Feed the Future: Knowledge-Driven Agricultural Development

Evidence Base for Collaborating, Learning, and Adapting

Final Report | Grant number KDAD-16-0004

Strategies for Measuring the Impact of CLA on Development Outcomes: A Case Study in Uganda

March 2018

USAID FROM THE AMERICAN PEOPLE

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Acknowledgements

This final report and analysis was prepared for the QED group for its Evidence Based for Collaborating, Learning, and Adapting (EB4CLA) grant to The Global Knowledge Initiative under USAID's Knowledge-Driven Agricultural Development (KDAD) project. The co-authors of this report are Global Knowledge Initiative's Manmeet Mehta and Causal Design's Keith B. Ives, with support from Cait Goddard, Renee Vuillaume, and Sara Farley from The Global Knowledge Initiative.

We would like to acknowledge the expertise and insightful contributions of Dexis Consulting Group, CLAIM working group, and the LEARN network.

Table of Contents

Abstract

Motivation

The Global Knowledge Initiative (GKI) asserts that recognition and rapid responses to the complex range of systemic influences on any program creates opportunities for impactful collaboration, supports identification of needed resources, and advances or minimizes barriers to program outcomes. This assertion is core to GKI's approach to Collaborating, Learning, and Adapting (CLA and the Theory of Change proposed for the Evidence Base for Collaborating, Learning and Adapting (EB4CLA) project. To apply this approach, the GKI team focused on Uganda.

Historically, banana has been one of the most grown, eaten, and exported crops in Uganda (UBOS 2011). Beneficial for reducing malnutrition while boosting farmer income, banana production has declined more than 80% over the past 20 years due to disease and climatic challenges (FAO 2011). Against this backdrop, biotechnology innovations provide potential solutions. BioCrops Uganda Pvt. Ltd uses tissue culture technology to produce nutritionally rich planting materials for farmers and radically increase the availability of planting material for banana that is not affected by the diseases that have harmed the industry. GKI and BioCrops collaborated to implement pilot GKI's approach to CLA and track the impact on program outcomes.

Methods

GKI notes that BioCrops, operating in the complex Ugandan agricultural innnovation systems was influenced by a number of elements in the system (enabling environment, actors, and the linkages between them. These systems elements influenced private research, development, marketing, distribution, and other business-related activities pertinent to BioCrops' operations and growth.

GKI's initial approach to evaluating the impact of CLA on BioCrops' development outcomes focused on econometric methods for estimating the impacts of GKI actions and adaptations on BioCrops outcomes[1] (improved production efficiency, staff retention, firm expansion, revenue). However, as the project unfolded, there was concern that there were too many covariates - or variations in implementation - to appropriately model using traditional impact evaluation techniques. At this point, the research team at GKI shifted to understanding GKI's highly adaptive engagement process as an optimization problem.

[1] These are the outcomes for BioCrops as a firm. However, our theory of change links these – with evidence – to increasing

Key Findings

GKI's experience with BioCrops in Uganda revealed a range of factors influencing an organization's ability to practice CLA, including the value of in-person engagement with implementing partners, incentives for adoption and practice, organizational resource constraints, and the need for an innovation focused open mindset ready to grapple with complexity and adapt as needed. Tools like the CLA Maturity Matrix create an assessment of client/partner readiness to practice CLA. GKI's experience suggests that these can be a powerful starting point to determine the right partner for experimentation on the effectiveness of CLA processes in action.

In addition, our findings and reflections from this project indicate that for expanding the practice of CLA and building an evidence base to track its impact on development outcomes requires an investment in building newer mindsets, integrating failure as an adaptive action, designing experiments allowing for longer timelines, and an unflagging commitment by funders and implementers to simplify systems-driven insights to facilitate informed and effective adapation in a complex development context.

Introduction and Motivations

A Position Paper by the United Nations Industrial Development Organization (UNIDO) on Innovation Systems for Development states:

In the face of the opportunities presented by globalization, and the multiple challenges arising from poverty and resource scarcity, the ability to innovate relates not just to the ability to survive but the ability to thrive. Innovation lies at the heart of peoples', firms', sectors', and countries' ability to cope with change (Farley et al, 2007).

The challenges confronting the world today are complex and multi-sectoral. Whether we are talking about mitigating climate change, ensuring food security, generating income for millions of unemployed youth, or any of a number of other grand challenges - solving these problems demands linkages across sectors and connecting diverse domains of knowledge that typically exist within silos, such as agronomy, biology, architecture, mechanical engineering, or zoology. Collaborative Innovation is an approach that seeks to overcome these challenges by fueling networks that bring together diverse problem-solvers to align resources and create partnerships toward shared goals. Collaborative Innovation is thus defined as "the creation of a good, service, or process using the shared knowledge, resources, and capacity of partners who seek to solve problems that are beyond the capability of an individual partner" (GKI 2012).

The capacity to creatively problem-solve depends not only on individual institutions' abilities to participate in innovation activities, but also on "the degree to which these institutions collaborate, partner, and link to generate, adapt, use, and diffuse innovations" (Farley et al, 2007). Taking an innovation systems approach allows problem-solvers to consider the array of actors, functions, and interactions required to achieve innovation that delivers meaningful outputs: solutions to development challenges, new jobs, and increased livelihoods. Figure 1 illustrates a simple innovation system and the numerous interactions that define it. This implies the need for an organization to adapt its activities, strategies and collaborations in response to changing systems dynamics. A June 2016 World Bank study found that good-quality

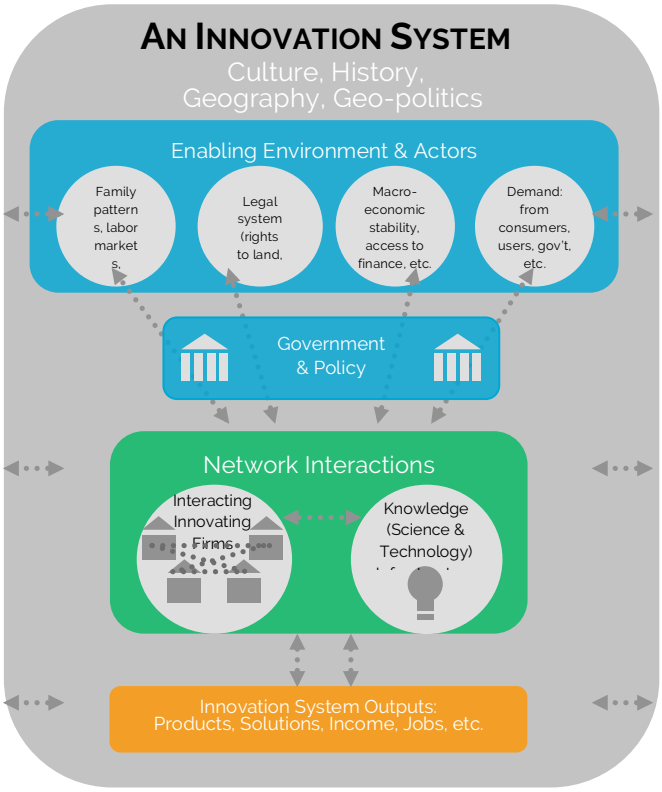


Figure 1: Global Knowledge Initiative, 2012

monitoring and evaluation (M&E) that informs decisions during and after implementation is positively and significantly associated with project outcomes.

The QED Group, LLC, (QED) through its subcontract with Insight Systems Corporation (Insight) under the United States Agency for International Development (USAID)-funded contract Feed the Future Knowledge-Driven Agricultural Development (KDAD) Project provided Grants Under Contract to provide assistance for the program entitled "Collaborating, Learning, and Adapting (CLA)".

The Global Knowledge Initiative (GKI) and its research partner Causal Design were awarded a grant from QED under the KDAD contract to partner and participate in USAID's Bureau of Policy, Planning and Learning's (PPL) "Learning Network" and engage in a co-creation process to collaboratively advance the understanding of how to measure and demonstrate the effects and potential impact of investments in CLA. Specifically, the goal of the grant was to advance approaches to answering the following questions:

- Does an intentional, systematic and resourced approach to collaborating, learning and adapting impact development outcomes?
- If so, how? And under what conditions?

GKI's approach to Collaboration, Learning, and Adaptation (CLA) focuses on how systemic influences affect organizations. The goal is to "Better understand, measure, assess, and demonstrate the results, contributions, and potential impact of time and material investments in strategic collaboration, program and organizational learning, and adaptive management, in service of improved development outcomes." In this effort, GKI is collaborating with a Uganda-based organization, BioCrops Uganda Limited, to apply the CLA Framework under the EB4CLA grant. As shared in the previous section, founded by David Talengera, John Bananuka, and Dr. Geofrey Arinaitwe, BioCrops provides access to quality banana planting materials, a staple crop in Uganda, as well as quality materials for other critical crops such as sweet potatoes and cassava. With bacterial wilt disease destroying up to 80% of Ugandan staples, food security remains one of Uganda's most pressing challenges. To fight the spread of disease, BioCrops uses plant tissue culture technology, a method where plantlets are produced from the roots, leaves, and stems of disease-free plants in a sterile lab. Plantlets are then transferred to different parts of the country to be distributed to farmers to plant in the field. These high-quality planting materials derived through tissue culture offer a solution to bacterial wilt, as they are pest- and disease-resistant, and enhanced with iron and vitamin A nutrients.

Background and Program Overview: GKI's Approach

Under the aegis of the "Evidence Base for Collaborating, Learning, and Adaptation (EB4CLA)" project, GKI aims to better understand, measure, assess, and demonstrate the potential impact of the following on improved outcomes:

1. Strategic Collaboration
2. Program and Organizational Learning
3. Adaptive Management

To do this, GKI developed a Theory of Change (Figure 2) that asserts that applying insights from stakeholders, context, and systems to make (sometimes substantial) changes to a project's approach and/ or activities will lead to improved results within the timespan of the project. It will fuel more effective innovation, and increase the resilience of organizations.

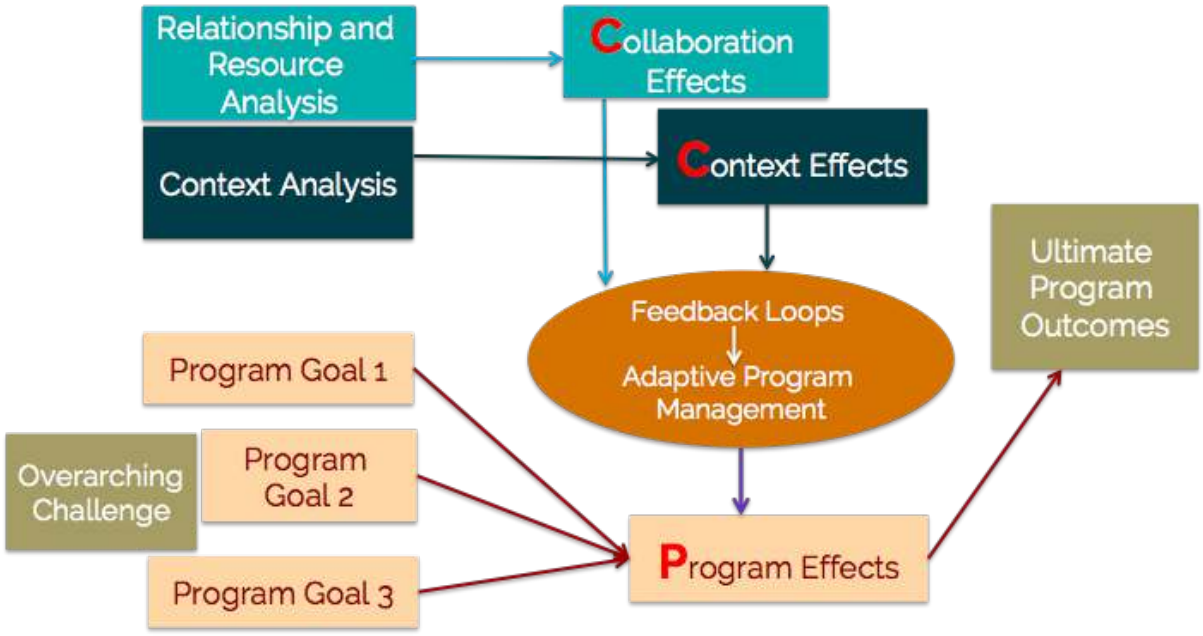


Figure 2: Theory of Change: Collaboration (C), Context (C), and Program(P) Effects on Program/Development Outcomes

In general, this approach focuses on how systemic influences effectively support or hinder the work of organizations working to solve social challenges. The GKI team developed the Context-Collaboration-Program (CCP) Framework to operationalize this approach. It focuses on understanding and applying insights on the three parameters that correspond with the CCP Framework (Figure 2). GKI worked with BioCrops to assist them in adapting to the change captured in this framework emerging from the constantly-evolving and complex Agricultural Innovation system to more effectively their growth goals. This framework has the potential to aid USAID and its network of collaborators—stakeholders that have identified areas of shared interest and who are working together—to better understand how

to measure the impacts of increased awareness of the context within which they operate, and collaboration with actors within a system.

In demonstrating the utility of its CCP framework, GKI collaborated with BioCrops to apply the CLA Framework under this EB4CLA grant. GKI's approach, reflecting the Theory of Change illustrated above, relied on an ongoing analysis of the Context in which BioCrops is operating (the Ugandan Agricultural Innovation System) and an analysis to identify collaboration and resource needs to accomplish the program goals articulated by BioCrops. The GKI team initially relied on desk research and interviews to analyze the Agricultural Innovation system and then validated the analysis and findings through in-person interviews and co-working sessions with the BioCrops leadership team and staff.

Collaboratively, GKI and BioCrops priorized 12 factors of the Ugandan Agricultural Innovation System that either enabled or impeded the ability of BioCrops to accomplish their goals. Of the 12 systems factors, 7 factors were identified as negatively impacting the ability of BioCrops to accomplish their goals, which are referred to as "Barriers". Conversely, the 5 factors identified as contributing to their success are referred to as "Enablers". The detailed systems analysis was included in GKI's Baseline report submitted to the Knowledge Driven Agriculture Development Project (KDAD). For quick reference, the 12 prioritized Enablers and Barriers are listed below:

Enablers:

E1. Support from national and international tissue culture researchers
E2. Government support for biotechnology and agriculture
E3. Increasing access to new markets and value chains within Uganda
E4. Growing availability of educated workers in Uganda alongside improvement in technology used in tissue culture
E5. Increasing access to new export markets and new forms of biotechnology (including genetically modified crops)

Barriers:

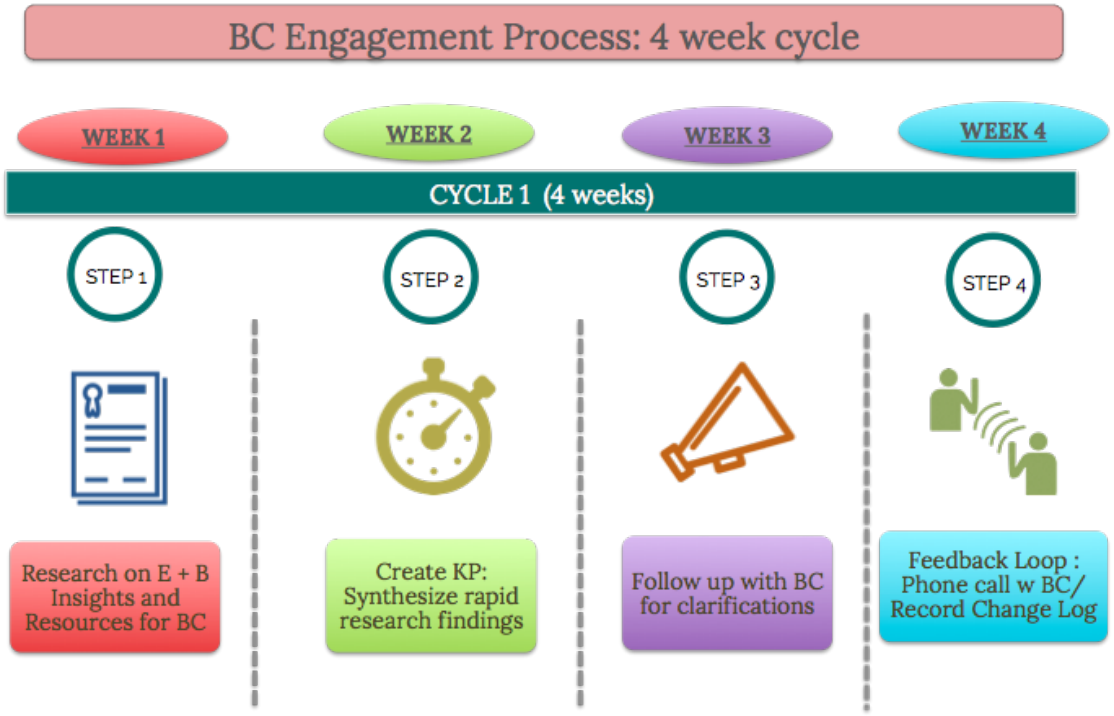
B1. Challenges in growing the export markets for farmers who grow TC bananas
B2. Difficulty retaining skilled workers
B3. Lack of awareness or mistrust of TC
B4. Banana is not a cash crop in Uganda
B5. Difficulty transporting banana plantlets with current infrastructure
B6. Advanced technology is required to maintain a tissue culture lab and Continued research required to optimize this technology
B7. Developing leadership and management skills pertinent to growth in TC industry

CCP Framework in Action

In January 2017, in coordination and with feedback from BioCrops, GKI designed a repeating four-week engagement process and feedback mechanism to continually research, analyze

and share updates on the 12 system variables outlined above. This feedback cycle (Figure 3) was then launched in February 2017.

Figure 3: Operations and Research Cycle



GKI refers to each four-week cycle as a "Research Round", and the insights offered to BioCrops as "Knowledge Products" (KPs). By receiving regular insights to inform decision-making – operational as well as strategic – informed by GKI's Theory of Change that BioCrops will be better positioned to take the necessary steps to adapt their activities, partnerships, and resource mobilization and deployment plans.

The GKI team recorded the Knowledge Products, BioCrops' feedback and related decisions in a "Change Log", also referred to as "Network Dashboard". The engagement process with BioCrops incorporated regular feedback loops, allowing GKI to reflect on BioCrops' feedback, assess the relevance and effectiveness of the Knowledge

Operationalizing GKI's Theory of Change

The proposed engagement process reflects GKI's theory of change. The theory is two-fold.

First, GKI provides insights from the context and other stakeholders to BioCrops in the form of research papers, insights into policy shifts, market opportunities, collaboration opportunities, introductions or events. Application of these insights allow BIoCrops to leverage emerging opportunities and remove barriers for BioCrops, thereby enhancing their business (staff retention, firm expansion, and revenue) and in turn food security in Uganda.

Second, we theorize that GKI's adaptive management – or dynamically updating management approach – will maximize product use, and subsequently improve these BioCrop's outcomes.

Products, and related adaptive actions by BioCrops. The reflection and learning from this feedback allowed GKI to adapt its own research approach and management.

Logical/Results Framework

This project constructed a logical framework to understand if and where GKI's Theory of Change is confirmed, The team intended to measure the program's performance by measuring results at every stage from inputs through outcomes. In addition, these performance indicators would be leveraged for mapping and analyzing the most successful pathways to impact. The blue pathways (Context, Program, and Collaboration) expand upon the first aspect of our Theory of change; the green row sequences the second.

Figure 4: Logical Framework

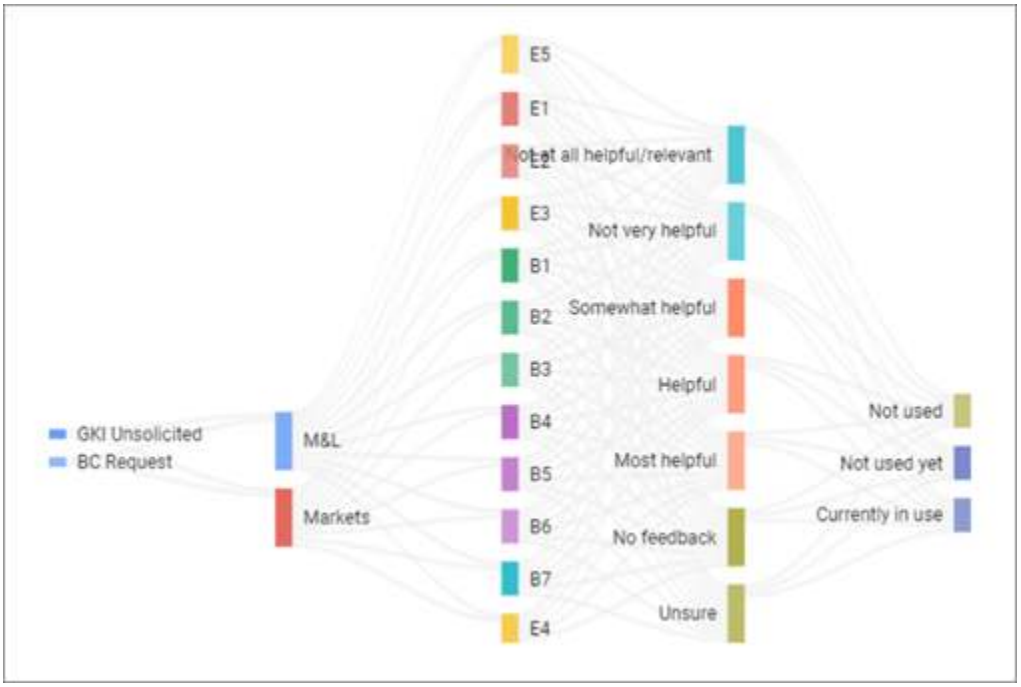
	Inputs		Activities		Output (Immediate)		Outcome (Intermediate)		Impact on Dev. Outcomes	
	Inputs	**Indicator**	**Activities**	**Indicator**	**Output**	**Indicator**	**Outcome**	**Indicator**	**Outcome**	**Indicator**
Context →	**GKI Resources**	Man-Hours Money Spent Materials Used	**Identify Context/Need Through Baseline** **Create Request System**	Count of Requests Received	**Update in Context**	Change of Barriers Change of Enablers	**Decision makers learn to analyze systems and apply systems insights to make better decisions**	Staff Surveys	**Improves Program Outcomes (Food Security)**	Products Delivered to New Markets
Program →			**Create Knowledge Products**	Research Conducted Knowledge Products Created	**Products Delivered**	Emails Sent Memos Written Phone conversations	**BC Change in Operations/ Actions**	Operational Changes Made Change in Inputs/Outputs Used		Improved Distribution Channels
Collaboration →			**Create Network Products**	Networks Explored or Identified	**Products Delivered**	Introductions Brokered	**Improved Team Effectiveness**	Staff Surveys		Leadership and Management Skills
Feedback Loops →	**GKI & BC Resources**	Man-Hours Money Spent Materials Used	**Collect Feedback (Pause & Reflect)**	Amount of Feedback Received	**Adaptive Management**	Changes in GKI CCP Products	**Improved GKI Products/ Service Delivery**	Product Value; Product Use		Staff Retention

Plan of Research: Measurement Strategies

Our initial approach to evaluating the impact of CLA on development outcomes was focused on econometric methods for estimating the impacts of GKI actions and adaptations on BioCrops outcomes[2] (staff retention, firm expansion, revenue). However, as the project rolled out, there was concern that there were too many covariates - or variations in adoptions and implementation of KPs, including slow or no responses from BioCrops to appropriately model using traditional impact evaluation techniques. At this point, the GKI research team shifted to understanding its highly adaptive engagement process as an optimization problem.

Intuitively, optimization is an effort to find the best solution out of many of the possible approaches to solving a problem. In an system, it is the process of seeking the most efficient (from an input perspective) way to accomplish your task or goals[3]. This process has inspiration from early Greek mathematicians such as, Euclid and Zenedorous, but was furthered in the 17th and 18th centuries as calculus and least squares methods were developed. By the 20th century, optimization was an area of study of its own. As computers were introduced, optimization algorithms become commonplace and multidisciplinary; today we see optimization used in engineering, science, economics, and even the way ads are presented to us while browsing online.

Figure 5: Knowledge Product Process Map



[2] These are the outcomes for BioCrops as a firm. However, our theory of change links these – with evidence – to increasing food security and in turn other more traditional development outcomes.

[3] Arora, R. K. (2015-05-06). Optimization : algorithms and applications. CRC Press.

Using these data points, we approached the challenge of getting BioCrops to use the Knowledge Product as an Optimization problem. We start with an assumption for the probability of success (Using a Knowledge Product) at each decision node. For example, KPs that BioCrops requests were more likely to be used than unsolicited materials sent by GKI. Everytime a product is delivered and feedback is received, the GKI team used that data to update its assumptions and map out the product delivery paths with the highest likelihood of use/ adoption. This strategy implied that GKI adapt their operations to provide support to BioCrops in the way that is most likely to result in product use/adoption.

Measuring Success: an Optimization Approach

GKI addressed optimization through multiple approaches, using both a Bayesian approach to conditional probabilities and process mapping of positive deviance, elaborated below. In the first stage of research, we leveraged these two methods to use evidence-based adaptive management (optimization) to improve the impact of GKI's work with BioCrops.

In the Stage II, we engaged[4] in a meta-analysis of those operational changes over time to allow us to understand the impact of CLA on development outcomes[5].

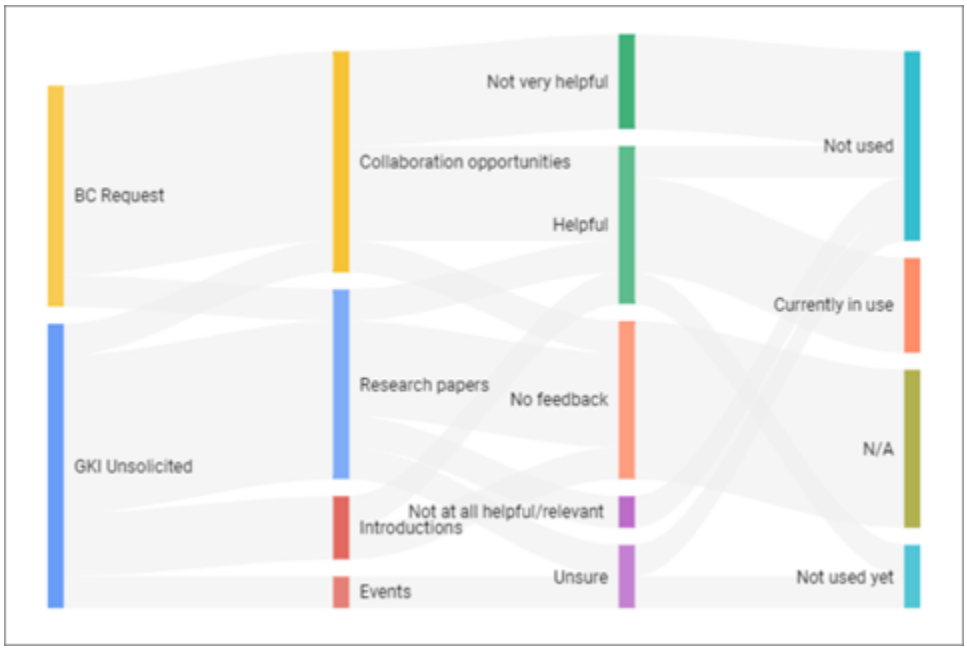
Stage I: Quantitative Optimization Through Conditional Probabilities

Bayesian Decision Theory is a statistical approach to pattern classification, wherein information from the data is dynamically integrated to convey conditional probabilities. In this case, preliminary information about certain decisions made by GKI – for instance, the type and content of Knowledge Products sent – was used to assess the probability that the product is a "success," or in this case, perceived to be helpful and subsequently used. These pathways are graphically depicted using Sankey charts (below), which illustrate the flow each Knowledge Product through this process. The width of the bars, or flow rates, represent the quantity of products that followed a specific route.. Figure 6 illustrates this process using the *format* of Knowledge Product presented – whether it was a collaboration opportunity, research paper, introduction, market opportunity, or event.

[4] As noted later, multiple rounds of research were not successfully completed due to non-participation by BioCrops. This prevented the meta-analysis from being conducted.

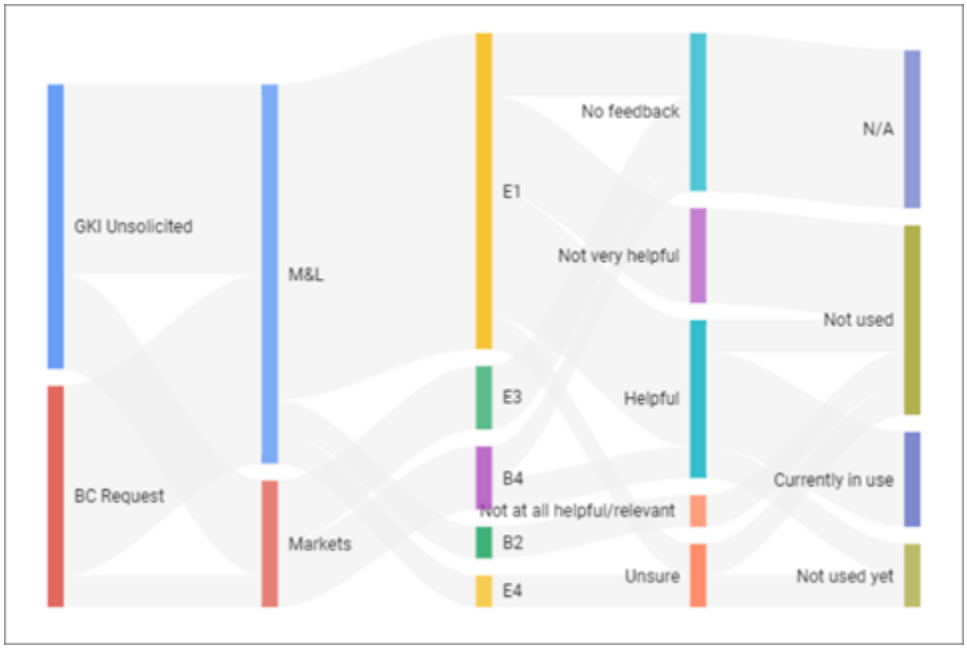
[5] Here we make a giant leap in our theory of change from output to development outcomes. This is likely the closest proxy for development outcomes we will be able to observe in this project. However, these methods could be applied in other studies where the development outcomes were observable and measurable.

Figure 6: Sankey Chart by Knowledge Product Format



An alternative pathmap, Figure 7, instead, sorts products according to the *content*, By this, we mean which original enabler or barrier (E1-5; B1-7) the Knowledge Product aimed to address. The figure below only displays 5 of the 12 Es & Bs, as products were not delivered for every content area.

Figure 7: Sankey Chart by Knowledge Product Content[6]



[6] M&L refers to "Management and Leadership" and Markets to "Accessing New Markets". BioCrops grouped the 12 Enablers and Barriers into these two organizational priorities.

While the second Sankey Chart gives a conceptual and descriptive example of the process of optimization, our final mathematical model was restricted to testing the pathways illustrated in Figure 5. The variables tested are below:

- Initiation Source (Solicited by BioCrops, Yes/No)
- Challenge Area (Leadership or Market Access)
- Knowledge Product Type (Collaborations, Introductions; Research)
- Knowledge Product Quality Assessment by BioCrops

Results

Using the conditional probabilities (see Annex 1) we identify four main takeaways from quantitative optimization:

1) Knowledge Products are always reported as useful given that they are also used by BioCrops. While this seems incredibly simple and intuitive, it does help confirm our assumption on the correlation between perceived quality and adoption rates.
2) Knowledge Products are more likely to receive feedback (from BioCrops) and/or be reported as helpful given that the Knowledge Product was not solicited. This finding is more surprising - if not counterintuitive.
3) Knowledge Products focused on collaborations consistently have high likelihood of receiving feedback or being reported as helpful. This finding encourages an operational shift by GKI towards more *Collaboration* products.
4) *Research* focused Knowledge Products only receive feedback 50% of the time, none are them are currently in use, and these products are only reported as helpful 16.7% of the time.

These results from the first rounds or GKI's engagement with BioCrops encouraged a shift in programming to focus on *Collaboration* products, stop providing *Research* products, and continue to support BioCrops with Knowledge Products - even when unsolicited.

Limitations:

Unfortunately, we were unable to run multiple iterations of the quantitative model. After the two rounds of data (analyzed together above), BioCrops did not provide feedback on any further Knowledge Products. This initial dataset consisted of 16 Knowledge Products; 5 of which had no response values from BioCrops. Because of this, not all possible calculations were possible or informative.

In general, the dataset is limited and thus, unreliable. The rate of feedback we received was heavily biased by the in-person data collection. This means that feedback is more strongly correlated with in-person visits than it is the content of the Knowledge Product. For example, our results show that unsolicited Knowledge Products are the most likely to get feedback from BioCrops. However, the initial rounds of research had a lot of unsolicited

products as the project was just starting and BioCrops had not requested anything specific yet. In turn, the field trip followed the delivery of the products - creating the relationship between unsolicited products and response rates.

The subsequent lack of feedback for rounds 3 and 4 meant we had less data than expected, more time lag between Engagement Cycles and finally an inability to complete multiple engagement cycles. Without multiple engagement cycles this method cannot provide insight on the potential impact of the Knowledge Products used.

Stage I: Qualitative Optimization Through Process and Positive Deviance Mapping

Positive deviance is a qualitative method used to evaluate change ex poste. By examining positive outliers – individuals or groups that have reached optimal outcomes – it seeks to identify the conditions and strategies that have led to those outcomes. Intuitively, you seek out an example of success and then investigate the factors that may have contributed to the positive outcome. This backwards mapping starts from the right side (end) of the pathways mapped and Figures 6 & 7 and works backwards to contextualize their success.

In applying the positive deviance approach to the current project, two indicators were used to assess the products that were "successful" relative to the others: 1) ratings on the perceived helpfulness of the products and 2) whether the products were used.

Results

Of all 16 Knowledge Products sent to BioCrops, three were rated as helpful and were reportedly used. As the positively deviant products, we can trace the previous decisions that led to these outcomes. Four out of five Knowledge Products that were rated as helpful corresponded to Enabler 1, or "Support from national and international tissue culture researchers."

Of those products that were helpful and used, two were requested from BioCrops and one was sent without solicitation. One product – a research paper that was sent unsolicited - was deemed "not at all helpful/relevant to our work," corresponding to Barrier 2, or "difficulty retaining skilled workers."

Stage II: Measuring the Impact of Learning and Adaptive Management

To hone in on the impact of adaptive management, we hoped to look at increases in outcomes relative to operational changes (adaptation) between research cycles. The intention was to examine net change in outcomes (staff retention, firm expansion, and revenue) and look for a correlation with the rate of adaptation from the previous round. Ideally, marginal shifts in these development outcomes could thus be attributed to GKI's adaptive management. However, as noted in other sections we were unable to get adequate data and successfully implement the program over multiple rounds.

While this was a severe limitation in to the success of the intervention in this context, we believe it still provides a strong case study on the potential application of these tools in other development contexts where one seeks to understand the effect of CLA on development outcomes.

Data Sources and Details on Measuring CLA

GKI identified and shared 16 Knowledge Products with BioCrops across three Research Rounds, seeking and logging detailed feedback and responses from BioCrops on these products

The 12 systems factors (E1-5; B1-7) prioritized in collaboration with the BioCrops team informed the development of these Knowledge Products. These Knowledge Products shared included strategies for developing talent at BioCrops, new policy regulation, information on accessing new markets in East Africa, summarized analysis of knowledge resources in response to needs expressed by BioCrops, and introductions to potential collaborators, buyers,, and funders.

At the conclusion of each Research Round, GKI requested feedback on the relevancy and value of each Knowledge Product. The engagement process was designed to apply this feedback to facilitate GKI's adapt and provide additional and increasingly relevant feedback in the the next cycle of research to better suit BioCrops needs. GKI hoped that by providing relevant and compelling Knowledge Products it would create an incentive for BioCrops to apply this information to their current activities and operations. GKI recognizes, however, that mere access to high-value information is not sufficient to result in its application. Thus, GKI must employ a flexible and responsive engagement process with BioCrops, and seek feedback on BioCrops' changing research needs, communication preferences, and organizational priorities.

These products, responses, and adaptive actions were recorded by GKI in the "Change Log", also referred to as the "Network Dashboard".

Data Collection

GKI's initial approach to evaluating the impact of CLA on development outcomes used econometric methods for estimating the impacts of GKI actions (researching and providing insights via Knowledge Products) and their impact of related adaptive management by BioCrops on their outcomes (measured via indicators like staff retention, firm expansion, revenue). However, as implementation of GKI's support to BioCrops commenced it became evident that obtaining data on those firm-level outcomes would be very challenging. This was further highlighted by the limited responses GKI received from the BioCrops team and that, when given, responses were delayed or received much later than the agreed upon date. This undermined the sample size of data needed for assessing meaningful statistical analysis.

Given this context, the GKI team adapted to refocus its evaluation lens on examining the process through which GKI attempted to support BioCrops. GKI's Theory of change for EB4CLA requires the local partner to engage with the product in order to have an impact on development outcomes. The "Use of Knowledge Product" by the partner is a necessary condition (albeit not sufficient condition) for impact on firm level and development outcomes. GKI's measurement challenge was then to understand how and when to adapt - when feedback signals a need to change strategies- and the impact of changing strategies on targeted BioCrops' outcomes. To accomplish this, we observed the source and topic of requests, the media through which the products were delivered, the local partner's (BioCrops) perception of their quality, and BioCrops' final disposition or use of the knowledge.

GKI completed three Research Rounds during which the team identified and shared 16 Knowledge Products, offering insights ranging from strategies for developing talent at BioCrops, m summarized analysis of knowledge resources in response to the needs expressed by BioCrops to introductions to potential buyers and funders. At the conclusion of each Research Round, GKI requested feedback on the relevancy and value of each Knowledge Product, with the intent to use this feedback to adapt the next cycle of research to better suit BioCrops needs. GKI hoped that by providing relevant and compelling Knowledge Products it would create an incentive for BioCrops to apply this information to their current activities and operations. GKI recognizes, however, that mere access to high-value information is not sufficient to result in its application. Thus, GKI focused on employing a flexible and responsive engagement process with BioCrops, and seek feedback on their changing research needs, communication preferences, and organizational priorities.

Overall, the feedback process was slow and BioCrops' engagement remained significantly lower than that agreed upon at the launch of the project in November 2016. This has reduced the quantitative dataset that GKI had hoped to collect, and analyze, thus limiting the depth of findings on the t plausible impact of adaptive management. While that continued to be our core-guiding question, the GKI team adapted to these unfavorable factors by performing additional analysis on the data collected alongside its own observations. This analysis used a mixed methodology approach, including decision tree mapping to illustrate the pathways of delivery of each Knowledge Product, its receipt, relevance, and application. The team then layered this modeling alongside a general application of Bayesian statistics and positive deviance mapping, with the hope that it would reveal factors that will more favorably influence the probability for adaptive management. This methodology and the findings are outlined in the section below.

Program Realities and Operational Adaptations

GKI's Manmeet Mehta, Cait Goddard and Renee Vuillaume began the CLA project with a systems analysis which revealed key enablers and barriers in the Uganda plant tissue

culture space impacting BioCrops. After 20 unique enablers and barriers were decided upon internally, GKI designed an interview protocol to collaborate with BioCrops Founders Geofrey Arinaitwe, John Bananuka, and David Talengera to prioritize the enablers and barriers that they felt most influenced BioCrops.

In November, 2016, two team members (Cait Goddard, Renee Vuillaume) traveled to Uganda to meet with the BioCrops team and define the parameters of the CLA grant. GKI had decided that the 20 enablers and barriers initially selected must be narrowed down to present a more focused research opportunity, but the decision of how many and which ones must be left to BioCrops. Ultimately, BioCrops grouped the 12 enablers and barriers into two core areas of focus for the organization:
:

- Developing management and leadership skills (M&L)
- Accessing new markets (NM)

As a result, GKI began Research Round 1 focused on leadership development and management chosen specifically because Geofrey Arinaitwe had strongly championed the need for more management training. Geofrey was identified early on as a challenging collaborator, and GKI focused on the business area where he had most interest.

As implementation of the GKI support to BioCrops commenced it became evident that obtaining data on the adoption, use, and inmpact of Knowledge Products on firm-level outcomes identified in the Theory of Change would be very challenging. Our Theory of change requires the client to engage with the product in order to have an impact on development outcomes. Their “Use of Knowledge Product” is a necessary condition (albeit not sufficient condition) for impact. Further, with limited responses and long turnarounds from the BioCrops team, the level of engagement or interaction with BioCrops to have the sample size necessary for meaningful statistics was also undermined.

Given the updated context, GKI refocused our evaluation lens to examine the process through which GKI attempts to support BioCrops. GKI noted the organizational constraints at BioCrops and their limited ability to immediately respond to and act on Knowledge Products, even those with the potential to be acted on immediately. The challenge remained through the project duration, with the team noting higher engagement and responsiveness by BioCrops only occurs immediately following face-to-face interaction and collaboration. In-person engagement is not just helpful for accessing data consistently, but may also have the potential to create more impetus to act on the Knowledge Products considered relevant by the local partner. Limited and inconsistent data has compounded the challenges of tracing the contribution of the Knowledge Products to firm level and development outcomes.

Throughout the project timeline, GKI adapted in response to the feedback received (or lack of feedback received). The team recorded 15 pivot points, or adaptive actions. 7 Adaptive

Actions in the process for developing Knowledge Products, and 8 Adaptive Actions in its engagement methodology with BioCrops. These are detailed below.

GKI Adaptations: Developing Knowledge Products

Initial Kick-off process:

Adaptive Action 1: The GKI team identified core organiztional priorities for BioCrops, adapting to request of BioCrops to frame the systems enablers and barriers within the larger context of the two core priority areas, as opposed to individual enablers and barriers.

Research Round 2

After completing Round 1, GKI suggested that BioCrops relay the feedback in-person as Cait Goddard would be in the country in upcoming weeks. Cait set a time with BioCrops to meet on a Friday morning at their office prior to the trip. On arrival, BioCrops shared that their plans had changed and they would be unable to meet on a Friday or Saturday, the 2 days Cait previously agreed.

Adaptive Action 2: Cait shifted her work schedule to meet with BioCrops on a Thursday evening. Only John Bananuka and David Talangera were able to attend. GKI focused on listening to their feedback and consequently pursued John and David's research requests for Round 2 rather than follow leadership and organizational management, previously requested.

Adaptive Action 3: BioCrops requested a focus on research emerging from organizations and individuals working in low-resource countries who may not have labs with all available materials and try substituting out alternatives for high-cost supplies. GKI adjusted its research focus to low-resource contexts.

Adaptive Action 4: BioCrops then indicated they would like to be introduced to people "doing the work" i.e. scientists outside of labs, experimenting and applying the tissue culture practices. GKI identified introductions to other organizations to set up a discussion for BioCrops as a priority for Round 2.

Research Round 3

GKI did not hear from BioCrops after Round 2 was completed. [7]

Adaptive Action 5: GKI responded to the most recent feedback from BioCrops and follow-up on emails to tissue culture organizations and experts based in low-resource countries.

[7] Communication section in the Change Log/Network Dashboard provides details information and GKI team would be happy to share the data exports from the Dashboard and Communications Log.

Adaptive Action 6: GKI attempted to make the feedback process easier for BioCrops (allowing any one of them to fill out the feedback, or split the task) and created an online survey form for each of the Knowledge Products. Initially, BioCrops requested an email or, if necessary, a phone call.

Research Round 4
GKI did not hear from BioCrops after Research Round 3.

Adaptive Action 7: Based on no feedback despite repeated outreach, GKI decided to stop research efforts until feedback could be obtained.

GKI Adaptations: Engaging BioCrops

There were several adaptations in the communication and engagement process driven primarily by the lack of response from BioCrops. The details are outlined below:

- **Adaptive Action 1:** As part of a series of collaborative kick-off discussions, BioCrops had indicated emails as a preferred method of communication due to time constraints and scheduling challenges for their team. As the project rolled out they shared their preference or providing feedback also on email, instead of phone calls. However, they remained unresponsive to GKIs request for feedback on Round 2. GKI team was unable to ascertain their response to the KPs from Round 2 (collaboration opportunities with researchers) as the GKI team were not cc'd on any responses BioCrops may have sent to GKI's email introduction.
    - GKI attempted to phone BioCrops for feedback in late March.
    - GKI tried both Dr. Geofrey Arinaitwe (main contact) and John Bananuka (suggested contact if Geofrey was unavailable). The team was not able to reach either contact.

- **Adaptive Action 2**: Receiving no response from BIoCrops at the conclusion of Rounds 1 and 2, GKI decided to design and share an online feedback survey with their team in an attempt to offer a potentially more convenient feedback mechanism for BioCrops. On May 17th, GKI sent a feedback survey which included 6 Knowledge Products.

- **Adaptive Action 3**: On June 22nd, GKI sent an email to the full BioCrops team stressing the need for communication and a request for feedback.

- **Adaptive Action 4**: On June 28th, GKI sent a Whatsapp message to Geofrey rather than a phone call, after receiving no responses to email.

- **Adaptive Action 5:** On June 30th, GKI tried to reach David Talengera on the phone, rather than Geofrey or John, and received no response.

- **Adaptive Action 6**: On July 3rd, GKI sent an email to David Talengera with another request for feedback.

- **Adaptive Action 7**: On October 7th, GKI sent a formal email to Dr. Geofrey Arinaitwe explicitly reminding him of the BioCrops and GKI, agreement on participation in the EB4CLA grant.

- **Adaptive Action 8**: On November 15th, GKI sent an email stating the partnership would be terminated if BioCrops did not respond within a week.

During the course of these adaptations, the team reflected on the experience and key learnings:

1. **Responding to Knowledge Products:** BioCrops highlighted two forms of action they could take in response to GKI's Knowledge Products: (1) Reflect and process information and consider new ways to do things. and/or (2) Implement actions suggested in the Knowledge Product. BioCrops initially was open and reflective to information received from GKI, but indicated that there has not been enough time to review and implement all the Knowledge Products. In fact, the GKI team realized that the four-week engagement cycle could be too short a time frame for BioCrops to act on GKI's Knowledge Products. Collaboration opportunities may require a longer time frame before they are realized or implemented.

2. **Application of Knowledge Products:** GKI has offered BioCrops 16 new Knowledge Products in three rounds of research. Seven of these were initiated as a result of direct requests from BioCrops, to supplement the 12 Enablers and Barriers prioritized previously. These seven Knowledge Products included recommendations for connecting with tissue culture companies in low-income contexts. GKI introduced BioCrops to the three companies with whom BioCrops expressed a desire to connect. While each company responded positively to GKI's outreach email, BioCrops, as far as we know, did not. We are still awaiting feedback to get additional details on any follow up that might have happened extraneous to GKI.

3. **Organizational Constraints:** BioCrops is leading timely and critical work in the agricultural sector in Uganda, and operating with scarce resources. The leadership team members have full-time jobs outside of BioCrops. Despite responding favorably to the information being provided by GKI via the Knowledge Products, these constraints limit BioCrops' ability to process and apply new information.

4. **Pivoting to New Products:** Amidst the illustrated organizational constraints, BioCrops remained focused on developing new production methods and expanding

their Research & Development efforts to include new crops, such as apples and citrus fruits. They are also interested in expanding their core business lines to include genetically modified seeds. In the pursuit of these goals, they requested GKI to research opportunities to collaborate with scientists and entrepreneurs working in tissue culture labs that have successfully scaled and are located in similar low-income contexts, particularly in Asia. These collaboration opportunities were incorporated in Research Round 3.

At the end, we were unable to ever sincerely operationalize the optimization approach as proposed in Figure 8 below, principally due to a lack of feedback.

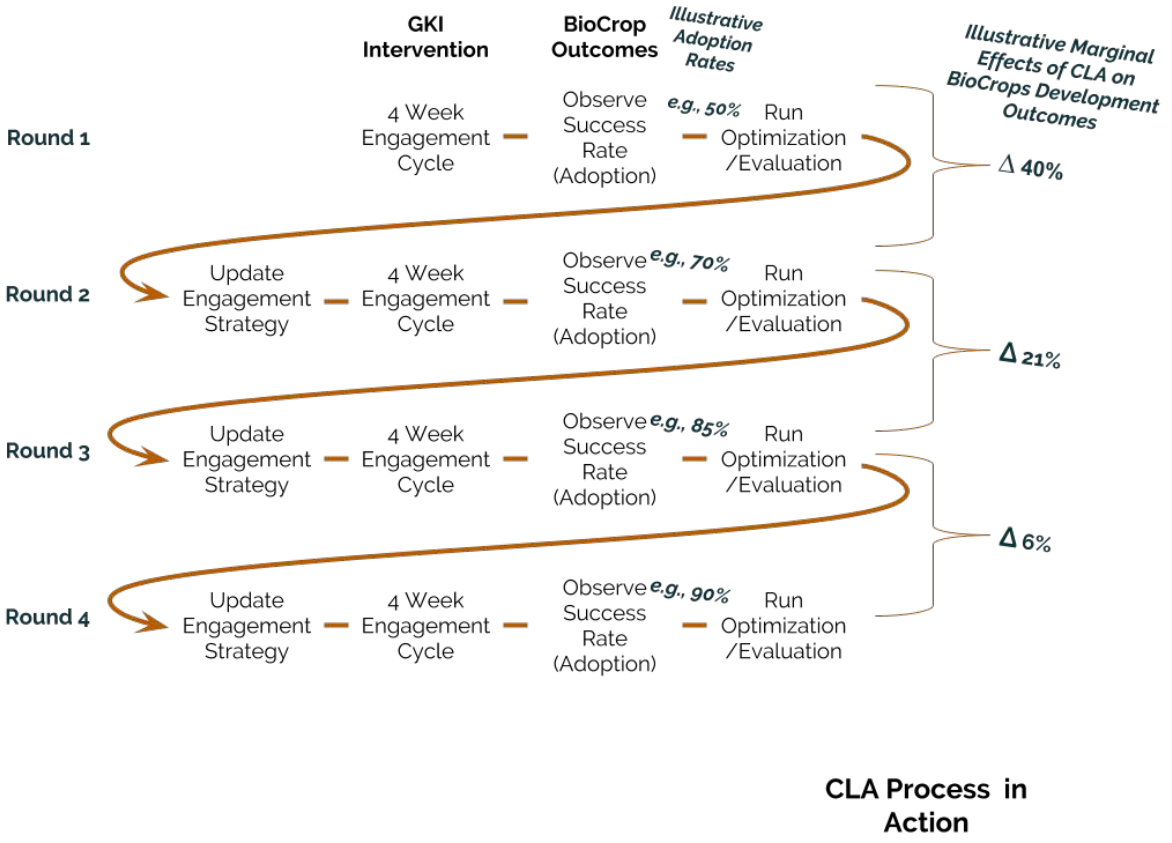


Figure 8: Timeline of Challenges and Adaptation

The data from Rounds 1 and 2 were combined in GKI's first execution of the quantitative models to give us a larger sample size (16). However, the team only received complete feedback on 11 of the delivered products. For our models we consider the 5 non-responses (31%) as lack of adoption/failures. According to the in-person feedback we received on 19% of the 16 Knowledge Products were immediately put into use by BioCrops and 12% were cited as "Not yet in use, but we plan to use it in the future."

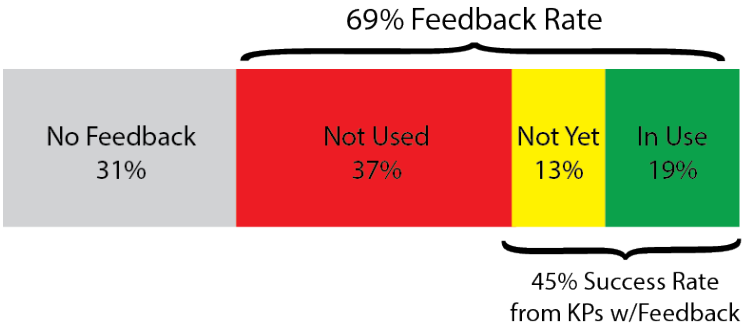


Figure 9: Rate of Feedback and KP Adoption from Engagement Rounds 1 & 2

Discussion of Findings

Previous sections describe the results of our work, both operationally and in terms of measuring the impact of CLA on development outcomes. Both experiences resulted in disappointing outcomes for our team. However, this pilot expanded our experiences and was a learning opportunity on implementing CLA strategies and relevant measurement approaches. Below we discuss our use of an optimization approach and reflect on our concerns regarding the operationalization of CLA.

Reflections and Learning From the Operations

This report outlines the proposed CLA framework designed by GKI and implemented in collaboration with BioCrops, the subsequent lack of communication and engagement by BioCrops, and the adaptive actions implemented by GKI in response. Our reflections elaborated below examine the relationship between CLA and lack of success in establishing evidence contributing to improved (or otherwise impact) development outcomes at BioCrops during the course of this EB4CLA project grant. These reflections raise questions for further research, discussion and experimentation.

When does CLA prolong failure? When do you adapt; when do you stop?

Optimization – the impact assessment approach underlying GKI's CLA approach - assumes once there is deeper awareness of the systems factors that may be leveraged to identify a path to success, i.e., improved development outcomes. Application of an optimization approach encourages the users to exploring alternate and increasing effective pathways to get there.

The GKI team adapted its research, communication and engagement processes with its partner BioCrops in addition to encouraging the practice of CLA by BioCrops. With its adaptive actions GKIs goal was to improve our Knowledge Products, to encourage adoption and application and subseuqent impact on BioCrops' program outcomes. Essential to the CLA framework is the culture of creative problem-solving, collaborating to identifying root causes, testing different solutions, and moving forward with the solutions that show

promise. As the project progressed with GKI adapting its research and engagement processes rapidly (Pgs 19-21) , the team grappled with a question. This question was – what might be the optimal number of adaptive actions to influence a project's success and the inflection point after which you might be practicing CLA without any potential for project success? The variables influencing this scenario in this case and others, can include and are not limited to – the challenge of virtual communication and engagement in influencing practices requiring behavior change, lack of real-time feedback, and working with an uniterested and unengaged partner.

In GKI's case, BioCrops had expressed significant interest in our support signaling demand for knowledge products from GKI. However, once the work was operationalized the GKI tea found them unresponsive. During the weeks in May 2017, when GKI team decided to respond with the Adaptive actions #2 and #3 detailed on Page 20 (diversifying methods, timing, and frequency of communication), the team discussed the possibility of pivoting to a different context and partner (Agriculture System in Rwanda). However in the end, the team focused with more vigor and creativity on adapting and improving the way we worked with our Ugandan partner. GKI experimented with modes of communication, product type, attempted to leverage different relationships, created added incentives, and eventually resorted to threats (rescinding grant funding). Over the period of a year, resources were leveraged to continuously experiment with the research process as well as process to engage BioCrops to ascertain feedback on previous Knowledge Products and request different or new Knowledge Products.

It is worth asking the question if we should more actively explore and define the parameters that could effectively indicate the optimal point to cease adaptation, in fact determine that "stopping" and reapplication of funds could be the most effective adaptive action for influencing development outcomes .

The GKI team have attempted to come up with an actionable method for determining when to adapt and when to stop. One consideration should be the opportunity cost of adaptation. While many elements of CLA are less tangible or focused on fostering a specific culture within the organization, some elements have identifiable costs. For example, our team recognized that BioCrops engagement with our team and products was significantly improved by in-person engagement. That moment provided an example of a true cost (travel or relocation expenses for a GKI staff member to Uganda). Those expenses can be quantified and benchmarked against the alternate uses for those dollars. If we cannot find a more effective place to improve development outcomes with that money, then it should be used to adapt our approach in Uganda.

However, if the same cost could be applied to another program - and increase the impact on outcomes by a larger margin - than the adaptation should not be pursued.

We believe this question of identifying parameters to ascertaing "ceasing a project" as an effective adaptive action merits further exploration and discussion.

What might have been the leading indicators for us?
While framing decisions in opportunity costs seems like a logical decision point, we are still concerned with defining ex ante what might have been the early warning signal of the challenges we would face. Further, we are all susceptible to the sunk cost fallacy; the more we invested in our beneficiary the more we were determined to make the project a success.

Tools such as the CLA Maturity Matrix may provide a tangible way to assess if a client or program are a sufficiently developed to engage with more adaptive programs. In our case, we understood that there were internal communication and leadership challenges for BioCrops. However, our intervention was specifically designed to provide resources to address these deficiencies.

In other case studies we've understood that a single person or leader within an organization can create the enabling environment for CLA success. Inversely, we'd note that the logic applies inversely as well; an individual can undermine success.

Additional broad indicators uncovered by GKI during this project include:

- Irregular communication
- Infrquent in-person communication
- Unfrequent or no feedback on products, ideas, or processes
- Low or no adoption of insights and Knowledge Products without any accompanying feedback
- Absence of data tracking and data collection on agreed program and outcome indicators
- Lack of committed organizational resources for the practice of CLA, at least initially, to influence wider adoption and behavior change
- Absence of an experimental and iterative mindset

Reflection on Optimization Methods
As implementers and donors collaborate to drive discussion for an expansion of collaboration, learning, and adaptation within development programs, there is an emerging debate on the efficacy of standard evaluation methods for capturing program effects. In identifying non traditional evaluation approaches in this case, the GKI team focused on optimization rather than assessment. Many development actors call for an integration of monitoring, evaluation, and learning activities into project management. However, common M&E approaches are designed to define *what* happened rather than *how* it occured or could be improved. Approaching programs and their evaluations as an outcome focused optimization challenge could potentially close rapid feedback loops and create learning cycles during project implementation. This approach is commonplace in the private sector; particularly in large industries, manufacturing, and computer science.

Unfortunately, our attempt to manage this system with BioCrops did not meet our ambitions. We were not able to collect the quantity or quality of data required for

informative or actionable quantitative results. While this could be seen as a threat to this empirical approach, we believe our methods principly failed to measure the impact on development outcomes because of an untested program, unreliable partner, and insufficient incentive structures.

Our initial round of analysis on conditional probabilities actually identified a few areas where the program might be able to shift strategies to improve Knowledge Product use. However, this apparent opportunity for learning and scaling success was confounded with a period of heightened collaboration due to an in-person site visit. While the identified pathways were not causal in nature, we were able to quantitatively identify the periods in which success in improving outcomes were most likely. Unfortunately, increasing our on-the-ground presence was not an option. With this example, we continue to be optimistic that these types of methods provide a viable option for future CLA operations and research.

Conclusions

Tools like the CLA Maturity Matrix create an assessment of client/partner readiness to practice CLA. GKI's experience suggests that these can be a powerful starting point to determine the right partner for experimentation on the effectiveness of CLA processes in action.

GKI's experience suggests challenges to readiness can include those outlined on Pages 25 and 26 and exploring evidence base for effectivness of CLA can require an investment in building newer mindsets, identifying incentives for adoption and practices, and designing experiments allowing for longer timelines, integration of failure as an adaptive action, and an unflagging commitment to simplify systems-driven insights to facilitate informed and effective adapation in a complex development context.

Annex 1: Quantitative Optimization Results Round 1-3?

Note: The results that follow were derived using the rules of conditional probability as follows. Let A and B be events. Then we have the following results,

$$P(A|B) = \frac{P(A \cap B)}{P(B)}, if\ P(B) \neq 0$$
$$P(B|A) = \frac{P(B \cap A)}{P(A)}, if\ P(A) \neq 0$$

P (A|B) should be read as: "The probability that event A occurs, given that event B occurs"; or more succinctly, "The probability of A given B."

Calculated Probabilities

This analysis focused on determining the optimal pathways to maximizing response rate and reported Knowledge Product usefulness. The following table outlines some of the most important probabilities that came out of the analysis. We attempt to observe the "Pathways" where KPs are most successful (BioCrops uses the product). We look at the following variables along the "Path" to adoption:

- Knowledge Product Quality Assessment by BioCrops
- Initiation Source (Solicited by BioCrops Yes/No)
- Knowledge Product Type (Collaborations, Introductions; Research)
- Challenge Area (Leadership or Market Access)

Disclaimer: The entire data set consisted of 16 observations; 5 of which had no response values from the customer. Because of this, not all possible calculations were possible or informative.

Variable of Interest: Event	Condition: Event	Probability
KP Use: Yes/Currently	KP Type: Collaborations	0.286
KP Use: Yes/Currently	KP Type: Introductions	0.5
KP Use: Yes/Currently	KP Type: Research	0.00
KP Use: Yes/Currently	Solicited: No	0.286
KP Use: Yes/Currently	Solicited: Yes	0.111
Response: Yes	KP Type: Collaboration	0.857
Response: Yes	KP Type: Research	0.500
Response: Yes	Solicited: No	0.857
Response: Yes	Solicited: Yes	0.556
Usefulness: Helpful	KP Type: Collaboration	0.429
Usefulness: Helpful	KP Type: Events	0.000

Usefulness: Helpful	KP Type: Introductions	0.500
Usefulness: Helpful	KP Type: Research	0.167
Usefulness: Helpful	KP Use: Not Yet	0.500
Usefulness: Helpful	KP Use: Yes/Currently	1
Usefulness: Helpful	Solicited: No	0.429
Usefulness: Helpful	Solicited: Yes	0.222

Key Points

1. Knowledge products are more likely to receive feedback and/or be reported as helpful given that the Knowledge Product was not solicited.
2. Knowledge products are always reported as useful given that they are also used.
3. Collaborations have consistently high likelihood of receiving feedback or being reported as helpful.
4. Research Knowledge Products only receive feedback 50% of the time, none are currently in use, and are only reported as helpful 16.7% of the time.

Annex 2: Variable Key for Data and Charts

Raw Value	Re-coded Value
GKI Research	Solicited
Revision/Follow-Up to Existing KP	Solicited
New BC Request	Unsolicited
Collaboration Opportunities	Collaborations
Research Papers	Research
Introductions	Introductions
Events	Events
Management & Learning (M&L)	M&L
Markets	Markets
Yes, this Knowledge Product is currently in use.	Yes/Currently
Not yet, we plan to use this Knowledge Product in the future.	Not Yet
No, this Knowledge Product is not currently in use.	Not Currently
Enabler 1: Support from national and international tissue culture researchers	E1
Enabler 2: Government support for biotechnology and agriculture	E2
Enabler 3: Increasing access to new markets and value chains within Uganda	E3
Enabler 4: Growing availability of educated workers in Uganda alongside improvement in technology used in tissue culture	E4
Enabler 5: Increasing access to new export markets and new forms of biotechnology (Genetically Modified)	E5
Barrier 1: Challenges in growing the export markets for farmers who grow TC bananas	B1
Barrier 2: Difficulty retaining skilled workers	B2
Barrier 3: Lack of awareness or mistrust of TC	B3
Barrier 4: Banana is not a cash crop in Uganda	B4
Barrier 5: Difficulty transporting banana plantlets with current infrastructure	B5
Barrier 6: Advanced technology is required to maintain a tissue culture lab and Continued research required to optimize this technology	B6
Barrier 7: Developing leadership and management skills pertinent to growth in TC industry	B7

This document was produced for review by Feed the Future and the United States Agency for International Development (USAID)

It was prepared by the Global Knowledge Initiative and under The QED Group, LLC for the Feed the Future Knowledge-Driven Agricultural Development (KDAD) project.

For further information, please contact:

Manmeet Mehta
Senior Program Officer
manmeet@gkinitiative.org

USAID
FROM THE AMERICAN PEOPLE

FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative