall seed system, it is not included in this chapter.

Part 2 assesses GLCI farmer group management in the following areas: 1) the model establishing nearly 3,000 farmer groups, strengthened by the SILC activities, as a delivery channel for the cassava seed system in the context of existing and emerging diseases; and 2) the impact of the project's delivery of clean seeds of improved varieties on cassava yield, production, consumption and marketing.

Part 1. The Process of Implementing the Farmer Group Component

Farmer group registration and characterization

A questionnaire was developed to characterize and map existing farmer groups according to basic skill sets following the CRS 5 skill-set concept to develop strong farmer groups. The results guided planning for farmer group training and location. The Democratic Republic of Congo (DRC) was the first country to have successfully used the questionnaire to characterize farmer groups according to their 5 skill sets. This survey was conducted among 120 farmer groups in DRC and the questionnaire was subsequently implemented by the other country programs.

It took a while for the project to develop the system to register, particularly to characterize, the farmer groups after their establishment. With the need to engage farmer groups to begin multiplication activities, approximately 40% of farmer groups were characterized, and their existing capabilities in the 5-skill sets established, during the third year of the project. This registration and characterization was important as it enabled farmer group training plans to be tailored to the needs and interests of each group and it served as a baseline against which to judge progress later on. The remaining groups continued to be characterized and by the Dec 2010, 2,320 farmer groups had been registered, of which 524 had been characterized. All farmer groups by this time were producing cuttings (Table 1).

Table 1. Farmer group (FG) and SILC group establishment, as of December 2010

Country	Farmer Groups			SILC Groups			
	No. FGs	Total Members	% Women	No. SILCs	% SILC	Total Members	% Women
Burundi	293	9473	64	35	12	1,175	67
DRC	612	33,025	70	166	27	8,861	67
Kenya	316	7,296	72	137	43	3,506	79
Rwanda	456	9,671	63	424	93	9,116	63
Tanzania	400	6,840	51	79	20	1,488	60
Uganda	243	6,253	58	138	57	3,275	63
Total	**2,320**	**72,558**	**66**	**979**	**42**	**27,421**	**66**

At registration, organizational management and financial skills were fully practiced by 73% and 45% of farmer groups respectively. The other three of the CRS five skill sets of natural resources management, marketing and innovation were practiced by less than 10% of groups. Since most (72%) of registration took place in FY2010, these skill levels reflect farmer training from 2008 to 2010 and not a baseline. Please see Farmer Group Characterization Appendix to view the skill set profiles of the farmer groups.

By June 2011, GLCI has registered 2,962 farmer groups, which was 97% of the 3,045 targeted. These groups included 109,243 members of which 68% were women (Table 2). By this time, some of the groups had become inactive and the reason for them included: 1) GLCI partner decision to no longer work with the group (77), 2) group had disbanded (65), 3) group graduated as seed needs in the area had been satisfied (60), 4) partner no longer working in that area (33), 5) group chose to no longer participate due to unmet high expectations of benefit (15), 6) group did not receive the cuttings in time (11), and 7) no longer possible to work in the area due to war (1).

Table 2. Status of GLCI farmer groups by June 2011

Country	Active	Inactive	Cumulative total	Total members	Women	% Women
Burundi	401	21	422	12,685	8,293	65%
DRC	763	102	865	59,504	44,454	75%
Kenya	360	14	374	10,124	6,622	65%
Rwanda	413	72	485	10,882	6,651	61%
Tanzania	430	95	525	8,682	4,508	52%
Uganda	277	14	291	7,366	4,268	58%
Total	**2,644**	**318**	**2,962**	**109,243**	**74,285**	**68%**

Since June 2011 not many new farmer groups were established, as by then most multiplication had been suspended for the September-December 2011 season while the project wound down and all the fields needed to be disseminated by the February-April 2012 season. GLCI had all but reached its target of 3,045 and had established 3,023 farmer groups at the end of year 4, with 109,522 members, 68% of them women. When the project was completed in May 2012, a total of 3,048 farmer groups had been established and registered.

Table 3. Status of GLCI farmer groups by December 2011

Country	Active	Inactive	Cumulative total	Total members	Total women	% women
Burundi	456	13	469	13,500	8,827	65%
DRC	735	146	881	59,237	43,985	74%
Kenya	352	14	366	8,981	6,007	67%
Rwanda	417	72	489	11,378	6,979	61%
Tanzania	431	95	526	8,595	4,460	52%
Uganda	278	14	292	7,381	4,275	55%
Total	**2,669**	**354**	**3,023**	**109,522**	**74,533**	**68%**

Training and capacity building

A strategy was developed to guide the planning process of working with farmer groups. This strategy included: 1) identifying existing CRS SILC staff or partners with SILC skills to train GLCI partners in each country, 2) the inclusion of community-based voluntary field agents (VFAs) (in addition to using paid field agents, PFAs, as trainers of farmer groups) and budget shortfalls. In the new strategy, the caseload of PFAs and VFAs training and monitoring farmer groups was reduced from 19 to 4-5 farmer groups per field agent. This resulted in improving community empowerment and better farmer group formation, monitoring and long-term sustainability.

To ensure long-term quality of service, partners emphasized capacity building on working with the farmer groups, both at the field level (CRS staff and partners) and supporting institutions (National Agricultural Research Systems - NARS, Departments of Extension and Departments of Plant Health and private traders). Table 4 below summarizes the field staff in place by Apr 2009 for such needs.

Table 4. Field staff in place to work with farmer groups by April 2009

Country	N° of partners	Institutional support					N° of FG	N° of groups practicing SILC	No. of FGs charact-erized
		CRS	Partner Supervisors	PFAs*	VFAs**	Others			
Burundi	10	3	9	22	3	1	185	0	159
DRC	13	3	17	25	0	3	190	9	127
Rwanda	5	2	5	33	133	5	330	133	117
Tanzania	12	4	18	0	0	6	315	0	41
Uganda	6	2	6	8	28	1	228	109	65
Kenya	3	2	3	9	0	2	150	10	50
Total	**49**	**16**	**58**	**97**	**164**	**18**	**1,398**	**261**	**559**

* Paid field agents and ** voluntary field agents.

All partner supervisors, PFAs and VFAs were in post by 2010. Women represented 10%, 20% and 25% respectively. The number of FG to monitor and support per VFA averaged 4.5, but ranged from two in Rwanda to up to seven in DRC and Tanzania. To make the staff efficient and effective, most supervisors were made mobile with motorcycles supplied by the project, but only half of the PFAs had access to a motorcycle, although they did have access to bicycles. Mobility was a limiting issue for the field agents, particularly in vast countries like DRC and Tanzania that was continuously addressed during the project. Though, it was recognized that it was an issue never fully addressed as most of the field agents were put in charge of large areas with only bicycle to aid them to cover the long distances between their sites. And, some of the VFAs never even had bicycles to assist them to cover the various villages or farmer groups for which they were responsible (Table 5).

Table 5. Project staff inventory and mobility as of Sept 30, 2011

Partner names	Staff inventory and mobility (as of Sept 30, 2011)								
	Supervisor			PFAs			VFAs		
	Total #	# female	# w/ m/cycle	Total #	# female	# m/ cycle	Total	# female	# w/ bicycle
Burundi	7	0	11	11	2	0	43	10	32
DRC	15	1	19	45	3	35	131	60	42
Kenya	3	3	0	14	3	9	128	46	120
Rwanda	5	1	5	22	9	20	77	21	63
Tanzania	13	1	13	39	6	6	107	19	100
Uganda	6	2	6	20	5	19	135	55	96
Total	**49**	**8**	**54**	**151**	**28**	**89**	**621**	**211**	**453**

By 2011, all participating groups had been trained in cassava pests and diseases, cassava seed multiplication and cassava seed dissemination. Those participating in SILC have also been trained in group management and SILC. Burundi and DRC were the only countries that held training in gender for farmer groups. A total of 7,166 training sessions were held for all the countries during the life of the project, plus some of the training which were classified as "others." (Table 6)

Table 6. Number of training events held for farmer groups as of Sept 30, 2011

Country	# of farmer groups trained in each of the topics (as of Sept 30, 2011)						
	Group strengthening		Cassava Pest and Diseases	Seed multipli-cation	Seed dissemi-nation	Gender	Other
	Group manage-ment	SILC					
Burundi	138	38	171	200	80	32	
DRC	562	263	587	645	576	22	Climate change, PVS, ICM, farm management
Kenya	134	125	185	63	162	0	0
Rwanda	109	260	238	238	187		
Tanzania	209	38	346	353	353		Networking (20); agronomy (45); leadership (4)
Uganda	129	129	208	193	193		PVS (12)
Total	**1,281**	**853**	**1,735**	**1,692**	**1,551**	**54**	

Considerable more training was planned for 2012, during the extension of the project (Table 7). These planned events were not verified, since these were usually verified during the bi-annual country planning meetings. As only closeout meetings were held in 2012, these numbers were not verified.

Table 7. Planned farmer group training events for the FY2012

Country	# of farmer groups to be trained in each of the topics in FY12						
	Group strengthening		Cassava Pest and Diseases	Seed multipli-cation	Seed dissemi -nation	Marketing & business skills	Gender
	Group management	SILC					
Burundi	118	44	250	93	93	0	110
DRC	205	135	229	195	246	0	14
Kenya	150	36	160	269	280	39	0
Rwanda	120	118	122	69	122	149	126
Tanzania	0	0	227	164	233	0	0
Uganda	287	204	275	273	253	0	0
Total	**880**	**537**	**1263**	**1,063**	**1,227**	**188**	**250**

The effectiveness of these training events in facilitating farmer groups to perform their tasks of multiplication and dissemination, and in changing their behavior in dealing with the diseases, was assessed, analyzed, and reported in Part 2 of this report.

Farmer group multiplication and dissemination

During the year 1 activity review, doubts were raised over the quality of support to farmer groups, particularly in countries where long distances are involved (DRC and Tanzania). Group support was strengthened by increasing the interactive time between the members and groups. Most farmer group activities were scheduled for the dry months of May to September, when farmers were less intensely involved in farming.

With the belief that farmer groups, versus individuals, were the best venues to conduct multiplication fields, farmer groups were formed and trained in seed multiplication and dissemination, as mentioned above. During the first years of the project, the project stipulated that multiplication sites must belong to farmer groups only, and in turn all farmer groups formed must engage in cassava seed multiplication, while SILC was seen as an added strengthening activity to ensure solidarity and sustainability. As the project progressed, more individuals began to take on multiplication sites (Table 8). As this change took place on farmers' level and persisted even at the resistance of project management, it strongly suggested that farmer groups may not be the best, or not the only venue, for multiplication activities.

Table 8. The number of farmer group vs individuals engaged in multiplication in FY11

Country	No. of FGs multiplying seed	No. of individual multipliers multiplying seed
Burundi	203	31
DRC	292	23
Kenya	81	282
Rwanda	78	97
Tanzania	285	175
Uganda	52	24
Total	**991**	**632**

This prompted the project management to question its paradigm that farmer group should be the only venue for multiplication, and a study to focus on the comparative advantages and disadvantages of farmer groups versus individuals. The study results showed that, given the advantages and

disadvantages, multiplication was probably best done individually, while farmer groups were the best conduit for receiving and passing on training and information (see Part 2 of this report for details).

Savings and Internal Lending Communities (SILC)

The launch of SILC activities was delayed in the beginning of the project due to the urgency to exploit the March 2008 planting season, assess the threat of Cassava Brown Streak Disease (CBSD), carry out the baseline survey and orient and train the partners. It was recognized that, during the periods of crucial rainy seasons (October–December and February–May), emphasis was placed on maximizing seed multiplication to achieve the project target, and SILC activities were to be reduced to accommodate the core activities of GLCI. Nevertheless, all countries were oriented to the SILC methodology and the use of field agents to develop SILC-based farmer groups. All countries were also exposed to concept of SILC groups during the Participatory Variety Selection (PVS) training in July 2008 in Tanzania.

The above delay fortunately had no long-term deleterious impact on the project outcomes. All countries were well positioned to introduce SILC as a community entry point and basic training in financial and group organizational skills in farmer groups even in Year 1 of the project. Burundi, Kenya, Rwanda, Tanzania and Uganda each had CRS staff and partners who had already introduced SILC to non-GLCI farmer groups. Only DRC did not have SILC trainers from within CRS or from among its partners. However, DRC staff and partners attended a regional SILC training in May 2008 in Kigali and were actively training other partners and communities.

During farmer group formation and characterization, it was noted that many were already involved in some form of savings or financial group. Rather than introduce SILC and risk creating conflict or confusion, these groups were not trained in SILC. Similarly, some groups indicated that they were not interested in SILC. The number of groups targeted for SILC was thus reduced to approximately 50% of the total per country. GLCI trained farmer groups in Kenya, Rwanda and Uganda in SILC and sensitized their communities. CRS and partner staff in DRC were trained in SILC in Rwanda. Burundi and Tanzania were the last to start on SILC activities. Differences in approach between countries depended upon the familiarity with SILC by partners and CPMs and the oversight by CRS country program staff and the prioritization of other activities, notably a reflection of the importance of CBSD.

These factors resulted in marked differences between countries in the proportion of FGs using SILC due to differences in country and partner strategies. Some groups appeared not to be following established SILC principles and an assessment was thus carried out by certified SILC trainers to identify areas needing improvement and to guide the following phase of SILC group formation and training. An assessment was conducted between May and August 2010, by taking a random 10% sample of all GLCI SILC groups, to determine if the groups were meeting GLCI requirements for seed production and dissemination and CRS SILC standards. The assessment showed the following findings, most of which were reassuring that the GLCI SILC was on the right track:

- Partners had supervisors and PFAs trained in SILC were able to support groups and VFAs.
- Training was insufficient and frequency of visits too low and retraining was needed.
- PFA workloads were large and increasing and more VFAs needed to be recruited to help.
- CRS SILC officers in each country needed to re-train partner staff, introduce the management information system, and monitor.
- GLCI SILC groups promised to be a sustained presence of cassava excellence in communities.
- Most GLCI SILC groups followed recognized procedures and were not a threat to members' savings.
- "Peer-to-peer" training by exposure visits among groups could be effective in upgrading quality.

Once the SILC Assessment Report finalized, the CRS country programs and partners then implemented the recommendations (please refer to the SILC Assessment Report Appendix for details). The assessment boosted confidence in the quality of the GLCI brand of SILC group, and the recommendations guided further establishment of the SILC groups. One of the features of SILC is to "graduate" groups once they have reached maturity and continued to do SILC without needing partner services. By the end of GLCI, approximately half of the SILC groups were graduated (Table 9).

Table 9. The number of farmer groups participating in SILC

Country	No. FGs doing SILC through Sept 30, 2011	No. FGs which graduated in FY2011	No. FGs anticipated to graduate in FY2012
Burundi	35	14	50
DRC	245	73	163
Kenya	117	77	40
Rwanda	458	356	102
Tanzania	38	21	17
Uganda	190	39	151
Total	**1,083**	**580**	**523**

A SILC form was added to the monitoring and evaluation (M&E) system, but unfortunately this form never came to fruition as the partner staff felt that they were fully occupied with the forms for the core project activities—related to the seed system—and asked not to be burdened by this extra form.

Agro-Enterprise Development (AED)

AED was included in the proposal as a minor component to assist farmer groups to process and market their products. GLCI conducted a rapid appraisal of the cassava value chain in all countries, except Tanzania, in Year 2, and the findings formed the basis for AED activities. Most farmers said that cassava was their number one food and cash crop and that 90% of households sold, on average, 40% of their cassava, usually as dried chips except when near large cities. GLCI had planned to pilot AED activities in mid-2010 with strong farmer groups in DRC, Kenya, Rwanda and Uganda where interest was greatest.

However, with the focus on the core seed and the disease activities, the AED activity was subsequently suspended. Moreover, the orientation of the core activities of GLCI made it only possible to undertake AED in an ad hoc fashion which, while distracting the team from the core activities, would not likely yield significant results. It was acknowledged that postharvest utilization and marketing were important issues as they were most frequently requested by partners and farmer groups, but it was also recognized that GLCI was not designed to undertake AED in a systematic enough manner to have significant impact.

An assessment was nevertheless done in five GLCI countries in 2010 with the following results:

- Most farmers in groups ranked cassava first as both food and cash crop.
- More than 90% of households in GLCI areas sell some cassava.
- Proportions of cassava sold versus consumed across the countries ranged from 27% to 47%.
- There was high demand in local villages, towns and cities for dry chips and standard quality flour.
- Farmer groups continued to demand help to link to markets in anticipation of increased production.

The results of the cassava AED assessment are available in the AED Assessment Report Appendix attached to this chapter.

Part 2. The Assessment of the GLCI Farmer Group Component

This part of the chapter reports on the assessment and analysis of the GLCI farmer group component, drawing lessons from the farmer group and SILC activities to determine what might be the ideal model to establish a sustainable seed system and what impact these activities may have on the group members and the beneficiaries at large. These findings and conclusions were extracted from the case study on farmer groups. To view the full report, please refer to Case Study Appendix – Farmer Groups.

This section reports on the general profile of the groups as well as the following:

- **Training:** includes both training received and what the group members have done with the training, such as effectiveness of passing on information as a group and as individuals, and behavioral changes in cassava production practices.
- **Behavior change:** assess the changes in cassava production, consumption and multiplication experiences as the result of the farmer group members' involvement with the project.
- **SILC:** examines the effects on social cohesion, solidarity and economic resilience of group members.

1. Group profile and general information

The section reports on the profile of the farmer groups working with GLCI: the number of years the groups have been together; years they have worked with GLCI; how the groups were originally organized; number of seasons the groups engaged in GLCI multiplication, as a group or individually; and the members' perception of advantages of belonging to multiple groups.

Not all the groups were started by the four-year GLCI project as these farmer groups have, on average, been together for 4.2 years (Kenya groups lead this at 5.1 years). On average, the groups have worked with GLCI only 2.2 years. On average, the groups have multiplied with the project for 2.4 seasons, while on average they have harvested the multiplication fields 1.5 times. High percentages of the groups in each country, particularly Tanzania, were originally formed as agricultural groups while a good portion of these groups, particularly in Rwanda, were organized as GLCI multiplication groups. A smaller percentage of them, except in Kenya, started out as some traditional micro-finance groups, most commonly as merry-go-round groups (Table 5).

Table 10. Activity around which the groups initially were formed (%)

Country	Agriculture	GLCI multiplication	Microfinance
Kenya	55.6	16.7	27.8
Rwanda	35.7	50.0	14.3
Tanzania	72.2	22.2	5.6
Average	**54.5**	**29.6**	**15.9**

Nearly half of the members belong to more than one group (Figure 1). The reasons stated by farmers for choosing to belong to multiple groups are:

- Because each group works on different projects and has different functions (40%).
- To cash in on project resources such as accessing planting material, training opportunities and financial and resource, such as tools and seeds support as the group gains recognition and support by institutions (40%).

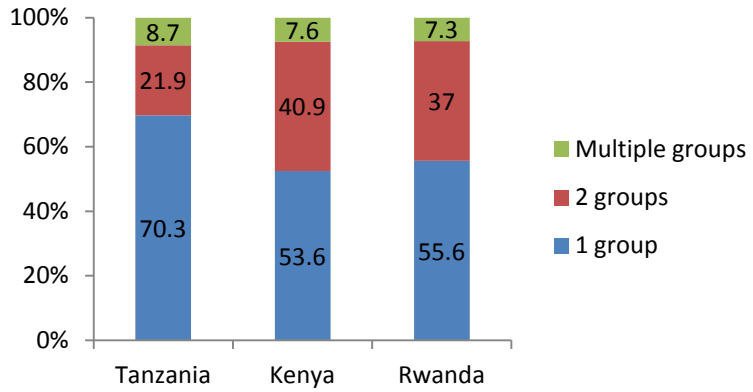


Figure 1. Percentage of members belonging to more than one group

Interestingly, sharing risks, exchanging labor, supporting weak groups, providing social and financial support, and gaining new knowledge and ideas from group members while strengthening community were not considered advantages by the farmer group members who responded to the survey.

2. Group work vs. individual work

The GLCI assumption was that it is best to work in groups, particularly in multiplication and training; however, the study found that the farmers' view was that it is best to work both in groups and as individuals, though some Tanzanian farmers are more inclined to work in groups (Table 6).

Table 11. Farmer group members' view of best mode of working

Country	Work as both in groups and as individuals	Always work as group	Gain knowledge as group then work individually
Kenya	100	16.7	5.6
Rwanda	100	0	7.1
Tanzania	66.7	44.4	16.7
Average	**88.9**	**20.4**	**9.8**

There are advantages to working both as groups and as individuals. For the farmers, the biggest advantages are to access resources, such as capital, planting material, and information together, as well as the easy access to communal labor (Table 7). At the same time, they also acknowledge that there is much better control over decisions and more commitment and allocation of responsibilities when they multiply individually (Table 8).

Table 12. Advantages of working as groups to manage multiplication sites

Country	Easy to access resources	Easy to access labor	Public recognition	Reach more people	Create more social cohesion
Kenya	72.2	83.3	55.6	55.6	44.4
Rwanda	78.6	57.1	35.7	35.7	57.1
Tanzania	94.4	77.8	50.0	38.9	27.8
Average	**82**	**74**	**48**	**44**	**42**

Table 13. Advantages of multiplying individually

Country	Better control over decisions	Commitment and responsibility	Easier to make money individually	More flexibility
Kenya	83.3	66.7	27.8	22.2
Rwanda	85.7	21.4	42.9	50.0
Tanzania	66.7	44.4	38.9	22.2
Average	**78**	**46**	**36**	**30**

Given the advantages of each, ultimately, it is almost unanimous that they should work both in groups and individually, depending on the nature of activities. While these farmer groups are still multiplying together as groups, almost all the group members in Kenya and Rwanda also multiply as individuals. As indicated in Tables 6, 7 and 8, Tanzanian farmers saw more advantages in working together than individually and they advocate to always work as groups (Table 9).

Table 14. Percentage of farmer groups members who also multiply in individual plots

Country	% of FG members also multiply as individuals	
	Mean	Median
Kenya	90.8	100
Rwanda	94.6	100
Tanzania	47.9	50

3. Training

This section reports on the training the farmers groups have received, the behavioral change and changes in practices as the result of the training received, and the extent to which the information learned from the training was passed on other farmers.

GLCI trained partner staff and farmer groups through online GoCourses and face-to-face cascade training. The former consisted of six courses that were available online to the PFAs who were given mini-laptops and training to use computers and take the courses. The latter was conducted by the NARS to the partner staff who in turn trained the VFAs. The PFAs and VFAs, in turn, provided face-to-face training to farmer groups. Partners have reported more than 8,000 farmer group training events over the life of GLCI, and this section verifies the authenticity of these events and assesses their effectiveness.

The survey results show that most farmer groups have received most of the training offered by GLCI, though variations exist among countries (Table 10). Of these, farmer group members appreciated the disease awareness and management and variety identification courses the most (72%). The rest of the training courses received 0-12% of vote on their importance. The subject of all the courses were decided by the project, except for some value addition and marketing courses requested by groups in Kenya.

Table 15. Training courses received by the farmer groups

Country	Clean seed handling	ICM* practices	Disease aware-ness & mgm't	Variety ID	QMP**	Dissemi-nation planning	Inter-cropping	Average
Kenya	88.9	83.3	77.8	83.3	66.7	72.2	77.8	78.6
Rwanda	100	100	92.9	100	92.9	100	50	90.8
Tanzania	100	100	100	83.3	100	72.2	61.3	88.1
Average	**96**	**94**	**90**	**88**	**86**	**80**	**64**	**85.4**

*ICM: Integrated Crop Management, **QMP: Quality Management Protocol

Farmer group members found observation in demonstration plots and practices in the field to be the best part of the training, particularly by farmer group members in Tanzania (100%). Given the prevalence of CBSD and the difficulty in identifying the symptoms of this virus, it is not surprising that the Tanzanian farmers would highly value the opportunity to observe the symptoms in the field and practice identifying the disease during training. Meeting and making connections with resource people is a distant second (30%) in terms of importance to farmers, followed by meeting other farmers or groups (22%). Receiving handouts from the training is the least important among the farmer group members (12%). Interestingly, among the beneficiaries who received seeds from the project, 82.4% of the respondents thought that distributing handouts is the best way to make training better and memorable for them. Having not expected this result, the questionnaire did not have a follow-up question to explain the discrepancy. One can only speculate that, because farmer-group training was by far more extensive with more tools, handouts are just one of several ways they know to improve the training. The beneficiaries, on the other hand, having only been through the rudimentary extension at dissemination, cannot think of any other ways to improve the training.

One assumption of working with farmer groups versus individuals is that, as groups, they are a more effective and efficient conduit to pass on information to the mass of the farmers. The respondents confirmed that 82% have shared their training information with other individual farmers, while only 38% have shared with the other groups they belong to, even though many belong to more than one group. Half of the respondents have shared the training information by showing their demonstration plots to other farmers. This indicates that most farmers pass on the information on individual level; in other words, belonging to multiple groups does not consistently lead to passing on information to other groups. That said, providing training to farmers groups reaches more people than to individuals, and in turn many more may receive information as 82% of original trainees do pass on information.

4. Behavior changes and changes in practices

For each category of question, only the answers with >50% of respondents are considered significant enough to be listed in Table 11. For example, of the various ways diseases are managed, while 100% of respondents now manage them by roguing, only a small percentage plant only improved varieties (28%), and fewer yet manage by rouging off types or isolating the improved varieties from the local ones. The answers in Table 11 reflect only the behavioral changes that the majority of respondents undertook. While roguing diseased plants is the most consistent change of behavior, farmers have also recognized the importance of sourcing clean seeds, better spacing, weeding, and seed planting practices.

Table 16. Changes in practices and behavior regarding cassava seed and production as result of training

Country	Seed sourcing practices		General management within disease context			Seed planting practices			Disease mgm't
	From known person & inst only	Confirm quality of the seeds	Distance from diseased fields	More weed -ing	Rogue diseased plants	Shorter cutting	Better spacing	Plant in an angle	Rogue diseased plants
Kenya	83.3	66.7	88.9	100	72.2	94.4	72.2	94.4	100
Rwanda	100	78.6	85.7	85.7	85.7	78.6	85.7	71.4	100
Tanzania	94.5	55.6	100	88.9	66.7	77.8	83.3	33.3	100
Average	**92**	**66**	**92**	**92**	**74**	**84**	**80**	**66**	**100**

This raises the question as to why farmers are not rushing to plant the improved varieties only. The discrepancies among the three countries are a clear reflection of the different disease situations in those countries (Figure 2). Tanzania has been plagued by CBSD in recent years, and despite GLCI efforts to identify, multiply and disseminate seeds of tolerant varieties, these varieties continue to succumb to diseases. There are few truly tolerant varieties, and the seeds of which are often not available. For this reason, farmers continue to rely on local varieties, as well improved varieties, wherever they can access the seeds, for their cassava production. Rwanda, on the other hand, had not had signs of CBSD until the current outbreak in 2011, and had been confronted with Cassava Mosaic Disease (CMD) only. The CMD-resistant material has long been well established and these improved varieties do not succumb to CMD once every few years, making it easier to build up the stock of the needed seeds. Thus, 85.2% of farmer group members are planting only improved varieties, while 18.3% in Tanzania are able to do so. The CBSD situation in Kenya is far less severe than in Tanzania, but it has been present there nevertheless, thus, a higher percentage of farmers have access to improved varieties.

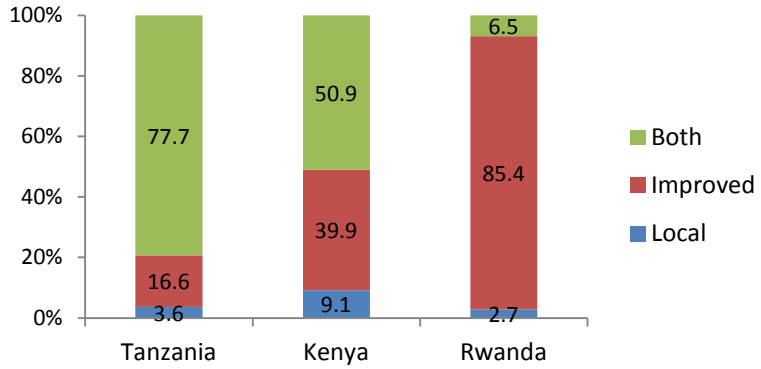


Figure 2. Percentage of farmers planting local or improved varieties or both

This analysis is further confirmed by the farmer group members' response on why they continue to grow local varieties. While only 7% in Rwanda responded "do not have enough seeds to plant only improved varieties", 83.3% in Tanzania and 66.7% in Kenya responded so. Whether farmers plant only improved varieties is almost totally a function of access to seeds, as few cited "better taste of local varieties" or "in the process of evaluating improved varieties" as the reason for planting local varieties.

What is the definition of improved varieties from farmers' perspective? The different responses from the CBSD- and CMD-infected countries clearly indicate the current ability to battle the two diseases, and farmers' view on whether the diseases can be contained by planting improved varieties. While all agreed that high-yielding and short-season are desirable characteristics of improved varieties, the Tanzanian and Kenyan farmers, plagued by CBSD, do not see disease resistance as part of the traits of improved varieties (Table 12). This is because CBSD tolerance, let alone resistance, has so far eluded them. Contrasting these responses are those from Rwanda where a resounding 100% of respondents considered disease resistance as a trait of an improved variety. This is attributed to the fact that the CMD-resistant varieties perform drastically more effectively in resisting CMD than the temporarily CBSD-tolerant material that farmers have received so far. Contrary to conventional wisdom about the importance of texture and taste to farmers, only 48% respondents considered those as important variety characteristics.

Though high-yielding is directly related food security and income, the farmers did not seem to make those connections—while they relate high-yielding to improved varieties, they did not connect improved varieties directly to better food security or high income. Meanwhile, 92% of them produce cassava both for consumption and income, while only an insignificant number of them produce it for consumption only (8%) and none for income only.

Table 17. The characteristics of improved varieties

Country	Higher yielding	Short season – early maturing	Disease resistance	Better taste
Kenya	94.4	94.4	55.6	61.1
Rwanda	100	92.9	100	35.7
Tanzania	88.9	88.9	50	44.4
Average	**94**	**92**	**66**	**48**

One "forced" behavior change is the practice of Quality Management Protocol (QMP). GLCI introduced QMP as a field-based seed quality management tool to complement lab-testing, which was very costly. To obtain 95% confidence of 1% infection, leaves of 100 plants of each multiplication site from two diagonal lines are sampled, regardless the size of the site or the number of plants in the site, are investigated for pests and diseases, particularly CMD and CBSD. In addition, the roots of every tenth sampled plant, for a total of 10 plants, are harvested and chopped up to look for disease in the roots. This is designed as a joint exercise between farmer groups, partners, district agriculture workers and extension agents.

This behavior change is mainly requested by GLCI, except in Rwanda where half of the farmer multipliers themselves actually requested to have QMP performed in the fields (Table 13). The farmer group members' participation in the exercise was a way for farmers to learn and ascertain the health of their own fields. The data confirmed that there is almost 100% of farmer group participation. As there is a regular turnover of the members, frequent training in order to have new members learn to do and understand QMP is considered the most important way to improve QMP. Such turnover and frequent training in turn leads to farmers' familiarity with the diseases and ways to monitor diseases in their field.

Table 18. Who requested the QMP and ways to improve QMP (%)

Country	Why QMP was done		Ways to improve QMP			Members participation
	Required by GLCI	Requested by group	Frequent training	Increase # people doing QMP	More community involvement	
Kenya	61.1	5.6	33.3	0	5.6	100
Rwanda	61.5	57.1	64.3	7.1	14.3	92.3
Tanzania	100	0	94.4	55.6	55.6	100
Average	**74.2**	**20.9**	**64.0**	**20.9**	**25.2**	**97.4**

The purpose of QMP is to "certify" the quality and health of the crop. For GLCI purposes, once certified, the site can be onward multiplied in the secondary or tertiary sites, or disseminated to beneficiaries. For farmers, this could be a tool for commercial purposes if they are interested in selling clean seeds. For now, farmers do not yet associate QMP and the subsequent certificates as a way to sell seeds or bring buyers to them; this tool is viewed by farmers as a way for them to gain confidence in the disease free status or, to a much lesser extent, help them identify diseases in their fields (Table 14).

Table 19. Farmers' view of the utility of QMP

Country	Confident in disease free status	Help identify disease	Know the amount to disseminate	Help sell seed	Inspector recommend buyers if pass QMP
Kenya	55.6	33.3	0	0	0
Rwanda	100	0	14.3	0	0
Tanzania	94.4	38.9	16.7	0	0
Average	**83.3**	**24.1**	**10.3**	**0.0**	**0.0**

5. SILC

All GLCI SILC groups were part of farmer groups that were involved in multiplication activities. SILC activities were intended to add value to the farmer group-based sustainable seed system, with the assumption that farmer groups, reinforced with SILC, make the most cohesive multiplying groups and service delivery channel.

Participation of GLCI farmers in SILC among the sampled beneficiaries in Kenya, Rwanda and Tanzania varied widely. Of the three sampled countries, there is a gradation of the SILC engagement. The Rwanda program took on SILC with great enthusiasm and formed SILC groups beyond the seed multiplication farmer groups, despite the project's aim to tie SILC to multiplication. Thus, it is not surprising that, among the interviewed farmer groups, 100% of the Rwanda groups, while only 44.4% of the Tanzania groups and 33.3% of the Kenya groups, also belong to SILCI groups (Table 15).

Table 20. Summary of SILC activities

Country	% FGs involved in SILC	% members of these FG belong to SILC	% members of these FG borrowed money	% members spent on borrowed money on Income activities
Kenya	33.3	100	100	85.5
Rwanda	100	98.7	92.8	74.6
Tanzania	44.4	73.1	71.9	19.1
Average	**59.2**	**90.6**	**88.2**	**59.7**

Not all the farmer group members belong to a SILC group though the majority does, and most of them have already borrowed money from the SILC savings. Kenyan farmers are the most practical and have invested the borrowed money mainly in income-generating activities, while the Tanzanian farmers tend to spend it on non-income generating activities, such as paying for school fees or doctor's visits which could still be a productive investment as it might have protected them from selling of productive assets. 100% of those who spent their SILC loan on income-generating activities claimed to have made profit from it.

The major advantages perceived by the SILC member across the countries are economic. They most appreciate the fact that they are no longer at the mercy of the local money lenders who levy a hefty interest on the loans. By pooling funds to undertake activities together, each member has also become better off financially; though not yet financially self-sufficient (Table 16). The advantages of belonging to SILC groups are mainly confined to individual benefits of becoming more economically resilient as they no longer have to go to money lenders because SILCs pool funds for members to undertake activities individually or collectively. The idea that SILC contributes to social solidarity or cohesion did not come across in the responses, as few respondents noted that the advantages of SILC groups is that the

members help each other or are brought closer together though this finding may pertain to the aforementioned issue of lack of self-selection.

Table 21. SILC members' view of the advantages of forming and belonging to SILC groups (%)

Country	Never again need to borrow from money lenders	To become financially better off	Pooling funds to undertake activities together	Members help each other and become closer	To become financially self-sufficient
Kenya	83.3	83.3	66.7	16.7	33.3
Rwanda	64.3	78.6	86.7	25.2	42.7
Tanzania	100	37.5	0	37.5	0

Not surprisingly, the respondents who did not belong to SILC groups did not agree to any of the advantages to SILC activities. Either they did not see advantages of belonging thus did not join, or since they did not join they have not been able to see such advantages.

6. Impact on cassava production and consumption

Precise cassava yields on farmers' fields in this part of the world are difficult to ascertain. First of all, farmers practice piecemeal harvest in which they harvest the largest roots of each plant while leaving the smaller roots in the ground to continue to bulk. In light of the lack of storage, this is the best way to store the roots in the ground while they continue to gain volume. Such harvest can go on for two years or longer. Secondly, there hasn't been systematic data collected on the weight of the roots, even though farmers may know precisely the number of roots harvested per plant. Thirdly, when cassava is sold, it is sold based on volume, not weight, whether it is sold as fresh roots or as flour. There is no known weight associated with these volumes in addition to the lack of information on the dry matter content, hence the lack of information on root-to-flour conversion rate. In the face of the lack of all such information, the yields are mainly based on guess work.

The lack of knowledge of cassava yields made it necessary for GLCI to estimate yield and production changes by using known indicators of measurement. Since farmers value short season varieties and are clear on the number of roots they harvest, months-to-maturity and number-of-roots-per-plant are two appropriate indicators.

As shown in Table 17, the traditional (old) varieties produce significantly fewer roots than the new ones, and it is most pronounced with the varieties in Kenya where the average increase is 9.1 roots per plant. It is worth noting that the old varieties produce 2-9 roots per plant while the new ones range 6-17 per plant. In addition to the number of roots produced per plant, the sizes of these roots are also considerably larger. While almost 90% roots of the old varieties are of small and medium sizes, almost the same percentages of roots of the new varieties are large and extra large.

Table 22. The differences in # roots per plant and sizes of roots between old and new varieties

Country	# roots per plant					Sizes of roots (% roots of each size)						
	Old variety		New variety		Mean	Old variety			New variety			
	Mean	Range	Mean	Range	increase	Small	Med	Large	Small	Med	Large	XL
Kenya	3.1	2 - 5	12.2	8 - 16	9.1	50	44.4	5.6	0	16.7	66.7	16.7
Rwanda	5.1	3 - 9	10.5	6 -17	5.4	42.9	35.7	21.4	0	7.1	64.3	28.6
Tanzania	4.6	3 - 6	9.1	6 13	4.5	22.2	72.2	5.6	0	0	77.8	22.2
Average	**4.3**		**10.6**		**6.3**	**38.4**	**50.8**	**10.9**	**0.0**	**7.9**	**69.6**	**22.5**

While the yields of the improved varieties, imprecisely indicated by the number and the sizes of the roots, have significantly increased, the growing season has also been substantially decreased, even to a 17-month reduction in Tanzania (Table 18). While the old, local varieties may take up to 36 months to mature and harvest, the new ones only take approximately 12 months. While the new varieties in Kenya tend to produce 9.1 more roots per plant, Tanzania and Rwanda's varieties tend to decrease the growing season by 13 -17 months in comparison. This considerably shortened season allows more crops, or fallow, on the same piece of land. It is thus not surprising that nearly 90% of the farmers have increased cassava production, with Kenya leading this increase. Few have decreased production while a very insignificant (8.4%) number have maintained the same level of production.

Table 23. Number of months before the roots can be harvested

Country	# months before harvesting					% group members increased production
	Old variety		New variety		Old to new decrease	
	Mean	Range	Mean	Range		
Kenya	18.7	12-36	9.7	9-11	9	92.8
Rwanda	24.4	18-30	11.5	8-14	12.9	89.9
Tanzania	26	12-36	9.1	8-12	16.9	79.9
Average	**23.0**		**10.1**		**12.9**	**87.5**

When asked what accounted for this significant increase in production, 96% of members attributed it to the high-yielding nature of the improved varieties. Few attributed this increase in production to disease-free varieties, changes in management practices, incentives from the possibility of selling stems or roots, or the need for more roots for consumption. It is very clear that high yielding is both the incentive and the cause for increased production, though it must be acknowledged that increased areas of production are another factor that account for the increased production (Figure 3). GLCI did not feel that it was possible to obtain valid information on precise number on cassava production or area of production; nor the precise number of increase or decrease of them. Thus the questionnaire only asked whether production, and area of production, has increased, decreased, or remained the same.

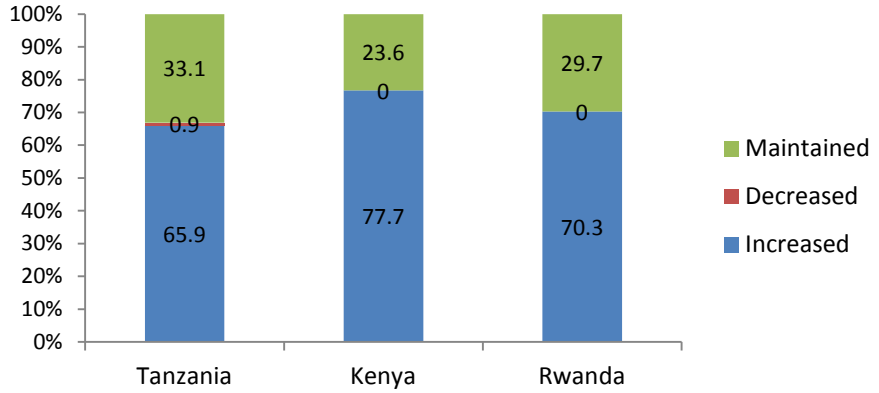


Figure 3. Percentage of farmers increased, decreased, and maintained areas of cassava production

The increased production has resulted in 86% of respondents eating more cassava while 82% sell more cassava, once again indicating the dual significance of cassava for these farmers.

7. Passing on seeds and selling seed

As indicated in Figure 2, where CBSD has been an issue farmers do not have enough seeds to plant only improved varieties. By the same token, 46% of Tanzania farmers do not feel that they are in a position to either give away or sell the scarce seeds they have. Seed is not nearly as scarce in Kenya as the CBSD pressure is lower, but the Kenyan farmers tend to sell seeds rather than give them away. In Rwanda where the problem had been confined to CMD against which there are effective resistant varieties, and seed supply was not nearly as limited, it is thus no surprise that farmers give away seeds to more families and neighbors (Table 19).

Table 24. The rate of farmer group members passing on seeds to others

Country	% respondents gave seed to # people				Reason to give	% respondents sold seeds
	0	1	2 -- 5	>5	Social responsibility	
Kenya	40.6	10.2	33.2	16	55.6	12.6
Rwanda	14.7	0	37.3	48	92.9	1.9
Tanzania	45.8	0	33.1	21.1	38.9	0
Average	**33.7**	**3.4**	**34.5**	**28.4**	**62.5**	**4.8**

In addition to better access to seeds, it is also a cultural practice and obligation, particularly in Rwanda, to provide free cassava seed to others. Giving seed away is a responsibility to help neighbors and family and a way to build social capital, and this is basically the sole reason to give seeds away as opposed to selling them. Cassava seeds are almost never sold because it is not considered an acceptable social behavior to sell cassava seeds and one is expected to share them. It is not because there is not enough seed to sell, or lack of demand for seed, nor is it because it is not profitable that farmers do not sell them. Most farmers find it unthinkable to sell cassava seeds to relatives and neighbors, though it is conceivable to do so to strangers far from their village. It is acceptable to sell other seeds, such as beans, of crops that are either not vegetatively propagated or not related to food security. During discussions with farmers in Rwanda, they adamantly stated that it is very bad behavior to sell cassava seeds to family or neighbors, though it is acceptable to sell to outsiders or seeds of other crops.

It should be noted that selling cassava seed is more acceptable among Kenya farmers. On the farmers' level, this is probably because cassava is not nearly as important as a staple crop in Kenya. The GLCI activity may have had some influence since Kenya is the only country where the multiplication and dissemination are conducted as a business. In Kenya, multipliers do not receive funds to cover the costs of managing multiplication fields; they sell the stems to beneficiaries who have received vouchers from GLCI. The multipliers in turn receive money for all the vouchers they collect from the beneficiaries. For better or worse, this practice may have served as an incentive for farmers to sell their seeds while also encouraging them to move beyond their traditional views of exchanging planting material.

It was expected to learn that the farmers do not give seeds to others at random, but it was somewhat surprising to note that it was more common to give to neighbors than family members (Table 20). The logical explanation is that families may be spread out while neighbors are close by and easier to pass on the stems or cuttings. This also implies that these seeds may not travel distances en masse from farmers' fields as they pass on to their neighbors. On the one hand, such practices prevent the spread of disease; on the other hand, it limits the geographical spread of the informal exchange of clean seeds of improved varieties.

Table 25. The percentage of farmers give seed to family, neighbors and others

Country	Neighbor	Family	Others
Kenya	60.9	25	4.1
Rwanda	85.1	56.2	47.7
Tanzania	47.4	2	7.8
Average	**64.5**	**27.7**	**19.9**

8. Discussions and Conclusions

This section examines the questions outlined in the objectives in the Introduction by analyzing the data presented in the findings and by performing additional analyses on the same data.

A. Training, behavior change, sharing information, and strengths of the groups

The strengths of the farmer groups were determined by the partners that work directly with the groups by training them and monitoring their multiplication activities. Table 10 shows the varying degrees of training the groups have received in each country. There is almost 100% correlation between the quantity of training the groups received and their strengths as perceived by the partners. The strong groups have taken more courses on every topic than the average ones, which in turn have received more than the weak groups (Table 21). We made the assumption that the partners gauged the strengths of the group based on the training they have received; rather, they simply noticed that these are strong or weak groups in their multiplication efforts and their overall performance. These data speak very strongly of the efficacy of training to strengthen farmer groups.

Table 26. Training received by weak, average, and strong farmer groups (%)

Farmer Group Strength	Disease awareness	Variety identification	ICM practices	Seed handling	QMP	Inter cropping	Dissemi-nation planning	Ave-rage
Weak	81.8	81.8	90.9	90.9	81.8	45.5	72.7	77.9
Average	89.5	84.2	89.5	94.7	78.9	63.2	78.9	82.7
Strong	95.0	95.0	100	100	95.0	95.0	85.0	95.0

The strong groups also tend to modify their behavior as the result of their training (Table 22 and Figure 4). The members of these groups have adopted all the improved practices introduced through the training mentioned above more than the members of the average group, who in turn have adopted more than the weak group members.

Table 27. Percentages of farmer group members have changed their practices in cassava production

Farmer group strength	Shorter cutting	Correct spacing	Plant on an angle	Plant sooner	Plant when raining	Better storage	Average
Weak	63.6	81.8	63.6	9.1	9.1	0	37.9
Average	89.5	78.9	73.7	15.8	15.8	21	49.1
Strong	90	80	60	15	20	20	47.5

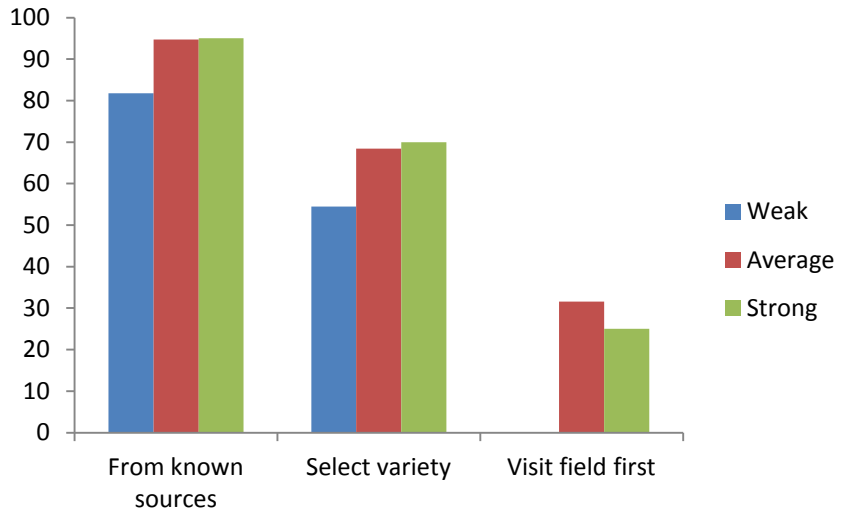


Figure 4. Percentages of farmer group members adopting improved practice of sourcing seeds

In addition to changing their own behaviors, the strong group members also tended to share the newly acquired information with others. A higher percentage of these members have shared with individuals and groups and have shown their demonstration plots to others. In turn, the average group members shared more via all three venues than the weak group members (Figure 4).

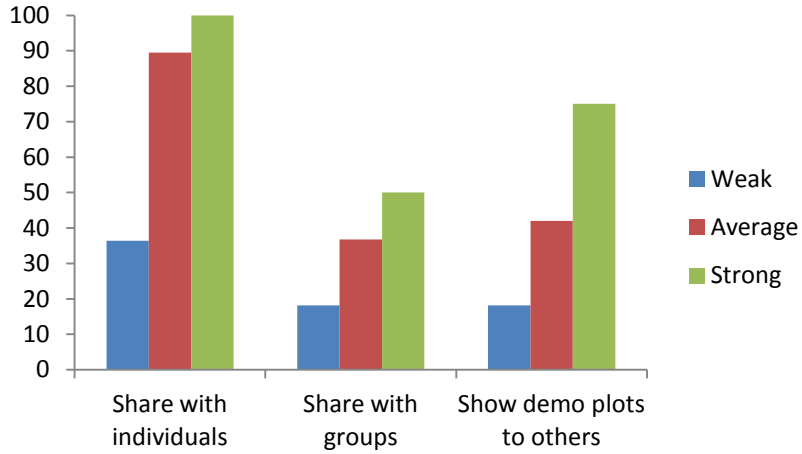


Figure 5. Percentages of farmer groups of different strengths shared information

We can draw the following conclusions from these analyses:

- The training provided by the project has been effective in building the capacity of farmer groups, and the strengths of the farmer groups are highly correlated to the training they receive.
- The more training provided, the stronger the groups are and the more they change their behavior and adopt the improved practices suggested in training. Not only did more members modify their behavior, they also adopt improved practices.
- The stronger the groups are, the more likely they are to pass on the information to others. They are more likely to engage both individuals and groups and reach more people through direct interactions as well as demonstrations.

B. Working as groups vs. individuals

Figure 1 indicates that, while all the respondents belong to the GLCI farmer groups, 41.3% of the respondents belong to more than one group. These numbers indicate farmers' interest in belonging to groups. However, it is important to note the reasons behind this interest, which are mainly to belong to various projects and gain access to project resources. Providing social and financial support to each other, gaining new knowledge and ideas from group members, or strengthening communities are not much cited as reasons or advantages to belong to groups. In other words, belonging to a group, or multiple groups, is out of practical consideration for self interest. Thus, it is important to match the group interest with that of the individuals in order to keep groups working together. As has been established above, the strength of a group is highly related to the training that its members have received, thus an individual's strength is highly related to the training s/he receives.

Group training is far more efficient than individual training with obvious reason of reaching greater number of people. The question is whether this is also true with multiplying seeds as groups. Considering that the majority of the respondents consider it best to work both as groups and individuals (Table 6), and the pros and cons of each, the lesson is to combine the advantages of the two approaches in order to create the best mode of operation. The major advantages of working as groups are access to resources and labor while the advantages of multiplying as individuals are better control over decisions and commitment and responsibility of the multiplication activities (Tables 7 and 8).

Based on farmers' interest, the suggested solution to combining the advantages of both is to have individuals, who belong to a group, take charge of the multiplication fields. In this case, the individuals have the full commitment, responsibility and decision-making power over the field while having access to group-based training and project resources and labor. After all, nearly all the interviewed group members are multiplying individually (Table 9).

Thus, we conclude the following to combine the pros and cons of working in groups and individually:

- Farmer groups are best formed to serve as the basis for receiving information and project resources.
- It is best to put the individual members of the groups in charge of specific responsibilities, which, in the context of GLCI, is seed multiplication.
- Some group-managed fields should be encouraged for groups whose members do not have enough capital, land or labor resources to manage individually.

C. SILC and farmer groups

SILC is a microfinance activity to help farmers participate in SILC groups which creates a safe and disciplined space to save money while using the savings for inter-lending to generate a profit for all members. Table 15 shows that most members have taken out loans from the pooled savings and most of them, except in Tanzania, invested in income-generating activities, which have produced profits. The economic benefit of SILC is self evident. The questions to be examined here are: 1) when superimposed on farmer groups, does SILC provide a further bonding mechanism which results in greater social cohesion and solidarity between the farmer group members, 2) should farmers self-select into SILC groups which are more risk diversified and open to all community members leading to longer-term sustainability of the group? Which strategy will lead to a more sustainable seed system?

Further analysis shows that the non-SILC members also tend to belong to more groups as they view it as an advantage to work together as groups (Table 23). These data indicate that SILC group members value SILC above more traditional informal savings and lending groups for its merits in advancing their economic well-being. They see a clear advantage to belonging to such groups and they tend to belong to

fewer groups than non-SILC members. Superimposing SILC activities does not necessarily contribute to the farmer groups working together in their multiplication activities while at the same time it can lead to poorer quality SILC groups with higher attrition rates as self-selection is not applied.

Table 28. The percentage of SILC and non-SILC members belong to one, two, or more groups

	One group	Two groups	More than two
SILC group	66.6	28.8	4.6
Non-SILC	52.1	38.2	12.1

That said, farmers may have joined SILC group for individual purposes and do not associate the SILC activities directly with improving the on-farm multiplication system; but the required regular meetings[1] inherently may have strengthened this system without the members recognizing this unintended, at least on the members' part, result. The fact that 65% of the strong farmer group members belong to SILC while only 27.3% of the weak groups do supports this theory (Table 24). Arguably, this system can be better fortified by farmer groups coming together once a week to visit the fields at the end of SILC group meetings as the motivation of money is by far stronger than that of learning and maintaining the crops for farmers to take the time to meet once a week.

Table 29. The percentage of members of strong, average, and weak groups belong to SILC

Farmer group strength	Belonging to SILC
Weak	27.3
Average	63.2
Strong	65.0

The conclusions that can be drawn from this discussion are:

- SILC members are inherently more interested in their individual concerns of home economics and not necessarily intrinsically group-oriented. The promise of loans brings individual farmers together more frequently than farmer groups only multiplying and not engaged in SILC activities.
- Farmers' participation in SILC groups helps them smooth cash flow, protect productive assets, and gives them access to emergency grants, all instruments that make them financially stronger and allow them to invest more in their agriculture activities.
- To reach the objective of strengthening the cassava seed system, the ideal model is to introduce SILC widely into the targeted geographic area while doing the promotion of capacity building in cassava product processing and marketing as an activity at the end-of-weekly SILC group meetings for interested farmers so that cassava production and individual economic advancement can be integrated and advanced in tandem. Alternatively, SILC groups can initially be used to raise interest among members in cassava production, processing and marketing after which specific farmer groups are formed (which could combine farmers from different SILC groups in the same area) for training and capacity building on the cassava value chain.

D. Impact on cassava production and consumption

Though we have no precise yield data to measure the impact of the clean seeds of improved varieties disseminated by GLCI on yields, or overall production, GLCI is confident in the yield increases based on the alternative measurements in Tables 15 and 16. The yield increase is the result of a combination

[1] The SILC design requires that the group meet once a week, but this is not strictly followed under GLCI. Some groups meet weekly while others may only meet once every two weeks or once a month.

effect of disease-tolerance or resistance and breeding for high yields. Tables 15 and 16 indicate considerable yield increase between the significantly increased number of roots per plant and the size augmentation of these roots. If the farmers have access to enough clean seeds of these improved varieties, the overall production increase would be overwhelming. Unfortunately, CBSD-infected countries still have limited access to such seeds. Thus, only 16.6% of farmers in Tanzania plant only improved varieties (Figure 2). The full-blown production increase would only be realized when all the farmers are able to plant improved disease-free varieties.

That said, most farmers actually plant both local and improved varieties which are high-yielding (Figure 2). Plus, with the access to improved seeds, farmers have also increased the areas of production (Figure 3), all of which contributed to the increased production level. This production level is expected to increase significantly in the future when more farmers have access to these seeds. The 1.15 million direct beneficiaries, farmer group members included, are passing on the seeds as they harvest. Table 17 shows that, though 33.7% of members did not pass on seeds after harvest, 62.9% pass on to two to five or more people. Estimating based on these numbers, if 63% of the 1.15 million beneficiaries pass on to three people each, there would be 2.17 million of indirect beneficiaries. If these indirect beneficiaries, with the improved varieties, increase their yields and production in a similar fashion as the indirect beneficiaries, the increase would be significant.

Given that 86% of the respondents now consume more cassava because of higher production while 82% claimed that they now sell more, when applied to the magnitude of 1.15 million direct beneficiaries plus 2.17 indirect, that would mean 2.86 million people with better food security, and 2.72 million with more income from selling cassava.

9. Summary

A. Training and group strength

The data indicate that farmer groups are indeed viable delivery channels to reach the mass of farmers, both to pass on information and seeds. Training proves to be essential in this process as it is highly correlated with the strength of the groups which in turn is highly related to both changing behaviors of those trained and their tendency to pass on the information.

B. Work in groups or as individuals

While it is most efficient to receive information as groups, it is not necessarily the best model to manage multiplication fields, or even pass on information. A model of combining group training while the individuals of these groups manage their own multiplication fields may be the most effective model for most of the multiplication fields. Some group-managed fields should still be encouraged for groups whose members who do not have enough capital, land or labor resources to manage individually.

C. Function of SILC

SILC groups attract members who are most interested in their household economic advancement and savings and loans provide strong motivation for SILC group members to meet regularly. In turn SILC can strengthen the farmer groups, as some or all of its members participate in SILC which builds their individual financial assets.

D. Linking SILC to multiplication

To further integrate the power of micro-finance with the GLCI project objective, the analyses suggest that the savings and loans from the SILC activities should be linked to cassava product development and marketing activities. This would create a considerably stronger synergy between the role of farmer groups and SILC activities for the sustainable seed system.

E. Impacts on direct and indirect beneficiaries

The data showed that there is significant cassava yield, production and area of production increase among the farmer group members, though we do not have enough field data to provide the specific numbers of on these increases. Based on the number of people the farmer group members pass on the improved seeds to for one season and their consumption and marketing increase, GLCI roughly estimates an additional 2.17 million indirect beneficiaries receiving clean seeds, 2.86 million farmers increasing food security and 2.72 million increase their income.

F. Disease, seed, and variety

An important finding concerning variety and seed is that the decision of which varieties to plant is almost entirely a function of access to seeds of the improved varieties. And, the perception of what constitute improved varieties is affected by the disease situation—where CMD is the only disease, farmers define improved varieties as resistance to disease since resistance is indeed possible; while farmers who are plagued by CBSD define improved varieties by yields since resistance to CBSD has not been possible.

Chapter 6. Monitoring and Evaluation

Part 1 of this chapter chronicles the process of setting up and implementing the monitoring and evaluation (M&E) system, starting from the baseline data collection by Kimetrica, proceeding to receiving the mini-laptops, designing the electronic M&E system, training staff members to enter data, verifying the authenticity of the data, to the final completion of M&E application. Part 2 of the chapter is an assessment documenting the evolution of the GLCI data collection tool, outlining the pros and cons of this system, and suggesting the appropriate settings to consider designing such a complex system.

Part 1. The Process of Implementing the M&E Activities

Baseline data collection with Kimetrica

The Great Lakes Cassava Initiative (GLCI) M&E system began with Kimetrica which developed and tested baseline survey tools. A two-month delay in starting the baseline survey was due to integrating the survey with that of the Food and Agriculture Organization (FAO), who received a grant from the European Union to distribute cassava cuttings in northern Uganda, Rwanda, Burundi, South Kivu in the Democratic Republic of Congo (DRC) and Kigoma District in Tanzania. By combining financial resources, the baseline was expanded geographically to give a better picture of the situation in the Lake Zone region. Kimetrica also included the questionnaire used by Dr. Stefan Abele of the International Institute of Tropical Agriculture (IITA) for the Crop Crisis Control Project (C3P) food security survey and other IITA initiatives to establish a time series.

Kimetrica drafted protocols for M&E data collection and presented them at a meeting of objective team leaders, country program managers and country grant officers in mid-June prior to roll-out in July 2008. 5,993 households from the six GLCI country target areas were interviewed along with 2,473 households from FAO target areas in Burundi, DRC, Rwanda and Uganda. Focus group meetings were also held. Initial findings were presented to a meeting of FAO, GLCI and major partners at a meeting in Bukavu in early September. At this meeting partners indicated the information that they would like highlighted and the report was being organized around these themes. It was also requested that there be a global report and then individual country reports. This required some re-analysis and arranging of data.

Next, a draft version of the baseline survey was discussed at a meeting of major partners at a meeting in Bukavu, Democratic Republic of Congo (DRC), in October and the final version approved by the joint sponsors, GLCI and the FAO, in December. It had limited release pending discussions with FAO on the distribution process. At the Bukavu meeting, there was an overwhelming request that individual country reports be compiled to emphasize context and address partner issues. Unfortunately, no country report was ever available and considerable work needed to be done, but was not, in order to make findings relevant and available to partners. Please see Baseline Report Appendix for the full report by Kimetrica.

Bringing on the mini-laptops to support the M&E system

The collection of large amounts of data and time delays and errors in transcription between field agents, partners and country program managers encouraged the search for electronic forms of data transfer in a similar manner to that proposed for the disease objective. It was decided to link with a NetHope-initiated project to demonstrate the feasibility of using small, robust, portable laptops. These machines, at $400 each, have all the functions of a regular computer and will be used by the field agents who will then upload data directly to the GLCI server. Additional assistance is being given by providers of the hardware (Intel), Formrouter on the design of user friendly forms and by Agilix on the use of computers

for training and the design of training materials. Through this method, it is intended to harmonize training sessions down the training cascade and ensure that key messages are given consistently.

Moving from baseline data collection to designing M&E data collection tools had not been operationalized before decision was made to discontinue Kimetrica's role in the overall GLCI M&E system. With this discontinuation, GLCI M&E system design stalled for a while as their departure created a vacuum and a gap between the baseline and M&E design.

Thus, two CRS M&E senior technical advisors were invited to work with the GLCI team in October 2009 to review M&E activities and to begin designing the system. An expected finding was the need to maintain paper documentation at the field level until substantially more information technology (IT) training can be provided to partner staff.

By March 2009, 250 mini-laptops were purchased from Intel and delivered for training and M&E protocols refined and loaded. The use of geographic information system (GIS) and mapping continued to be a major means of targeting and presenting M&E data, notably from the baseline study.

GLCI then won a $100,000 Intel Inspire*Empower Challenge grant to support a pilot phase of the mini-laptop roll-out. Sixty-eight mini-laptops were distributed and 69 partner staff received basic IT, GoCourse and electronic data collection training. The country-level IT consultants were recruited to support partners to fully adopt the computerized data collection and training programs. Basic computer skills, virus protection and IT troubleshooting were priorities. GLCI continued to use the FormRouter data collection platform for a while, but poor internet connectivity in many project areas necessitated alternative tools. CRS developed and field tested a new data collection tool which was a much-improved system to be adopted.

Development of the electronic M&E system

With the availability of the mini-laptops, GLCI developed a framework for an electronic M&E system that laid the foundation for robust project evaluation. The roll out of the mini-laptops was completed, more than 200 partners were trained, and partner supervisors and paid field agents and were given each a laptop. GLCI proceeded to digitize six data collection forms (in English, Swahili and French) directly related to the seed system immediately and more to be completed later. GLCI also rolled out a Frontline SMS communication program to support the M&E system by keeping field staff informed of deadlines, prompting non compliers, and enabling technical issues reporting.

The original FormRouter program was found to be unsuitable for this newly developed GLCI data collection as it did not work well in the occasionally connected mode and it was difficult for the GLCI team to alter datasets. This was then replaced by a more flexible data collection platform (GLCI data collection tool) which used Adobe Air that had been developed by CRS-India IT team. This enabled CRS to develop data collection forms for GLCI which were smaller than the FormRouter files, making them more suitable for areas with poor internet connectivity, offered users the flexibility of adding new farmer groups, and provided greater filtering options for generating reports. An extensive help desk and field testing of the tool was conducted in four countries after which CRS IT and GLCI staff refined the Adobe AIR platform and loaded it onto all laptops.

The CRS HelpDesk also supported GLCI by allowing field staff to report technical issues. GLCI added TeamViewer to the system, which allowed staff to enter any laptop remotely to solve technical issues. GLCI has upgraded the system so that the connection speed is faster. In addition, GLCI provided flash drives to field staff with no internet connectivity to save their data and send it to their office or CRS country program offices, which then uploaded the data to the server.

The M&E system was strengthened with an award and disincentive scheme to ensure high quality data collection and accountability. GLCI then attempted to tie the data submission to the budget for each country program to improve timeliness, quality and quantity of data submission and reporting. But due to the overall management structure constraint—that the country programs were fully in charge of the budget and activities in each country—the attempt failed as the GLCI regional coordination was not able to modify the country level budget according to data submission. This constraint, however, did not hinder the success of data collection in the end. It took persistence of repeated training, technical support, and follow-up workshops with each country to ensure that: 1) the partner staff thoroughly became proficient in entering the data, and 2) they understood the absolute importance of data entry. It had to be impressed upon them repeatedly that, now that the electronic M&E system had been installed, the project no longer accepted data that were not substantiated in the database.

To complete the GLCI data collection, the data recorded only on hardcopies during the first two years of the project needed to be keyed in. Clerks were hired to enter all paper field dissemination forms into the database. As the paper copy of the data collection forms had not been uniform across countries, keying in data posed a big challenge as there was a significant amount of data missing. Review and cleaning of data from these forms led to several new innovations in data record design to facilitate cleaning and monitoring. GLCI subsequently revised the forms so that data collection could become more efficient and easier for field agents.

Data audit—field verification of data

After collecting data, discrepancies between the actual data that was collected and the benchmarks (numbers to measure the amount of data that should be collected representing what had been done on the ground) given by country programs were observed. And these benchmarks again differed from what was originally reported before the comprehensive M&E system was in place. In order to monitor the project and make appropriate and effective adaptive management decisions it was essential to be sure that decisions were based on accurate figures and information.

It was essential therefore as a first step to validate that the quantity and quality of what was being submitted actually existed and was accurate. A decision was made that to move forward in this initiative the next step was to conduct a data audit.

Several key indicators were selected for the data audit to demonstrate whether data being submitted was accurate and to determine whether major outputs of the project were being achieved. These indicators include: existence of multiplication fields, validation of field size, existence of registered farmer groups, and number of cuttings beneficiaries received. A printout for each country and partner was made from the database's multiplication planting data sheet and from the farmer group registration sheets. From these sheets a random sample was selected by identifying every tenth record in each sheet and then selecting the closest records to this one that had multiple records where the location on the ground was logistically within 50 km of each other so that we could go to multiple sites in one day.

The audit verified that every multiplication site that was inventoried from the selected samples existed on the ground. Furthermore all farmer groups that were surveyed also existed, though some groups were no longer active in multiplication for GLCI. This led to the addition of a new form to the M&E system for farmer group deactivation so that an accurate count of active and inactive farmer groups could be tracked, while also keeping track of the reasons for deactivation. There was also some discrepancy between what was reported for multiplication field size and what was found on the ground, some over-reported while others under-reported. The mean difference of actual versus reported field size was -195 m2 or an equivalent of 8.42% over-reporting on field size. This indicated that the partners did not have an accurate tool to measure, and were estimating, but did not intentionally over-report the size. The discrepancy was due to a lack of understanding and technology to measure with the same accuracy as a global positioning system (GPS), and better tools were needed if accurate data were necessary. The audit led to confidence that the data in the database by and large reflected partners' work in the field. It was a worthwhile exercise which gave confidence to the GLCI regional team, the country programs, and even to partners themselves. For more comprehensive understanding of the data audit exercise, please read the Data Audit Exercise Appendix.

Prior the audit, discrepancies were observed between what was entered into the M&E system and what was reported to project management outside of the system. The audit helped to reconcile these differences and allowed the project management to ascertain the reasons that numbers did not match. The audit confirmed that all sites reported did indeed exist and there had actually been sites that had not been captured in the system because they were thought to be too small. However the number of farmers who actually benefitted from these seed was not insignificant enough. Those sites were subsequently accounted for in the system.

There were several other reasons why the numbers in the database did not match previous projections. First there were problems of drought. Some fields existed but died and so were not disseminated. Other sites were disseminated later than expected due to drought. Finally, since data collection was a new activity there was a learning curve for the partner staff to collect all the data in time and accurately. The data audit conducted however confirmed that multiplication and dissemination had actually taken place on scale and documentation was just then catching up.

Completion of GLCI M&E system

GLCI M&E system underwent several improvements and several seasons of data collection. Changes were made to the data collection tool, including shortening the Farmer Group Registration form, so that the project only collects essential information and reduced the time required to fill in the form. GLCI also revised the Multiplication form and added validation checks to increase data accuracy and eliminate errors including field size, GPS coordinates and number of cuttings planted. The Quality Management Protocol (QMP) form was revised and was about 90% faster to complete. The Dissemination Form was also redesigned in order to support several thousand beneficiary data points without affecting the speed of filling in the form. Three new forms were developed and added to the data collection tool: 1) Savings and Internal Lending Communities (SILC), 2) Farmer Group Deactivation (to track which groups are active and which are inactive and the reason for becoming inactive), and 3) Partner Mobility and Inventory. New reports were developed on the GLCI website for these forms.

A three-day training workshop was held in all countries from April-June 2011 to build on the experience and capacity of field staff and raise skills to a higher level while also starting to devolve responsibilities for data collection, monitoring and cleaning. Partner staff were trained to delete erroneous data, deactivate inactive farmer groups, review the dashboard and records, track data and use data reports.

Project staff cleaned common data errors and identified benchmarks for final data collection seasons. Following the training, data collection was initiated for January - July 2011 and the majority of the data was entered in the database. Please see the M&E Training Workshop Presentation Appendix for details.

Over the last year, the GLCI M&E system became more efficient in collecting data and generating analytical reports while the partner staff also became more proficient at operating computers and entering data. Forms were shortened and streamlined to ensure that the project only collected essential information, drastically reducing the time required to enter data. Quality checks and logical delineation were introduced in forms to increase data accuracy and eliminate errors in collecting data such as field size, GPS coordinates and number of cuttings planted. Three new forms were also developed and added to the data collection tool: 1) SILC, 2) Farmer Group Deactivation (to track which groups were active and which were inactive and the reason for becoming inactive), and 3) Partner Mobility and Inventory. Reports on the GLCI website were refined and rationalized to more effectively serve project information and reporting needs.

Broader measures were later put in place to support the complex GLCI electronic M&E system. Firstly, the partner staff were trained to delete erroneous data, deactivate inactive farmer groups, and review the dashboard and records, track data and use data reports. Secondly, GLCI engaged country, regional and global CRS information technology (IT) technicians to offer computer and software troubleshooting. Country level IT technicians provided hands on support like updating computers, cleaning viruses and installing programs. CRS regional and global IT teams used team viewer programs to remotely troubleshoot problems with data collection software. Thirdly, GLCI used Frontline SMS system to send messages to project staff on data collection schedules and alert them of approaching deadlines. This combination of training and support enabled project staff to collect quality data more efficiently, access the database, clean common data errors, generate country and partner level reports and use the reports to improve project implementation and management.

The strengths and weaknesses of the GLCI M&E system

As with all systems, there are a number of strengths and weaknesses associated with it. Below is a summary of the strengths and weaknesses of the GLCI M&E system.

1. Strengths

- Increased accuracy of information: GLCI data collection system drastically reduced the cascade in information exchange between farmers, field agents, partner staff and CRS country program managers. And information distortion can often be traced back to this long chain of information communication. With the centralized database, everyone had access to project information which minimized information distortion.
- Reduced labor: With the pencil-and-paper system, the project would be faced with a serious logistical nightmare including printing, distribution, collection, tallying and analysis. This was evident when the project digitized the data entered in paper before the system was introduced--15 data entry clerks were hired for three months to digitize about 500,000 beneficiary entries. With GLCI data collection tool, no printing, distribution, collection and tallying was needed.
- Increased data quality: GLCI data collection system built in quality checks and logical delineation to ensure data quality. In addition, forms could not be submitted without all the required information. Quality checks ensured that only relevant information was entered. Since data was almost real time, errors resulting from filling forms or project activities could quickly be noticed, their sources tracked, and corrections made.

- Reduced communication time. The time required to receive information from the field was drastically reduced with this direct data entry system. Connectivity permitted, data collection, entry, and report can all be completed in the same day. Reporting of up-to-date data to donors was also more accurate and timely.
- Increased capacity to handle large data: Computers have large capacity to store data without a lot of change in cost and logistics. Using paper, more data being collected means more paper, increased complex task of managing data and logistical costs and time needed to tally and analyze data.
- Data security: Data were managed by the CRS IT team who backed it up daily. This ensured that data were secure even for countries and partners who did not have this capacity.

2. Weaknesses

- Continuous human and resources support required: It required some considerable level of ICT skills to operate the system. Most field agents were first-time computer users who, even after intensive initial training, required ongoing support to effectively use the laptops. This was time consuming, requiring considerable resources and logistics for the continued support offered by the project. In addition, there were also high costs associated with the equipment, initial rollout, and training, not to mention the army of IT specialists who were involved in on-going designing, trouble-shooting, fine-tuning, and re-tooling the whole system. These stringent requirements made it not possible for other smaller, or less funded project, to replicate this system.
- Availability of power: The system relied on access to power to keep the laptop operational and to submit data. While CRS tried to supply partners with extra batteries and low-power consuming laptops, these did not prove to be effective or sufficient. Innovative ways of charging laptops by harnessing energy sources available would be necessary in the most remote places in Africa.
- Staff turnover: Staff turnover was high even prior to introduction of the mini-laptop and it became even higher as trained staff became more skilled and more desired by other projects. As they moved on to other institutions, GLCI faced with repeated challenges in training new staff from ground zero.

Overall, this novel electronic M&E system served GLCI well as it enabled the project to track the complex activities in a large scale with relative ease. GLCI might not have been able to have documented all 1.35 million beneficiaries, along with the details of the multiplication fields, farmer group activities, training, and etc. That said, such an undertaking required an army of experts, technicians, IT specialists, and consultants to design, implement, and maintain, which cannot be easily replicated by a project without the similar level of human and financial resources that GLCI was fortunate to be endowed with. Please see M&E Development Process and Evaluation Appendix for further details.

Part 2. The Assessment of the GLCI M&E System

This part of the chapter reports on the assessment and analysis of the GLCI M&E system. The assessment documented the evolution of the GLCI data collection tool, outlined the pros and cons of this system, and suggested the appropriate settings to consider designing such a complex system. Below presents the relevant part of the case study on the M&E System to this final report which pertains to the lessons learned and recommendations. To view the full report on the technical and ICT aspects of the M&E system, please refer to Case Study Appendix—M&E.

Lessons Learned	Recommendation
1. **Data collection not seen as a high priority and excuses given to not collect** A common problem in the beginning of the roll-out was that data was not collected and submitted and reasons given were because of non-existent electricity, Internet and IT problems.	Though there are definitely problems associated with lack of electricity, poor Internet connection, and IT issues (form filling or submitting errors and the server going down) these were often overstated and at times used as an excuse not to collect or submit data or as leverage to try and get more funding or equipment. We targeted each excuse one by one until finally field staff realized they could only provide valid reasons to not submit data. When people used electricity as an excuse to not collect data and we saw that most of them charged their phones we suggested that we would take back the laptops if they could not use them and they would have to use paper instead. (This may not always be the case, see the section below on electricity and internet for other recommendations when it is not the case.) All users who said they did not have electricity suddenly told us that they now had ways to charge their laptops. To address the lack of Internet we added an option on the data collection tool to export data and they could now send it to be loaded where Internet existed. We also provided memory sticks for this task. To address the issue of IT problems we started to use TeamViewer so that we could enter any problematic computer and determine what was wrong with it. On many occasions when we entered the computer no problems were found. We also added Frontline SMS and the help desk so that any technical problem could be reported immediately and so if it wasn't reported then there was no excuse to not submit data. We also strived to solve an issue within 2 days when an issue was reported with support from GKIM India and HQ to avoid frustration with the technology and also to avoid strengthening reasons not to submit. Finally, we instituted a performance based funding mechanism with data and a data audit as an indicator of performance to increase the seriousness and importance of M&E and data collection.
2. **M&E system initiated late** Because the M&E system was initiated 2 years after the project started there was a rushed rollout to catch-up with already running project activities; The project had to digitize old paper versions and load them into the system all of which incurred much higher costs, logistical problems, and frustration; There was not enough time for thorough testing on a small scale before roll-out;	Need to start to develop the M&E/ICT system from the beginning of the project otherwise huge costs and logistical problems may be incurred later to catch up. Thorough time should be set aside for testing before complete rollout and testers should understand that they are testing the system so there will inevitably be glitches. One should also make sure that the user interface is as final as possible before loading it onto all devices so that any updates are only made to forms and this can be done by connecting to the Internet without requiring a new installation of the tool directly on the device. This can be a very costly mistake if not taken into account.
3. **IT technical issues** There were several technical complications	There should be more oversight and thorough testing over the design of all data collection tools, databases and

Lessons Learned	Recommendation
due to incorrect coding, lack of thorough testing and also some resistance from IT support to thoroughly understand and address the issues immediately. This led to loss of some data, data quality and affected motivation and bred frustration in the field towards data collection and ICT.	coding. Also when a problem is reported it requires through investigation until a solution is found. If a solution can't be found immediately it should be raised to higher levels and a task force needs to be set up to trouble shoot it. Insisting that no problem exists and considering the issue closed cannot be a possibility.
4. **Lack of full access/control over database** Lack of independence and ability to manage, clean, query, load, and update data and relying on having this done remotely caused issues of efficiency and data quality; also having the remote server go down with a time difference between Africa and Baltimore and having to wait for it to be fixed is problematic and can also affect motivation in the field.	Every program needs to have full access to their database so that they can clean, load, query and manage their data. It is extremely inefficient, costly and prone to error to have this done through a second party. If data is housed centrally then there needs to be someone on 24 hour call for maintenance or the data should be served from a cloud where that 24 hour maintenance exists.
5. **Password registration process** A lengthy and complicated registration process was required by people who have minimal computer skills to get field staff access to the web based reports and database. At the time also permissions expired and had to be renewed in short periods of time. This caused delays in people using the system during training seminars which affected the training quality and also would affect overall web based reporting use.	An automated and simple password registration process should be developed that can be tailored to different project needs to avoid any complications or difficulties for people to quickly access reports and data.
6. Staff turnover In most countries there is a high staff turnover so once people are trained and have practice and experience in using the M&E / ICT system they move on to other jobs. This creates a challenge in getting new staff who newly come onto the job up to speed so that they can competently collect/submit data using the computers.	Develop a small training manual and within each partner office or country program and assign a person who can give a one-day training of trainers or every six months or so to new staff. They should team up for a week with an experienced staff member from their office after the training for practical experience and mentoring.
7. Unreliable power and internet connectivity Access to a reliable source of power and an internet connection is limited or non-existent in many of the remote areas in which GLCI operates, posing challenges to effective electronic data capture.	Before developing an M&E/ICT project an analysis of the electrical, telephone and Internet system should be made and mapped using GIS. Where internet, phone and electricity are needed one should ensure that at a minimum all partner offices have connectivity. Where possible, if Internet is not available but phone or cell lines exist that can handle data at a decent speed and cost mobile phone lines might be used. Field agents can also upload new data collection forms and update old ones from a memory stick and send data on a their stick. This data can be sent to partner offices who then send the data via internet. For severe and proven electricity issues consider voucher systems or solar chargers. Where only a few field agents do not have

Lessons Learned	Recommendation
	electricity, might explore using paper based forms while in the field and then having them loaded digitally once a month when they go to their home office. In a more severe case for emergencies one might set up a portable satellite antenna and use a generator for electricity.
8. Low level of computer skills Most field agents were first time computer users who, even after intensive initial training, require ongoing support to effectively use the laptops.	Train and support partner staff and as mentioned above under staff turnover have one or several designated trainer of trainers, a user's manual and mentoring.
9. Inadequate use of field IT support The field IT support system at the beginning of the project was inadequate so most IT issues had to be resolved by the regional office. People also didn't report problems in a timely manner and field agents did not make full use of the help desk or sms system to report issues. Not using the sms or helpdesk leads to the inability to track assistance and the trouble shooting instructions given.	Sensitize partners on using the help desk and Frontline SMS system to improve communication and trouble-shooting support. Incorporate ICT work into all CP IT staff's TOR's. Also have all CP IT staff able to use TeamViewer and train them if needed to manage the computers, re- image, install data collection tool, and report issues using the helpdesk– and to own the process.
10. Proliferation of viruses GLCI found that more than 60% of the laptops were infected, despite virus protection, from downloads from the internet and flash drives sharing. McAfee antivirus software was installed on all laptops, but was not updated by users or run. Each laptop was configured with two accounts; and Administrative Account and a User Account; This was done to help reduce the risk of virus and machine misuse. Users could not install new application, although they did have the ability to perform application updates for McAfee and Windows. However most users got access to the password for the Admin side and downloaded programs, music, videos, etc...from the Internet. Porn was also found on many computers.	Provide virus infection training and have CP IT staff regularly check and update virus scan and to do regular cleaning. It would be useful also to have an incentive and disincentive program to encourage clean computers. Re-image severely infected computers. If possible on any new device selected for use block the ability of users to download from the Internet and create permissions to access the usb port.
11. Hard disk misuse Misuse included storing large music or video files that filled the 30 gigabit disk capacity, loading incompatible programs or programs incompatible with Windows. This led to several computers crashing.	CP IT staff should regularly check and delete non-essential data and programs and penalize user if problem arises continuously. GLCI also advises users to buy external drives to store large non-work files to allow the operating system to function.
12. Cultural Change The initial introduction of computers into the field was met with resistance. It was found that some field officers preferred to print out the forms and then complete them with pen and paper. The justification for this, was they	Provide additional functionality to users so that the devices are attractive and they want to keep them. For example the mini-laptops give some level of prestige to the owners and they can use Internet and listen to music. Also, take time to demonstrate the advantages and cost savings of using a computerized system. For example it

Lessons Learned	Recommendation
required a physical copy to be stored. Resistance was also met by some CRS country and regional staff to the use of M&E /ICT. They preferred summary reports or the use of paper documentation.	can help boost their skills and improve their career path. A printing functionality was added to the GLCI data tool, to allow staff to keep hard copies within the regional offices instead of insisting that they had to collect only with paper for this purpose. One should also try to hire staff with some IT skills or at least have the interest to learn. It is also necessary to be committed to a long term vision. It will take time for attitudes and practices to change, but over time with experience, prolonged use and some level of positive re-enforcement to use the technology usage and the way ICT is seen does improve. An important element to this is that consistent messaging must be conveyed to the field from all CRS staff about the use of ICT. We must all be on the same page and give the same messages to others. If not, this can diminish the power of positive reinforcement and eventually stall the support for and use of the system. In an effort to build support within CRS for ICT high level advocacy should be carried out with clear examples of benefits and successes over other options given.
13. Version Upgrades Needed Revisions, additions and improvement of forms or to the system are required. Just like any technology new versions are always being introduced to improve on the old ones.	This should be expected and built into the program mentally, logistically and financially. Persistence and perseverance are required in the beginning when rolling out ICT especially when programs don't run perfectly. One should not give up but continue to improve. With time and experience systems will be of high integrity and quality. The update process and rollout is likely to need several iterations, ensure resources are planned for these tasks.

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Chapter 7. Gender

The gender and diversity situation analysis and audit

The gender component of the Great Lakes Cassava Initiative (GLCI) was incorporated at the end of the proposal design as requested by the Gates Foundation. GLCI then entered into an agreement with the Natural Resources Institute (NRI) to establish a gender learning alliance around the cassava value chain through GLCI and the NRI Cassava: Adding Value for Africa (C:AVA) projects. The main joint activities to be carried out in the GLCI/C:AVA gender learning alliance were the gender and diversity situation analysis and the gender and diversity audit. Costs would be shared between GLCI and NRI. With CRS having limited existing expertise and experience, it was agreed that NRI (with academic gender and diversity expertise) would take the lead and be responsible for the implementation of these activities, working in coordination with GLCI.

Tanzania and Uganda were common to GLCI and C:AVA project interventions. The context in which the studies in these two countries were conducted thus differed slightly from that of the other four GLCI countries. The gender and diversity studies in Tanzania and Uganda were conducted together with other C:AVA studies, after C:AVA decided to have them integrated with the start-up value chain analysis and scoping studies. With the process of the studies in these two countries underway in early 2009, the original intention of conducting the gender and diversity studies in all six GLCI countries was reactivated by NRI. For the gender and diversity studies in the remaining four GLCI countries (Burundi, the Democratic Republic of Congo (DRC), Kenya and Rwanda) GLCI contracted NRI as a consultant to lead the technical implementation of these studies. NRI had already developed a common methodology for the country studies and an analytical framework for cross-country comparison prior to C:AVA and the joint C:AVA/GLCI country studies. For the remaining four GLCI gender studies they backstopped the GLCI country program recruitment of national consultants to undertake the studies, introduced the methodologies and research tools to them during a training workshop (the GLCI and C:AVA gender learning workshop held in Nairobi, Kenya, 14 and 15 October 2009), and provided technical backstopping during data collection, analysis, the write-up of the reports and the drafting of the action plans. NRI also conducted the cross-country analysis and wrote the final report to submit to GLCI.

By the time all the reports had finally been received, the project was already at the stage of almost winding down its activities. There were some attempts, though somewhat ineffectively, at regional level to get the country programs to disseminate the report results, to conduct recommended training, or even to look into the possibility of integrating the results of gender analysis and audits into the project. The level of integration of gender into the overall project or the country programs varied, demonstrating varying levels of success in various aspects of this dissemination and integration process (Table 1).

The varied results among country programs led the project to conduct a study to examine the overall efficacy of the gender component of GLCI, with particular focus on the factors that accounted for the relative success in the countries where the country programs took the gender program further along than others. The study concluded the following factors that promoted or hindered the advancement of the gender component within GLCI and these considerations are relevant to any projects that plan to incorporate gender considerations into the overall project. For detailed understanding, please see the Gender Lessons Learned Appendix, or the Executive Summary Appendix.

Table 1. Conducting and disseminating gender and diversity studies among partners

Country	Were you consulted by the national consultants?		Did you receive a copy of the final report?		Did you read it?		Did GLCI discuss with you the findings of the report?		Did you share the report with others in your organization?	
	SA	AD	SA	AD	SA	AD	SA	AD	SA	AD
Burundi	No	No	No	No			No	No	No	
	No	No								
DRC		Yes		No				Yes		No
	Yes		No	No	No	No	Yes	No	Yes	No
Kenya		No	No	No	N/A		No	No		
	Yes	Yes	Yes,	Yes	Summary	Summary	Yes	Yes	Yes	Yes,
Rwanda	Yes	Yes	Yes	No	Summary	No	Yes	No	No	No
			No	No,		Yes		Yes		Yes
Tanzania	No	No	No	No	No	No	No	No	No	No
	No	No	No	No	No	No	No	No		N/A
Uganda	Yes	Yes	Yes	Yes	Summary	Summary	No	No	Yes	Yes
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

SA = Situation analysis, AD = Audit

Factors affecting success integration of gender component into the project

1. The role of a gender focal person

Apart from Burundi, the national consultants were all recruited from outside of CRS. A set up like this, where the gender and diversity studies were delegated to another (research) institution (that is, NRI) with its own personnel and consultants, carried with it the danger of becoming a project within a project, with no or little interaction during the execution of the studies that might create such problems as a report that was out of tune with the realities of the wider (development) project (i.e. GLCI). There were also issues of ownership and continuity after the reports had been handed over. The general lack of ownership, follow up, and continuity of gender and diversity within GLCI prompted the reflection on the interaction between the gender and diversity component and the GLCI project during the process of the studies and how this related to the follow-up, or lack thereof, of the studies and the impact on the objectives of the project when GLCI took ownership of the gender and diversity component again.

Upon examining the follow-on activities, it was clear that only one country program (Burundi) out of the six countries systematically disseminated and followed up the gender and diversity studies in the sense that concrete activities that had been planned for to address the recommendations of the studies were effectively implemented, and that a concrete impact in field activities and in the workplace was observed. Apart from Burundi, only GLCI Rwanda had expressed an intention to implement any activity.

Burundi and Rwanda shared two characteristics that set them apart from the other four countries. These characteristics held the key to the best practices of these two country programs and they were the factors to success. The most important factor of this success was the active gender focal person who was also the GLCI country program manager (CPM). Both Burundi and Rwanda had a gender officer and GLCI CPM that actively participated during the whole process of the gender and diversity studies. In Burundi, it was the existing gender program officer who was recruited as a consultant to conduct the situation analysis who later became the CPM. In the other countries, the participation of the gender focal point either waned as the studies progressed (Kenya), the gender focal point and the CPM had

since left CRS (Uganda), or the CRS country programs did not (yet) have a gender point person (DRC and Tanzania). In Kenya, DRC, and Tanzania the participation of the CPM in the gender and diversity exercise was limited to logistical organization of the national consultant's fieldwork, with little intellectual participation in the whole exercise.

The divergent experiences of Burundi and Rwanda as compared to the other countries suggested that, if a gender focal point does not exist in the country program, this position should be created, whether the gender docket is an added or a core responsibility. And, the active participation of the gender focal point *and* the CPM should be systematically and clearly built in during the process of the gender and diversity studies (preparation, fieldwork, analysis, and writing) to encourage gender awareness, capacity building, learning, ownership and continuity of the gender and diversity studies. The gender officer should take the place and responsibilities of the externally recruited national consultant to carry out the study. The gender officer's permanent employment in the institute would then ensure follow-up and implementation after the studies. Otherwise, the studies tend to fall by the wayside, as was the case with all the countries, except Burundi, and became an end in themselves without serving any real advancement of gender considerations.

2. Timing of the study

There was a general consensus amongst those who had any involvement in the gender studies or should have used the studies to implement any gender strategies that the gender and diversity studies came too late in the project cycle to make meaningful changes as regards gender and diversity in the workplace and in project activities. In fact, from documentation it became clear that the studies were precisely planned as an early project activity to enable timely gender and diversity mainstreaming over the project cycle, yet most reports were delivered in the course of the third project year. There were four contributing factors to the late timing of the studies and reports: different project start-up times between C:AVA and GLCI, late appointment of a regional point person, gender relegated as low priority, and the national consultants' lack of ability in analysis and reporting.

Different project start-up times: Given the different starting dates of the C:AVA and GLCI projects (C:AVA started work in April 2008 and GLCI in December 2007), the staggered C:AVA implementation strategy and especially the decision of C:AVA to hold their gender and diversity studies integral to other start-up and scoping studies the gender studies were held sequentially rather than simultaneously. By the time the Uganda and Tanzania projects were started it was already early 2009.

Late appointment of a regional point person: For a long time in the GLCI regional office, it was unclear whose responsibility it was to coordinate and communicate with NRI and drive the GLCI gender and diversity component. Thus, GLCI did not press for the studies to get started earlier and all activity and initiative laid with NRI such as reactivating the gender component and unilaterally changing implementation strategies in the joint C:AVA/GLCI countries that ultimately affected the timing of the studies in the GLCI project. Initially, intermittent communication with NRI was through the project director at the time. At these occasions NRI insisted on the need of a contact person but efforts by GLCI to find a gender focal point failed. When the GLCI deputy project director eventually was appointed the contact person for the gender studies, both sides agreed that communication and coordination was good from this point on, but the studies had already suffered delays.

Gender considered a low priority: Along with the start of the GLCI project came a lot of work that focused on the main activities of the project. Gender in this early phase was not a priority and simply slipped to the background, contributing to the delay of the gender component in the project.

National consultants' lack of ability: The delays in report submissions could also be attributed to some national consultants' inexperience in analysis and writing. In these cases NRI had to step in and contributed in analysis and editing, rewriting and writing sections to ensure quality reporting. Also, NRI indicated that in hindsight the amount of work of conducting two studies (i.e. the situation analysis and the audit) at once was seriously underestimated, creating unforeseen reporting delays.

3. Need for user-friendly reports

Although the reports were forwarded to all country programs to be read and shared with partners, only a small percentage of partner staff received a copy, and few of who actually read the reports, as most, at best, skimmed the reports and/or read the summaries, or did not read at all (Table 1). One factor that discouraged people from reading the reports was the length of the reports that in most cases exceeded 40 pages, as much as 75 pages. Such long reports do not encourage reading and in fact most GLCI staff only browsed the report or read the summary. This was the same with the partner staff who actually received the reports (while most others never even received them), few actually thoroughly read both reports. Considering the time and money invested in the studies and preparing these reports, it was a waste to have the messages lost because hardly anyone bothered to read them. Imposing and enforcing page limits, plus an executive summary, on such reports in order to ensure concise and useful reporting would have made these reports more user-friendly and readable. should also be required to make these reports more useful to

4. Funding

Almost all country programs mentioned that there was lack of funds specifically allocated to gender to undertake follow-up activities. As there was no original budget for gender-related activities, the regional team had advised the countries to combine or integrate gender activities with other activities to reduce costs. Though the Burundi and Rwanda experiences demonstrated that lack of funding need not be an impediment to implement activities; nevertheless, funding specifically targeted for gender and diversity activities would have contributed to increased gender activity after the studies.

5. Workload allocation

Country programs stated that they were faced with too much competing work, especially towards the end of the project cycle, when the studies finally came out to guide the gender strategy, to be able to address gender and diversity. The study made clear that gender needs to be an integral part of the project and be made as an equal component as the rest of the technical aspects of the project, as it tends to fall on the wayside if it was perceived as an add-on, or after thought as it was no doubt perceived in the case of GLCI.

6. Incentives or guidance

Related to the point above, gender and diversity was perceived not a priority in the GLCI project as the regional office did not offer sufficient guidance or stimulation to tackle gender and diversity after the studies. This view was further reinforced as the partners observed that "gender" did not belong to the five project objectives, which were clearly the priorities of the project, without knowing that it is housed in the planning and partnership objective. Some country programs and partners explained that it didn't perceive any stimulation/inspiration and guidance from the regional office to tackle gender after the

studies. Another country indicated that there was a lack of a gender policy at higher CRS institutional levels to guide gender mainstreaming in its projects.

Summary and Conclusions

Overall, GLCI achieved the following in the gender component:

- Completed gender and diversity analyses for all six countries.
- Completed gender audit for all six countries.

GLCI had limited success in implementing gender integration:

- Only few partners received the reports, and most of them did not read them.
- Only Burundi and Rwanda conducted some gender training events.
- All the partners now have initial awareness of the significance of incorporating gender into overall project objectives and activities.

The main reason for the limited success was because gender was not one of the main objectives of the project, and this resulted in the following constraints:

- Late appointment of a focal person on project level, which caused the following problems:
  - Delayed start of the study
  - Delayed report
  - Lack of guidance to the partners
- No focal person on country level
- Perceived by all levels of staff as a low priority
- No funding specifically allocated for any gender-related activities

The lesson learned and recommendations for integrating gender into the overall project are:

- Incorporating gender from the proposal stage.
  - Setting gender as a main component, along with other components of the project
  - Allocate funds for gender-related activities
  - Ensure baseline gender studies are conducted at the onset of the project
- If not a specific gender specialist, at least appoint a gender focal person to take charge from the onset of the project.
- The gender analysis and audit should not be done by outside consultants in total isolation of the project personnel. Even if it the studies are led by consultants, project personnel must be an integral part of the study and participate fully in the studies.
- Recruit qualified gender specialist as consultants which would serve the following purposes:
  - Good quality study and particularly reports with usable information and executable recommendations
  - Mentoring the project personnel during the process of studies