

FINAL TECHNICAL REPORT / RAPPORT TECHNIQUE FINAL SCALE-UP SUPPLY AND UTILIZATION OF PRECOOKED BEANS FOR FOOD AND NUTRITION SECURITY, INCOMES AND ENVIRONMENTAL CONSERVATION BY LEVERAGING ON PUBLIC-PRIVATE PARTNERSHIPS IN KENYA AND UGANDA

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Scale-up supply and utilization of precooked beans for food and nutrition security, incomes and environmental conservation by leveraging on public-private partnerships in Kenya and Uganda

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Executive summary

This report presents an account of the work carried out under the project titled “**Scale-up supply and utilization of precooked beans for food and nutrition security, incomes and environmental conservation by leveraging on public-private partnerships in Kenya and Uganda**” (hereafter referred to as the precooked bean project). The precooked bean project was implemented for a period of 27 months from, December 1, 2018 to March 31, 2021, with a no cost extension of 4 months.

The project aimed at leveraging on public-private partnerships to scale up utilization of precooked bean innovations for food and nutrition security, income generation and environmental conservation in a gender equitable manner.

Covering the entire implementation period, we have documented a number of milestones at different nodes of the bean value chain. The project worked with 20,558 farmers, 6,962 men, 9,893 women and 3,703 youth. The numbers increased by 1,659 in this phase compared to phase I of the project that engaged 18,899 farmers. The project also supported scaling to other areas with 9,000 farmers being involved in uptake of some of the project innovations (digital payments and expansion of precooked bean processing in Rakai, Kampala and Soroti districts of Uganda. Seed access by women, men and youth farmers has been eased through the Seed Credit Model (SCM) and Community Production and Marketing System (COPMAS). The seed credit model involves delivery of certified bean seed by CEDO to farmers in organised producer groups on credit and make payments at time of selling the harvest. The COPMAS system on the other hand relies on private agro-dealer networks near farmers to supply certified seed to farmers who pay for them on cash basis mostly used in Kenya. The models are versatile and inclusive. For the period of 3 seasons 100MT of certified bean seed were accessed by producers; of which 29MT were to males, 43MT to females, 14MT to female youth and 14MT to male youths. The seed was accessed as a package that included management practices and safe food production principles under the Hazard critical control point (HACCP) training to ensure safety of the harvests. This is in response to issues of aflatoxin that recur in the public domain thus making HACCP training critical. In addition, a more efficient approach and step towards achieving traceability in bean grain supplied for processing into precooked products. Information was given to farmers as a Package because the approach optimizes time and efficiency to achieve improved productivity. Note that other than seed, productivity is a product of an integration of practices like recommended spacing, weed, fertility, diseases and pest management.

The collective marketing model facilitated aggregation of 1,143MT of bean grain in Uganda for 3 seasons covering a period of 18 months. In terms of revenue from sale of grain, a total of CAD/831, 460 (AUD 891,641) was generated from the sales. The income distribution by gender were as follow; Males CAD 213,987 (AUD 229,475, Females CAD383,745 (AUD 411,520), Male youth CAD89,342 (AUD 95,808 and Female youth CAD 144,386 (AUD 154837). Under the project, productivity increased by 17% thus making a major contribution to these incomes. This has increased their incomes and consequently improved their livelihoods and investments in other ventures. In Kenya, 2 season data show that for the processor preferred Nyota bean variety 162,400kgs was consumed and traded with a value of CAD 154,667 (AUD 165,862). It is worth noting that this variety was not in production before project intervention and represents a 33% decrease in the production of the popular varieties Wairimu and Kifarm.

Also emanating from CultAF1 were issues of payment and cash handling and control risks that threatened bean grain availability for processing. This was because occasionally payments for produce were made through a third party since the farmers marketed as a group. As such, some farmers, especially women had their proceeds collected by third parties such as their spouses, children or other

relatives. In instances where third parties lacked integrity, the payment for crop delivered never reached the real bean farmer thereby demoralizing such a farmer. Based on these lessons, an ICT-based financial inclusive Application called Mastercard Farmer Network (MFN) was tested and promoted by the project for e-payment services. The APP provided a platform with a number of key functions such as farmer registration (19,094 farmers), digital aggregation, digital payments, produce collection, service support requests (923 messages), transport management, extension services, and linkages to financial institutions for credit (Equity Bank). Significantly, the App helps producers establish a real time financial history through digital records, which is useful for evaluating credit worthiness of the farmer. For example, Equity bank started evaluating farmer's credit worthiness before extending credit for input acquisition, among others. In addition, digital payment guarantees that payment goes directly to the supplier of the produce. Production and seed demands are derived from the historical data. Overall, the App improves farmer data integrity. The women that had been disadvantaged by the cash payment model, started registering their own phones following training provided to their groups. The App has also created jobs for 11 women and 16 men who work as agents. The APP further aims at significantly reduce gender inequality in markets and marketing of beans which prices were at CAD 0.65-0.71 (AUD 0.70-0.772) for both men and women in Uganda while for Kenya prices received by men per kg were CAD 0.94-0.95 (AUD 0.1.00-1.02) way higher than those received by women of CAD 0.86-0.88 (AUD 0.92-0.94). Prices are relatively lower in Uganda since it is a major production hub for beans and supplies Kenya, which is a bean deficit country. Gender inequality in markets appear to be reducing in Uganda than in Kenya, this could be due to increased openness and access to trading opportunities by both men and women due to the digital marketplace of the App and the extensive training accompanying it. The implementation of Application in Kenya was still at a nascent stage and slower.

The precooked bean products increased from the initial 1 (quick cooking bean) to 5; quick cooking bean, bean flour, ready to eat bean snack bar, bean noodles and bean chunks used as ingredients to manufacture other products such as bread) and have been promoted to other businesses using the business-to-business (B2B) models such as supermarkets, hotels, restaurants and kiosks and direct selling. About 365 tons of assorted products worth CAD 152,500 (AUD16,358) accrued from sale of 16,000 packets of beansy™, 120,000 packets bean flour, 2,585 packets of bean snack and 1,401 packets of bean noodles by the processors. These were sold in outlets including 4 supermarkets (1 in Uganda), 120 food kiosks, food vendors and in 2 residential areas of Nairobi using food outlets. A study in Kenya indicated that the most traded products were beansy™, a quick cooking precooked bean product, bean flour, bean snacks and bean noodles in the year 2020/21. Production of bean grain needed for processing has also expanded from initial 5 districts/counties in Kenya and 10 in Uganda to 15 in each country to meet the needs of the processors.

In efforts to de-risk the precooked bean processing industry, a study was carried out to establish the enabling and disabling actors and factors. The study recommends the public actors to formulate policies that:

- Incentivize investments through programs that allow SMEs and other investors to access tax breaks and make use of special investment zones and facilities with established infrastructure.
- Are impactful for nutrition, through mainstreaming the utilization of bean products that are rich in nutrients in public institutions
- Facilitate removal of taxes on e-payments for produce and engage more processors. Countries are currently taxing telecommunications services, which makes services such as e-payments more expensive for poorer smallholder producers and especially women while the upcoming processors and buyers may not be able to take on these added costs on behalf of the producers.

The project continued to engage with both public and private sector partners to support precooked innovations to new processors such as Community Enterprise Development Organization (CEDO), Eastern Agriculture Development Company Ltd (EADCL) and Sahel Foods and Beverages in Uganda and Azuri in Kenya who have taken up the technology, leveraging on earlier investments by support from IDRC/ACIAR grant to NARO and KALRO and partners (CIAT-PABRA, Caritas Homabay, CEDO, Lasting Solution and Smartlogistics Ltd). Research conducted on the partnerships model demonstrated the importance of producers being linked to other stakeholders such as off takers, financiers, and extension service providers among others. Farmers engaging with partnerships realized an increase in income of 70% for female and 30% for male farmers. Results also show that producers linked to other partners earned twice more revenue from their produce compared to non-affiliated ones. The study recommends that policies that include tax incentives for farm inputs, subsidized farm inputs, credit, extension, and secure markets for smallholder farmers, could greatly improve farmers' income. Overall, Public-Private Partnership models were deployed along the precooked bean value chains and showed potential to be used for promotion and scaling up of pre-cooked bean products to targeted consumer and user categories. Overall, PPP could be an effective way of improving smallholder livelihood.

The research demonstrated potential impact of precooked beans on the environment generally and on savings on cost of fuel. An analysis of the before and after introduction of the precooked beans indicated that there was a significant shift from use of firewood to gas and charcoal. To cook non-processed dry beans, consumers use charcoal (68%), firewood (14%) and gas (17%). However, for precooked beans, 42% were using charcoal and 46% gas; there was no significant difference between male and female consumers. Thus, in the cooking of precooked beans, there is a shift from wood-based fuel to cleaner energy - gas. The study establishes that the cost of preparing dry beans is CAD 0.91 (AUD 0.98) while for precooked beans is CAD 0.54 (AUD 0.58), resulting in a saving of CAD 0.37 (AUD 0.4). Furthermore, when precooked beans are prepared one saves 75% water relative to cooking dry beans. The precooked bean products had to meet the criteria of suitability for the consumer and be responsive to the perceived benefits. In a precooked bean product choice study in Kenya, it was found that the most preferred precooked bean product is the generic quick cooking at (45%) followed by bean snacks (11%). The main supply channel was the direct sourcing from processor followed by home delivery services, kiosks/vendors and retailers in that order.

The analysis using the Women Empowerment in Agriculture Index (Pro-WEAI) shows that the project improved empowerment for both men and women compared to its first phase. However, women are still more disempowered compared to men. Data shows that a gender gap still exists in access to land. Whereas in Uganda the inequality is not statistically significant, in Kenya, especially in the main cropping season, land allocated to bean farming by men was 1.46 acres, which is significantly higher than that allocated by women (1.23 acres). Results show that men are more empowered with an overall empowerment score of 0.86, while that for women is 0.79. The Pro-WEAI score for farmers in Kenya is slightly higher (0.82) than that of Uganda farmers (0.77). The 3DE and gender parity index for Kenya is slightly higher than that of Uganda, an indication that farmers in Kenya were generally more empowered than in Uganda. Disempowered women achieved adequacy at an average of 53% and 59% of the indicators in Uganda and Kenya, respectively. The disempowered men had a mean adequacy (3DE) score of 0.61 in both countries indicating that men achieve adequacy in an average of 61% of the indicators. Thus, whereas there has been improvement in some areas, more interventions are still required in the top 3 disempowerment factors for women and men i.e., decisions on credit and financial accounts, work-life balance and membership in influential groups for women; and membership in influential groups, group membership and autonomy in income control.

The project also built capacity of four students, 1 male and 3 females, who conducted their Master's degree research on the project. During the period, the students developed their research proposals, contributed to data collection, and started analysing their data by project end. One student submitted a thesis and generated a draft research paper.

Concerning sharing of knowledge with the wider scientific community, the project had 3 scientific papers published in peer reviewed journals. A further 4 papers were submitted and are under review. Additionally, 6 papers are undergoing internal review. The project also published 4 blogs and 8 newspaper articles; and the team made 9 oral presentations at different fora.

The project established a foundation for scaling out the precooked product innovations. More than 13 inquiries and requests for technical support were received by the project team and are projected to continue. The enquiries came from seven countries in sub-Saharan Africa (Tanzania, Zimbabwe, Zambia, Malawi, Ghana, Rwanda, DRC). Going forward, the project partners have mainstreamed the precooked innovations in their respective institutional programs to continue disseminating and scaling the precooked bean innovations to more investors and countries in Africa.

The key challenge was the COVID-19 pandemic that disrupted some key activities. The project, however, recovered after receiving a no cost extension to proceed with a tight implementation plan. The pandemic also affected fast tracking of the product commercialization process to key markets. Secondary was the high transaction taxes on mobile money imposed by the government of Uganda threatening e-payment acceptability. CEDO and EADCL are both adopting and expanding the MFN use with lessons learnt from the project. Policy lobbying is recommended to waive taxes for agricultural related transactions to encourage more women and youth to use the innovation.

Going forward, as a way of further leveraging on earlier gains in the precooked bean development and scale out, NARO signed MOUs with CEDO, EADCL, SAHEL Foods and Beverages in Uganda while in Kenya, AZURI Health limited will partner to make use of the precooking innovations to process other pulses.

The research problem

In sub-Saharan African (SSA), the contribution of pulses to protein is among the highest in the world. In East and Central Africa, bean is one of the most important pulses grown and constitutes most of the diets of the resource-poor segments of society (Akibode & Maredia, 2011). The per capita bean consumption increased at a rate of 1.67% per year between 1994 and 2008 in SSA, an indication of the important role the crop plays in food and nutrition security (Akibode & Maredia, 2011). However, the dry grain takes longer to cook, 2-3 hours, posing high fuel requirements (Aseete *et al.*, 2018). Given the rapid urbanization, income growth, time poverty, and high costs of energy, consumer preferences are gradually shifting to more convenient and easy-to-prepare foods (De Haen *et al.*, 2003; Pokins, 2001). Bean value addition in the form of precooked bean products is likely to spur bean production and consumption; thus, enhancing business opportunities amongst actors along the value chain. This will consequently lead to improved food security and nutrition, employment and income to small-scale bean farmers who are predominantly women. Given the short time precooked beans take to cook (10-15 minutes), the pressure on energy demand will decrease which is likely to contribute to environmental conservation due to reduced demand of charcoal and firewood. The precooked bean products adoption will also free more women's time to do more productive work or be more efficient in their reproductive and productive roles.

Since the introduction of the precooked bean products to the market during CultiAF1, its full potential has not been realized as the product has not been fully exploited and commercialized. This was due to the limited supply of grain for processing which affected volumes of the available final product. The CultiAF2 project overall object was therefore to leverage public-private partnerships to scale up utilization of precooked bean innovations for food and nutrition security, income generation and environmental conservation in a gender equitable manner in Uganda and Kenya. The impacts of the precooked bean products that has been documented include; women empowerment in agricultural index, value addition and commercialization of precooked bean, production and business models for supply of sufficient quantities and quality of precooked beans, boosting bean value chain performance through Public-Private Partnership models, evaluation and promotion of scaling up models for delivering of pre-cooked bean products to targeted consumer categories, and assessment of the impacts of social, gender and economic trade-offs of market-driven production and supply models on households.

Progress towards milestones

The write up in table 1 gives a summary of achievement of project milestones as spelt out in the grant agreement for the reporting duration. Where evidence of milestone achievement is tangible, is attached as annex. If a milestone was never accomplished, an explanation to that effect is given and remedial action to lead to its achievement as well.

Table 1: Presents the milestones as in agreement a summary of achievements, evidence and remarks

SN	Milestone	Achievement	Evidence/indicator	Remarks
1	A survey on efficiency of ICT-gender based responsive financial solutions in facilitating bean businesses conducted	A survey was conducted on women, youth and men perception on digital payments of farm produce. The study aimed at establishing the possibility of ICT enabled real time farmer transactions. The study finds that 87% of respondents owned phones, with 89% being women and 84% men. Also 10% of women report their spouse do not allow them to own phones. Additionally, 82% of the farmer SIM cards were registered in own names. While women (6%) and youth (6%) registered the SIMs in non-own names compared to the men's (3%). An intern was recruited by CIAT-PABRA to work with CEDO, EADCL and Mastercard to train agents, 5 sessions were held for 20 participants on the use of MFN and promote its usage among agents and producers in Uganda. The intern also supported more women to participate in MFN digital payments through recruitment. Digital posters have been printed and these are used as Information materials.	A report (<i>Annex 108855-014</i>) is appended. Sample of IEC materials (<i>Annex 108855-015</i>) MFN reports (<i>Annex 108855-016</i>); (<i>Annex 108855-017</i>)	Wholly achieved as planned.
2	Precooked bean scaling and uptake pathways assessed	A study was undertaken in Kisumu in the face of the COVID pandemic to identify alternative channels to sustain supplies. Most preferred channel was by processor; women 24% and men 26%, major reason for choice being proximity. Similarly, the proposed uptake pathway by Smart logistics was also documented. A study on diffusion of bean variety Nyota suitable for	A report appended as (<i>Annex 1008855-018</i>) A diffusion and seed models report attached	Wholly achieved as planned.

		processing was undertaken. The findings from 254 respondents were that 34% and 55% grew Nyota in the first and second season, respectively. This points to an increase in adoption of the new variety by farmers.	(Annex 1008855-019)	
3	Precooked bean product promotion strategy developed	The project has adopted the use of different media to promote precooked beans. Including, exhibitions and radio talk shows. There were 2 radio talk shows in Uganda.	Radio talk shows. A report containing the promotion strategies for precooked beans was generated Annex 105588-021	Wholly achieved as planned.
4	Seed and grain business to business meetings held	In Uganda, CEDO seeds, a subsidiary of CEDO that handles the seed component and uses similar models for grain and seed production held 2 meetings with the contracted seed producers, VEAs and Seed certification unit with major focus on seed quality enhancement.		Wholly achieved as planned.
5	Capacity development of farmer groups in production and quality control management implemented	In Uganda, farmers were trained in GAPs that include: i) pre/planting, ii) pest and disease mgt, iii) post-harvest handling and storage, food safety principles with focus on HACCP, gender dynamics in bean production while for Kenya it was on GAPs, bean varieties suitable for pre-cooking, precooked bean products and marketing. Overall, 12,835 farmers were trained among which were {M3,073, F4,540 Youth1,476} in Uganda whilst in Kenya, 3746 (M 1,780, F1,966) farmers and other stakeholders were trained in GAP and marketing	Training report and attendance list (Annex 108855-020)	Completely achieved.
6	Stakeholder engagement strategy to promote precooked beans available for use	As a way of further leveraging on earlier gains in the precooked bean development and scale out, NARO signed another MOU with CEDO to partner in precooked bean processing. As a way of implementing recommendations of the bean value chain study and for wider impact of the precooked bean technology, 3 processors (EADCL, SAHEL Foods and Beverages in Uganda,	A listing of key stakeholders engaged in uptake and promotion of precooked bean products and their roles is available. Partnerships interested in	Completely achieved.

		and AZURI Health Ltd in Kenya are on board.	scaling precooked were documented (Annex 108855-021)	
7	Strategies to upgrade value chains through the acquisition of technical, institutional and market know-how developed jointly with multi-actors	A meeting was held with SAHEL in Kampala to lay strategies on how to energize the momentum of the value chain. A road map was developed. Going forward, the team is to visit 3 processors namely Smart logistics, Kenyatta University and Farmfresh in Rwanda to come up with a hybrid processing plant. Different partners from development, private sector, producer organizations and government units were catalyzed to support uptake of the nutritionally enhanced precooked bean products		Completely achieved.
8	Survey to analyse producer household effects of the precooked beans conducted	A study on production and marketing of bean varieties suitable for processing and their effect on female and male producers was carried out. Further the influence of choice of sale of bean grain was undertaken. The factors that influence market choice were age, price, distance to market, farmer experience, farm size, patronships, access to credit and no-farm income.	A report (Annex 108855-022) Study annexed as (Annex 108855-25)	Completely achieved.
9	Gender mitigation plans for precooked beans developed and deployed	Intervention measures that include inclusive scaling of the precooked beans products and varieties, deliberate efforts in strengthening interventions that foster financial inclusion believed to promote women and men participation in on-farm and decision making. A Pro-WEAI study was carried at the end of CultiAF2 in March 2021 and results show a score of 0.8 with farmers in Kenya having a slightly higher score (0.82) than Uganda (0.77). The average gender parity index is 0.88 and follows a similar trend to the pro-WEAI score with Kenya having a slightly higher GPI (0.92) compared to Uganda (0.86). The 3 topmost disempowerment	Gender mitigation of plans for precooked beans (Annex 108855-023); (Annex 108855-022)	Completely achieved.

		factors for women are decisions on credit and financial accounts, work-life balance, and membership in influential groups whereas those for men are membership in influential groups, group membership and autonomy on income control.		
10	An analysis of consumption level effects and environmental effects of precooked beans documented	A study was undertaken in Kisumu County the pioneer area to access precooked beans products to understand consumer's precooked bean product access. Results show that 54% of respondents were aware of the precooked bean products. The sources of precooked bean products are the processors, kiosks, retailers, and other delivery systems.	Gendered effects of pre-cooked bean preferences, consumption and associated time and cost of fuel savings from preparing precooked beans. (Annex 1008855-018)	Achieved save for the long-term environmental impacts.
11	Develop a survey to understand how gender, food and energy nexus contributes to global sustainability	A study conducted on energy use provided insights on energy use by men and women. Results indicate a shift from dry beans to precooked beans as such affect type of energy, with a markedly shift to use of gas from wood fuel and charcoal by women. To cook dry beans, 68% used charcoal, 14% used firewood, 17% gas while for precooked beans, 42% were using charcoal and 46% were using gas.	(Annex 1008855-018)	Completely achieved.
12	Efficiency of business supply models documented and published	Precooked bean products have been promoted to other businesses using the (B2B) models such as supermarkets, hotels, restaurants, and kiosks. Products worth (CAD 152,500; AUD 163,538) accrued from sale of 16,000 packets of beansy™, 120,000 packets bean flour, 2,585 packets of bean snack and 1,401 packets of bean noodles by Smart logistics in 20/21.		Completely achieved.
13	Analytical maps of current market value chain pathways for the selected precooked bean products developed	An assessment of public private sector actor networks in the bean value chain was undertaken. The major products pathways were supermarkets, direct deliveries, via retailers, restaurants and kiosks and online. Women	A report detailing chain actors and pathways is appended as (Annex 108855-024/18)	Completely achieved.

		preferred buying from retailers 32% while men from processor 26%.		
14	Efficiency of promotion strategies for precooked beans established	Different promotion strategies were employed. In Kisumu, Lasting Solutions adopted direct consumer promotions through teams of sales staff, targeting households, kiosks, food vendors and medium sized supermarkets (tier 2) for the products. Smart logistics in Machakos and Nairobi adopted advocacy promotion strategy relying heavily on social media and direct references from a team of salespeople and users that agreed to become product advocates. The strategies efficiency is still under study.		More studies will continue post grant period to validate the strategies.
15	Bean business platforms established	Four vibrant bean innovation platforms are in operation, Masaka Uganda by CEDO, in Eastern Uganda by EADCL, in Homabay Kenya by CARITAS and in Kiambogo Nakuru by Smart logistics. While Caritas supports producers in aggregation of produce, the other platforms are designed around a buyer of the bean grains mainly for use in processing precooked beans and or seeds (CEDO case).	Annex 108855-016	Completely achieved.
16	An assessment on stakeholder engagement strategies and effects of scaling-up of precooked bean conducted	A study on partnerships in production of beans for precooked processing reveals the most influential partners and roles they play. Results show that producers engaged in partnerships, their income generally increased by 34% from bean sales compared to producers that do not engage in partnerships	Annex 108855-024	Completely achieved.
17	Evidence of impact of precooked beans on household and income documented	A total of CAD 831,460 (AUD891,641) was traded as follows; Males CAD 213,987 (AUD 229,475); Females CAD 383,745 (AUD 411,520); Male youth CAD 89,342 (AUD 95,808), Female youth CAD 144,386 (AUD 154836). The beneficiaries have been able to acquire moveable and immovable household items like, domestic animals, house construction and		Completely achieved.

		upgrade, purchase of motorcycles, land, paying tuition as well as investing in savings and credit associations		
18	Evidence of impact of precooked beans on consumer and environment documented	To cook dry beans, 68% used charcoal, 14% used firewood while 17% used gas. On the other hand, 42% of consumers were using charcoal to prepare precooked beans while 46% were using gas. Thus, in the cooking of precooked beans, there is a shift from wood-based fuel to clean energy-such as gas, which may save sources of wood fuel.	Precooked bean product consumption and supply channels in Kenya (Annex 1008855-018)	Completely achieved.
19	Effect of precooked beans on food-energy and water nexus documented	A study established that the cost of preparing precooked beans is CAD 0.54 (AUD 0.58) while for dry beans is CAD 0.91 (AUD 0.98). In addition, when precooked beans are prepared one saves 75% water relative to cooking dry beans.	Gendered effects of precooked bean preferences, consumption and associated time and cost of fuel savings from preparing precooked beans. ((Annex 1008855-018)	Completely achieved.
20	Project closure workshop	A virtual project closure workshop was held on the 31 March 2021		Compliant
21	Technical and financial reports finalized	Technical and financial reports were completed and submitted to IDRC/ICIAR as scheduled in the funding agreement		Compliant

Synthesis of research results

This section gives a narration of the research results by objective for all the objectives as in grant agreement. Where details are in form of reports, reference is made to the annexed report.

Objective 1. To test and validate the efficiency of business models for increasing production and supply of sufficient quantities and quality of bean targeted for processing.

This objective intended to test and validate the efficiency of the bean production models identified in phase 1 that include the seed credit, community collective marketing and direct contracting. This entailed supplying adequate quantities and quality of bean varieties of choice for processing. The write-up beneath is an elaboration of the findings.

Scale up availability of bean seed varieties for processing

Bean varieties selected for precooked bean processing were supplied to women, men and youth grain producers using the three earlier identified models. Under a PPP arrangement, NARO supplied CEDO with foundation seed. CEDO contracted farmer groups for certified bean seed production under the SCM arrangement. Under the SCM and directing contracting, CEDO supplied the grain producer groups with certified bean seeds for grain production. For CARITAS they acquire the certified seed from KALRO seed unit or any other agro-dealer to which they give the grain producers under the COPMAS and revolving arrangements. The varieties included NABE 4, NABE 14, NABE 19, NAROBAN 1, 2 and 3, KATB1, KATB2, Angaza and NYOTA. In Uganda the SCM arrangement was found to be more inclusive and therefore has been entirely adopted for both seed and grain production. While for Kenya, the COPMAS arrangement has been adopted to boost inclusivity and productivity.

Using the earlier derived seed road map for sustaining supply of seed based on the seed supply models, 100MT of certified seed were supplied to producers in the two countries (29MT were sold to men, 43MT to women, 14MT to female youth and 14MT to male youth). Five (5) new improved varieties that are rich in iron and zinc, with higher productivity of 1800-2500 kg compared to old varieties (500-800kg/ha), more stress tolerant were released and promoted during CultiAF2. Additionally, these new varieties are biofortified, thus require no need of further nutrition enhancement. In Kenya 2 biofortified varieties were promoted (Nyota and Angaza) whilst in Uganda, 3 varieties namely NAROBAN 1, NAROBAN 2 and NAROBAN 3 were promoted.

A bean production and marketing study was abridged to the PRO-WEAI study. The study was carried out in 6 districts in Uganda and 3 counties in Kenya (Annex 108855-022). An overall sample of 1121 respondents was used. From the study, it is observed that 23% of men and women in the two countries grow biofortified bean varieties that are also suitable for precooking. The most planted biofortified bean varieties are Nyota in Kenya and NAROBAN 1 and NAROBAN 2 in Uganda. The non-biofortified improved bean varieties suitable for processing dominate in Kenya, with about 62% and 55% of men and women farmers growing them in the last two production seasons. In Uganda, more than two-thirds of men (68%) and most women (72%) farmers planted both non-biofortified and biofortified bean varieties. The increasing number of farmers growing bio-fortified beans suitable for processing rose from 0-15%, between 2018 and 2020, which is because of interventions by CEDO and CARITAS, who are key partners in seed distribution under CultiAF2. It could also be because of the direct seed distribution model adopted by KALRO, NARO, County government, NGOs, and agro-dealers in the districts and counties.

Given the intervention for the achievement of the objective, that CEDO, CARITAS, NARO, KALRO and other development partners engaged, the study investigated to establish whether the status quo prevailed for source of seed. The summary of the findings is given in table 2 below. A key finding is that the proportion of producers relying on grain market for seeds was only 21%, this compares favourably with non-intervention areas that reported more than 70% of seeds from grain market. Beans allow farmers to save and replant their improved varieties for at least 2 seasons without significantly losing vigour while ensuring that quality is not compromised. The reported home saved seed in intervened areas is therefore more of the biofortified bean varieties.

Table 2: Percentages of responses to seed sources accessed and used by farmers in the March-July 2020 season

Model	Uganda							Kenya				
	Pooled		Men		Women		p-value	Men		Women		p-value
	Freq.	Percent	Freq.	Percent	Freq.	Percent		Freq.	Percent	Freq.	Percent	
Own saved seed	635	53.81	110	49.77	228	63.69	0.000	130	50.19	167	48.83	0.540
Local market	253	21.44	41	18.55	39	10.89	0.010	77	29.73	96	28.07	0.536
CEDO/CARITAS	125	10.59	44	19.91	53	14.8	0.115	13	5.02	15	4.39	0.673
Fellow farmer	70	5.93	11	4.98	24	6.7	0.384	10	3.86	25	7.31	0.083
NARO/KALRO	54	4.58	8	3.62	6	1.68	0.142	17	6.56	23	6.73	0.990
Government & NGO	10	0.84			2	0.56	0.264	2	0.77	6	1.75	0.451
Agro-dealer	24	2.03	1	0.45	4	1.12	1.012	10	3.86	9	2.63	0.642
Other sources	9	0.76	6	2.71	2	0.56	0.032			1	0.29	0.389

Scale up supply and delivery of preferred bean grain for processing

Having tested and validated that the SCM and COPMAS were the most suitable models for bean grain production, the same were employed to increase marketed volumes of grain. Also given that the adoption rate for the SCM stood at 57% from 22% and its inclusivity, it was prudent to scale it up to facilitate supply of the required quantities for processing. Using the collective marketing model, individual women, men, and youth farmers collectively assembled their harvest at their aggregation centres. Also in the farmer groups, management committees were formed that include marketing, monitoring/enforcement, saving and production. Each committee has a head and members. They have defined roles and penalties for defaulters. In Kenya, the varieties aggregated and sold were Nyota and KATB1 in the counties of Nakuru, Makueni and Machakos and Homa Bay. A volume 172 tons was sold. Of this volume, 53.8 tons was by men and 118.2 tons by women. In Uganda Table 3 gives a summary of the volumes traded in and the returns that accrued from the sales. Sales for season 2020A are not included because during the planting season, there was a total lockdown and at the beginning, agriculture had not been declared essential and as such, farmers did not receive seed for planting due to restricted movement. Consequently, there were minimal sales to the aggregator.

Table 3: Volumes of bean grains sold by season and respective returns

Year	Season 2019A		Season 2019B		Season 2020B	
	Volumes traded Kg	Returns CAD/AUD	Volumes traded Kg	Returns CAD/AUD	Volumes traded Kg	Returns CAD/AUD
Male	150,336	104,089(111,623)	112,035	81,449(87,344)	31,608	28,450(30,509)
Female	260,190	180,149(193,188)	206,130	149,855(160,702)	59,706	53,741(57,631)
Male youth	63,594	44,031(47,218)	49,290	35,833(38,428)	10,530	9,478(10,164)
Female youth	104,076	72,060(77,276)	80,655	58,636(62,880)	15,210	13,690(14,681)
Sub total	578,196	400,328(429,304)	448,110	325,773(349,354)	117,054	105,359(112,985)

Testing and promoting ICT-based gender responsive financial solutions

From the studies in CultiAF1 payment and financial control were risks to bean grain availability for processing. Ordinarily, the owner of the business (beans) should have been paid. This was because in many instances the bean owner did not receive the proceeds from bean sale directly. From lessons thereon, an ICT-based financial inclusion App and model that supports women, men and youth was tested. The model is now under promotion. This App, Mastercard Farmer Network (MFN), was developed through collaborations of mastercard, CIAT-PABRA, CEDO and NARO. MFN is designed to diversify saving options and give women more control over their income. The transactions on the network will also be used as collateral for loan acquisition. In addition, the App can be used for other functions like extension services, bulking information, and e-payments details that can be derived from

the data uploaded on the platform. It is also possible to retrieve historical seed and grain production data from MFN app. Furthermore, when fully operationalized, MFN is designed and expected to be a one-stop app for farmer data that will improve data integrity. The platform is a business model with high potential to sustain based on transaction fees generated.

In the post project activities, sustainability strategies are under way through MOUs with all actors to sustain and consolidate previous gains in the use of the MFN App. The strategies also include bundling MFN with other services (such as inputs, credit, and communication messaging and extension services) and promoted by partner programs in the two countries. Also, Mastercard has engaged a fulltime staff to ensure usage of all its digital platforms and do interact with CEDO on a weekly basis.

In October 2019, a study was carried out to understand the perception of farmers concerning digital transactions. The survey was administered to both project and non-project participants. Findings reveal that majority of the farmers would prefer cash payment followed by Mobile Money (MM) application. Notably, more project participants were willing to adopt the MM approach compared to non-participants (Figure 1).

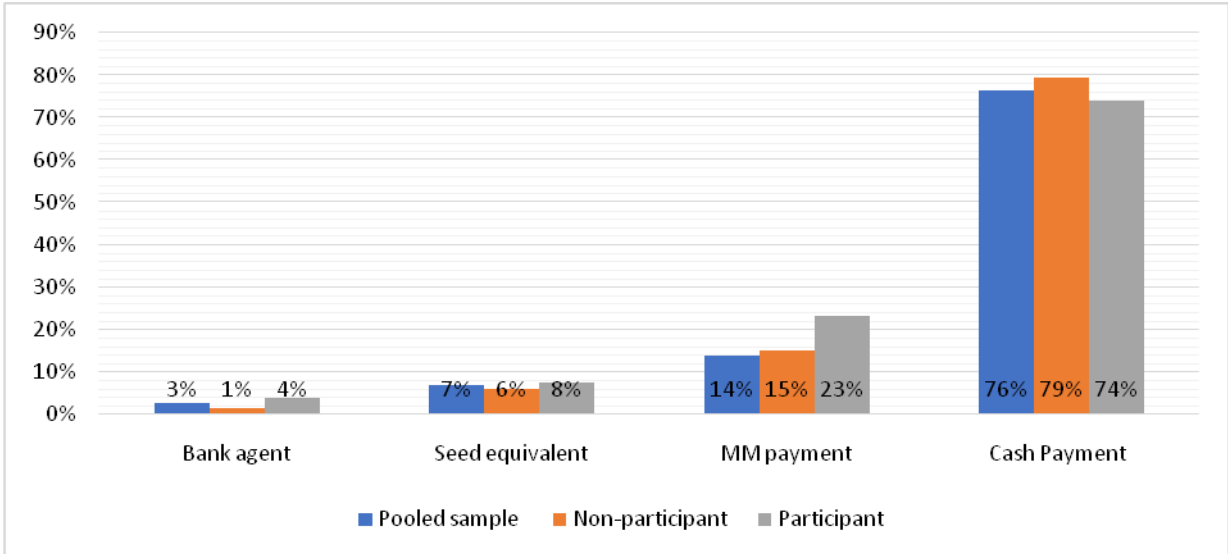


Figure 1. Perceptions of mode of payment by non-project and project participants

Farmer registration on the MFN App is still an on-going activity. For instance, CEDO continues to use MFN to register new farmers, receive new service requests from farmers and collect produce from farmers. The model uses village enterprise agents, VEAs, who also make payments to farmers during produce collections on behalf of the company. In the period under review, refresher trainings for VEAs on the use of the MFN App were held in December 2020. The training attracted 31 participants. Out of the 31 participants, 6 didn't own phones, their phones having become dysfunctional. For the training, CEDO provided handsets. Arrangements are underway for their replacement. The composition of participants was 21 male and 10 female championing e-enrollments. By end of the project the number of participating VEAs had increased to 50; 23 of them being female, comprising the original intervention areas with CEDO and the scaling areas in both Central Uganda and Eastern Uganda. The MFN users in the scaling areas were 9,203 (5,258 being women), bringing the total numbers of MFN enrolment to 28,297 farmers. Various loan types were also requested through MFN platform (338 loans on seeds,

fertilizers, and advance cash loans). However, complete adoption of the model is facing challenges in Uganda because of high taxation of mobile money transactions. The progress on ICT use is annexed as 108855-017. Other than showing the number of members enrolled on the platform, the App is used to capture, disseminate, and offer other services. These include purchase reports, payment reports, service requests including loans and the types of loans, produce categories (this includes variety and prices), expected harvests for a given season, precise farmer locations, message types for example on payments, training, collection, bulking alerts.

Objective 2: To evaluate, document and promote gender responsive alternative scaling up models and uptake pathways for delivering affordable bean products to targeted consumer categories.

The supply of precooked beans products to consumers, if it is to be impactful and self-sustaining, there is a need for sound self-sustaining supply and distribution mechanisms for the different channels. Objective two, assesses and documents business to business, business to consumer, business to producer and private public partnership for their suitability in scaling up the supply of precooked bean products based on the different uptake pathways

Testing models for sustainably delivering precooked beans.

The project has several models to reach consumers with precooked beans. Business to business models such as supply via supermarkets has focused mainly on tier 2 supermarkets (small and medium supermarkets which pay in a shorter time for the supplied products). Other outlets included retail outlets such as grocery stores. Delivery through smaller informal channels such as food vendor and kiosks have been used to supply precooked beans. More recently, home delivery, direct purchase from the processor and reference or advocacy channels have also been tested. These are mainly business to consumer models and consumer-to-consumer models where the consumer is playing the role of ensuring they personally acquire the products or that the products are delivered to them directly. Person-to-person references and social media are also playing a major role in the consumer-to-consumer models though these are still relatively new to establish trends.

A survey conducted in Kisumu (Annex 108855-018) shows that most precooked bean consumers were buying directly from the processor (57%), followed by kiosks and vendors (28%) and home delivery services (21%) and lastly by local retailers (23%). Whereas sourcing from processor was popular with both men and women, there were differences between them with respect to kiosks, retailers, or home delivery service. The processor (located in the industrial zone of Kisumu) may have been convenient for more men, possibly being near workplaces or along their travel route and low price. More women preferred buying from kiosks and home delivery than men. On the other hand, more men preferred buying from retailers. Comparison of the actual and preferred supply channels between men and women reveals an evenly matched preference to receive the products across all outlet types, with a major reduction from purchase from processors. Women have major preferences for purchase from retailers who are mainly nearer the residences while men use home delivery services (Table 4).

Table 4. Source/delivery mechanisms of precooked bean products

	Consumers of precooked bean products by sex			Most preferred delivery channel by sex		
	Male (N=34)	Female (N=50)	Total (N=84)	Male (N=34)	Female (N=50)	Total (N=84)
Processor	58.82	56	57.14	26.47	24	25
Kiosk/Vendor	32.35	26	28.57	23.53	20	21.43
Retailer	17.65	26	22.62	23.53	32	28.57
Wholesaler	5.88	8	7.14	2.94	4	3.57
Home delivery	32.35	14	21.43	23.53	20	21.43

Objective 3: To assess the enabling and disabling actors and factors in the performance of public-private partnerships models in the bean value chain.

In recent times, public institutions have been adopting private public partnerships to leverage on strengths from either counterpart. In Agriculture, the inability by smallholder farmers to access niche market has been a nightmare. This objective therefore assesses the factors that are likely to accelerate or hinder public and private sector actors in scaling up production and marketing of beans grain and precooked bean products. The study to address the objective was carried out in Kenya (Annex 108855-024) since it is where the precooked bean products were first introduced on the market, which gives the findings rigor. In Uganda where they are just trickling in, the findings would not be very reliable. A study tool comprising of open-ended questions was employed. A sample size of 64 bean value chain actors was interviewed. The interviewed actors and respective numbers were: Farmers (16), Agro dealers (16), Traders (wholesalers, retailers, aggregators) (16), Extension (2), Media (2), Financial institutions (1), other NGOs (6), Cereal growers association (1), Caritas (1) and Research institution-KALRO (1), Processor-Lasting Solution processor (1) and supermarket (1).

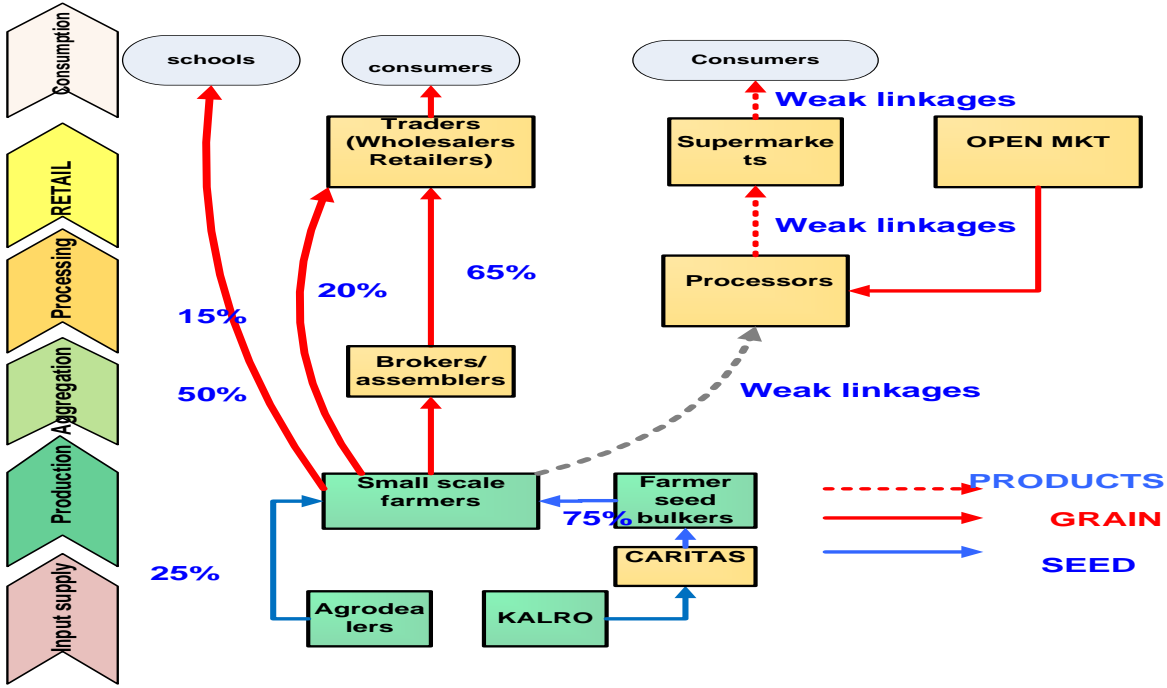


Figure 2: Bean value chain map and actors, Kenya.

Quantification of improved bean varieties value chain

Figure 2 shows the flow of seed, grain, and pre-cooked bean products in Kenya. Farmers obtain seed from two sources: KALRO through CARITAS (75%) and agro dealers (25%). Sustainability of KALRO-CARITAS pathway is not guaranteed given institutional challenges faced by KALRO as a public organization in doing business. Hence, there is need to strengthen the private sector seed pathway consisting of agro dealer and seed bulking by community-based seed producing farmers. Brokers are the largest buyers for grain (65%), followed by direct deliveries to traders (20%) while schools account for 15%. The processor obtained small amounts of beans from farmers for pre-cooking. This was a pilot of the processor-producer model to buy bean grain directly from contracted producers based on the seed the processors supplied to the producers, in order to secure sufficient grain supplies of acceptable quality with acceptable pricing per kilogram bought. Lasting Solutions Ltd in Kenya used this model. The success of this model will address the gap observed in the farmer to processor pathway. This finding suggests a need to have more private sector processors involved in the pre-cooked bean chain to provide market for farmers' beans. The project has addressed this gap by bringing new processors on board. The study further documents the current roles and networks, strengths, weaknesses by the actors in the bean value chain.

Roles of the bean value chain Actors

Furthermore, Figure 2 shows actor roles and level of influence in the bean value chain. The most influential actors in the bean value chain are the traders, followed by CARITAS. Traders are ranked more influential because they buy the bulk of the bean grain. The traders have a double pull effect as they influence the purchase of certified seed from agro-dealers and KALRO. While CARITAS plays a key role in farmer mobilization, community development and linkage with other stakeholders.

Strengths and Weaknesses of Public and Private sector actors in the precooked bean value chain

Table 5 shows strengths and weaknesses of the public sector actors (such as county/district governments, extension units, Product standards bodies, national and international research institutions and private sector actors (bean processors, grain aggregators, producer organizations, seed and input suppliers, banks and payment service providers) under a PPP arrangement for the precooked bean value chain. The main strengths of public sector actors are a well-trained human resource, wider coverage and well-defined institutional structures. The study further shows more strength of public sector actors with respect to availability of expertise, public good projects, wider coverage, transparency and well-defined structure. The main weakness of public sector were; too many regulations, bureaucracy in decision making, inadequate facilitation and personnel, lack of business orientation, poor enforcement of policy and lack of business acumen. On the other hand, the main strengths of the private sector actors were; commercial and goal oriented, better entrepreneurial and financial skills and strong market linkages. The main weaknesses of the private sector are namely, inadequate technical expertise, absence of public participation in their engagements, low sustainability, and traceability of projects. This finding suggests that in PPPs, there is need to optimize the synergy of a well-trained human resource and institutional structures from public sector while leveraging on commercial acumen, entrepreneurial skills and market linkages from private sector actors. Thus, partnerships centered around the private sector off-takers (e.g. processors, input dealers) and the producers developed around profitability and equitable income sharing with support from other stakeholders are key to cultivate the strengths and counter the weaknesses therefore suit the bean value chain.

Table 5: Summary of Strengths and Weaknesses of Public and Private sector actors in the bean VC

Sector	Strengths	Weaknesses
Public	<ul style="list-style-type: none"> Trained Expertise Institutional memory Public good projects Wider coverage of projects Structure well defined & transparent More influential 	<ul style="list-style-type: none"> Too many regulations Bureaucracy in decision making Inadequate facilitation Inadequate personnel Low sustainability Lack business orientation Poor enforcement of policy More funds spent in institutional hardware/meetings rather than implementation
Private	<ul style="list-style-type: none"> Goal oriented Commercial orientation Entrepreneurship skills Better financial /resource mobilization skills Easy to partner with Market linkages 	<ul style="list-style-type: none"> Inadequate technical expertise No public participation in projects implemented Low coverage Low sustainability Low traceability of projects

In a nutshell, the study sought to assess roles that are suitable for public and private sector actors in scaling up production and marketing of beans and bean products as well as factors that enable or hinder performance of PPPs. Results show that the main roles of public sector actors were mainly capacity building, advisory services, and dissemination of information, technologies, and innovations. The main interest of the public sector actors was to enhance productivity, food and nutritional security and improved incomes. On the other hand, private sector actor roles were specialized and specific to the

value chain node such as supply of inputs, production, aggregation, processing, marketing, financing. Private sector interests were driven by commercial interest and opportunities. The results of the actor network mapping show that in the dissemination of improved bean varieties suitable for precooking, KALRO, CARITAS, farmer organizations and agro dealers have strong relationships and influence, whereas in the grain flow, farmers had strong networks with traders. The weakest network is grain transaction between farmers and processors (Lasting Solutions Ltd and Smartlogistics Ltd) implying that existing models were not sufficient to meet the needs of both producers and processors. There was a missing system to aggregate produce from farmers and channel to the processors, yet processors did not have capacity to take up this function successfully. The implementing partners thus embarked on testing models that could overcome the weaknesses, such as direct contracting of farmers as opposed to initial aggregation models.

The study recommends that government actors formulate policies that incentivize investment by more private processors, promote utilization of precooked beans for nutrition in both Kenya and Uganda and engage ministries responsible for Agriculture and Finance on policies aimed at removal of taxes on e-payment for produce.

Objective 4: To assess the impacts of social, gender and economic trade-offs of market-driven production and supply models on households.

This objective was addressed through a Pro-WEAI study in the 2 countries of Kenya and Uganda. The specific objectives of the study were: i) to identify socioeconomic profiles and food security of men and women growers of common beans in Kenya and Uganda. ii) Assess bean varieties planted, farm sizes, volumes, and yields harvested and traded, seed access and grain marketing models, and constraints to production and marketing by men and women in Kenya and Uganda. iii) To determine how the CultiAF2 has impacted on women empowerment in agriculture on multiple empowerment indicators and domains. This study therefore was to determine how the CultiAF2 has impacted on women empowerment in agriculture on multiple empowerment indicators and domains.

In Kenya, the survey was conducted in three counties of Homa Bay, Makueni, and Nakuru counties. These counties were selected because they are among the five CultiAF phase 1 and 2 beneficiaries. The same criterion was used for selection of 6 districts in Uganda that included Mityana, Kiboga, Mubende, Lwengo, Lyantonde, and Rakai. In total, 1,121 respondents were selected and participated in the survey: 560 in Kenya and 561 in Uganda. For deeper understanding, focus group discussions (FGD) were used to collect qualitative data.

The study found that most households in the two countries owned and had access to communication and ICT assets and about 80% and 70% of women in Kenya and Uganda were literate and able to use communication assets. The project exploited this opportunity and increased diffusion rate of biofortified precooked bean varieties to 28% and 18% among women farmers in Uganda and Kenya respectively. About 17% and 32% of men in Kenya and Uganda planted biofortified precooked bean varieties. CultiAF emphasis of PPP enabled about 19% of farmers in Kenya and Uganda to access certified seed directly from agro-dealers, government and NGO projects, research institutions, and CEDO/CARITAS. Furthermore, while the gender gap in access to land in Uganda was not statistically significant, the inequality still persists in Kenya, especially in the main cropping season where land allocated to bean farming by men (1.46 acres) was significantly higher than that allocated by women (1.23 acres). Gender inequality to land access did not translate into significant gender yield gaps. For example, yields for men were (340 kg/acre) while that for women was (341 kg/acre) in Uganda in the main season. In the second season, women superseded men by harvesting 386 kg/acre against 352 kg/acre for men. In Kenya, yields

recorded by women in the main season (367 kg/acre) and short season (213 kg/acre) were higher than 333 kg/acre and 178 kg/acres harvested by men in the corresponding seasons. In terms of sales, while men in Uganda and Kenya respectively sold 75% and 63% of harvested volumes, women in Uganda sold 69% while those in Kenya sold 61% of their total bean produce. In addition, whereas men and women received almost same price per kg in Uganda (CAD 0.65-0.71/AUD 0.61-0.67), prices received by men in Kenya per kg (CAD 0.94-0.95/AUD 0.88-0.89) were higher than those received by women (CAD 0.86-0.88/AUD 0.81-0.83). Differences in marketed volumes and prices for men and women resulted in higher incomes for men than women. The differences in prices and consequently incomes point to unequal market access opportunities between men and women. These results show that although progress has been made in closing gender yield gaps, much remains to be done to bridge gender inequality in markets and marketing. The gap was less in Uganda possibly due to digital marketplace applications (MFN) that was more widely disseminated compared to Kenya and this points to the potential of the digital technologies in bridging the gap.

The Pro-WEAI overall 3DE score for men was 0.86 while that of women was 0.79. The aggregated Pro-WEAI score is 0.8 with farmers in Kenya having a slightly higher score (0.82) than Uganda (0.77). Disaggregated analysis shows average gender parity index of 0.88 (0.86 for Uganda and 0.92 for Kenya). Therefore, 3DE and gender parity index for Kenya is slightly higher than that of Uganda. These findings show that CultiAF2 improved empowerment for both men and women. However, women are still more disempowered compared to men. Of those women who are disempowered, the mean adequacy (3DE) score is 0.53 for Uganda and 0.59 for Kenya; this means that these women achieve adequacy an average of 53% and 59% of the indicators in Uganda and Kenya respectively. Of men who are identified as disempowered, the mean adequacy (3DE) score is 0.61 for both countries indicating that these men achieve adequacy in an average of 61% of the indicators. The top 3 disempowerment factors for women were in decisions on credit and financial accounts, work-life balance, and membership in influential groups while for the men, disempowerment related to membership in influential groups, group membership and autonomy in income control. Addressing these domains would reduce disempowerment in both the men and women.

Availability, access, stable supply, and increased consumption of precooked micronutrient rich food products in Kenya and Uganda is crucial to bridging food security and nutrition gaps as both governments seek to achieve SDG 2 by 2030. In the last ten years, the (CultiAF) precooked beans project has played a crucial role in improving food and nutrition security, as well as building resilience of smallholder farmers to constraints that impede bean farming and ensuring gender equality. These were designed to be achieved through up scaling of production, distribution, processing, and consumption of precooked bean products through PPP.

Objective 5: To assess impacts of precooked beans on household consumption patterns, food security, nutrition, social and economic welfare among bean consuming households.

To address this objective, studies were carried out that investigated awareness of precooked beans, preferences, consumption patterns and associated benefits in resource saving among consumers in Kisumu, Kenya where precooked beans have been promoted since 2017 (Annex 108855-018). The benefits of precooked beans to consumers such as cooking time, low cooking energy and water requirements were assessed. In Uganda, where the precooked bean products were not fully commercialized, the study assessed the food security situation of precooking bean variety growing households in a period of seven days using the food consumption score (FCS) and, for a period of 30 days using the household food insecurity access scale (HFIAS). The FCS is a quality-based dimension of

food security while the HFIAS is an access-based food security measurement. The study in Kenya was carried out in selected sub-counties in Kisumu county. The study used Face to face interviews. A total sample size of 167 respondents who are bean consumers was used. The sample comprised of 84 dry bean consumers and 83 precooked bean product consumers.

Results of the study indicate that 54% of the consumers were aware of the precooked beans. Their major source of information is the processors and their friends at 70% and 68%, respectively. The average frequency of consumption for both dry beans and precooked bean products was two times in a month. The lower and up limit frequency of bean consumption is 1 to 5 times in a month. The preferred precooked bean product is the generic quick cooking at (45%) followed by bean snacks (11%). The main supply channel is the processor followed by home delivery services, kiosks/vendors and retailers. Proximity or ease of access to supplies is the main factor for preferring the supply channels. It is also observed that Consumers (mostly women) shifted from wood fuel and charcoal (82% to 53%) to gas since it has become easier to cook the precooked beans. Use of gas is also seen to increase from 17% to 46%. The fuel cost reduced from CAD 0.86 (AUD 0.87) to CAD 0.52 (AUD 0.56) with precooked beans. Similarly, cooking time substantially reduced to about a third of dry beans (from 66 minutes to less than 20 minutes). The volume of water used in cooking precooked bean was only 25% of water used in dry bean cooking.

Impact of dry precooking bean varieties on household consumption pattern

In an attempt to understand the impact caused by the introduction of varieties suitable for processing, on the consumption pattern in a household, a sample comprising of participating and non- participating households was drawn. The basis for determining consumption pattern of dry beans is based on the frequency of consumption for the past 7 days in a household. The study was carried out in central Uganda. A sample size of 499 respondents of which 55% were female, 15% youths was used (Annex 108855-026). Frequency of dry bean consumption by Project and Non-project participating households Only 26% of the farmers planting precooked bean varieties consume the beans for 7 days in a week but about 98% of the farmers report that they consume beans for at least a day in a week (Figure 3).

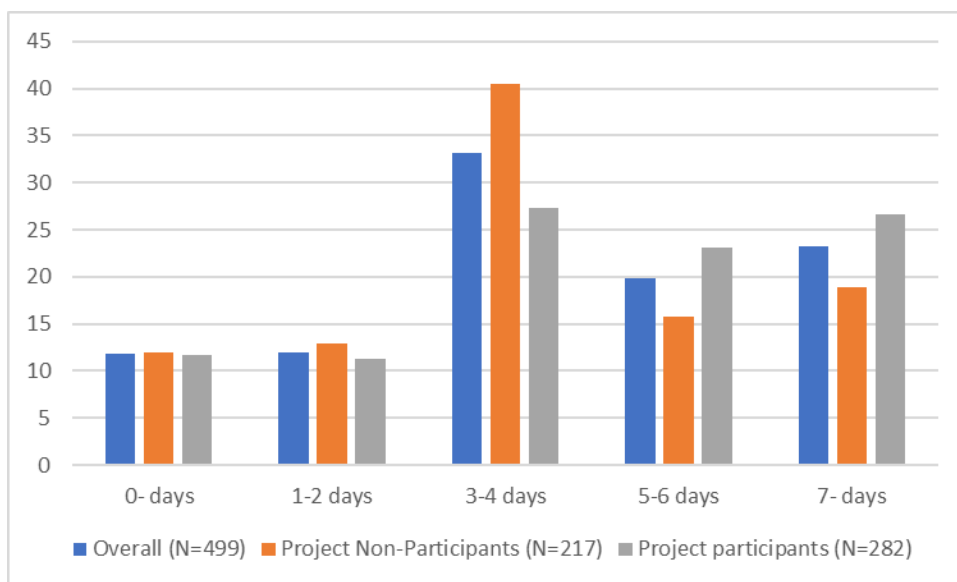


Figure 3: Frequency of precooking bean varieties by Households

Bean consumption and food consumption profile - based on the FCS

The food consumption score (FCS) indicator developed by the WFP was used in the study. The FCS captures the quantity and quality of food consumption in a household. Based on this approach for measuring food security, Figure 4 shows that majority of the farmer households were food secure in the week prior to the study. There were no significant differences in food security levels across project non-participants and project participants.

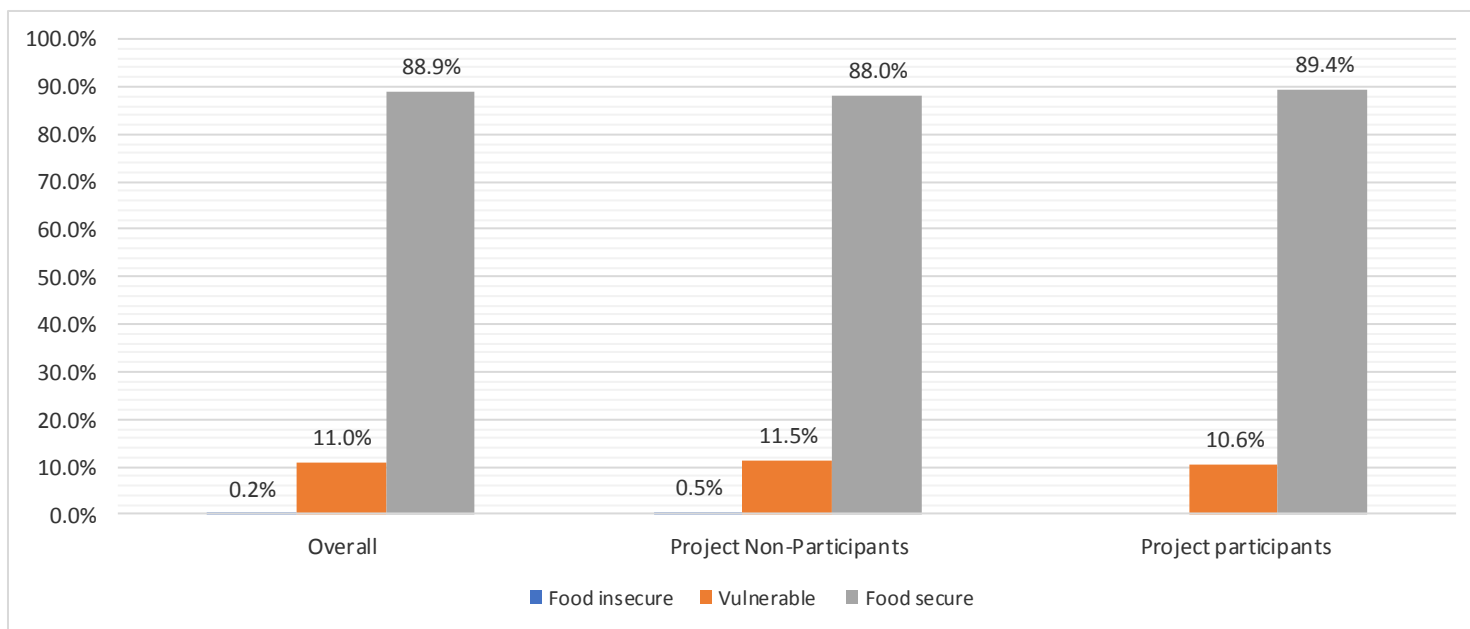


Figure 4: Food security status of sampled HHS for participating and non-participating HHS for past 7 days

Food access based on the HFIES

For the extended 30-day period, we measured food security using the FIAS approach and the results show that majority of the households had experienced food security 30 days prior to the study (Figure 5). In addition, by household headship as in table 5, male headed HHs were more food insecure compared to the female HHs in Uganda.

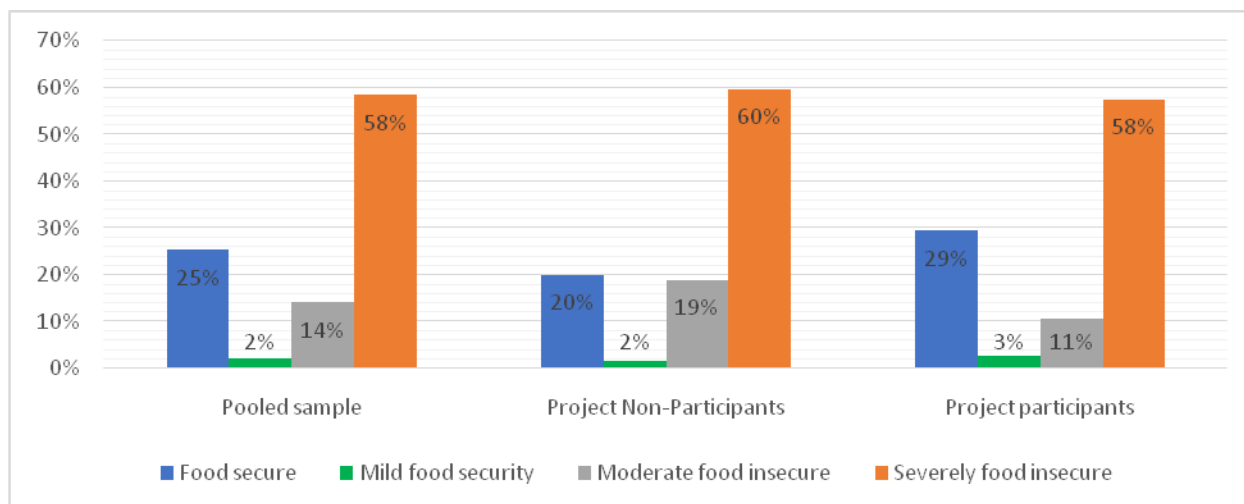


Fig. 5: Food security status based on the FIAS approach

The study as well reveals that female-headed households (FHH) were less prone to food insecurity than their male counterparts as in summary table 6.

Table 6: Food security by household headship

Food security level	Headed by Men	Headed by women
Food secure	24.2%	29.4%
Mild food security	2.5%	1.2%
Moderate food insecure	12.6%	20.0%
Severely food insecure	60.7%	49.4%

Project outputs

The project outputs were many and varied. Table 7 summaries the various outputs for the project and are subsequently annexed as evidence.

Table 7: Summary of project outputs, dissemination, and dissemination plans

Output type	Number	Dissemination plan
Peer reviewed journal article	8	Published under open access online. Links provided in table 9.
Research papers submitted under review	4	Publish under open access online
Research papers under development and internal review	6	Publish under open access online
Blog	4	Published online. Links in table 9
Oral conference presentations	7	Presented in different conferences and annexed where applicable
Documentaries on different aspects of beans	4	Online via you tube, links provided
Newspaper articles	6	Online and print media. Links provided in table 9.

Project implementation and Management:

Overall, the project was successful the COVID-19 global pandemic effects notwithstanding. The pandemic hit the world at a time when most critical milestones were just taking off. Nevertheless, most milestones were achieved satisfactorily.

Just like for CultiAF1, CultiAF2 outputs were affected because of the difference ways partners managed the affairs of the partnership. Negotiating a business model between the processor and the aggregator took longer than anticipated because both parties needed a profit, which purchase prices that would make it impossible for the processor to earn a profit. However, the delay opened more opportunities for scaling up. For example, three additional processors came in and stimulated healthy competition, which worked for the benefit of farmers. Additionally, alternative strategies like contract farming arrangements between the processor and farmers were employed to secure supplies from farmers directly cutting out the aggregators.

Table 8: Problems and challenges

No	Challenge	Action taken
1	The major challenge during the project implementation period was the COVID-19 pandemic that affected Kenya and Uganda, disrupting some activities. Governments responded by imposing various restrictions across the country, such as complete lockdowns and restrictions of movements. Only essential services were allowed, and agriculture was considered as one of the essential services at a later stage, while extension and other support services were restricted to minimal levels. Some of the retail outlets working with precooked bean products were also closed thus restricting planned supplies of products.	Some of the activities affected had to be rescheduled and alternative support mechanisms, such digital extension, used.
8	Increase in acreage for suitable varieties for processing, KATB1 and Nyota, led to increased quantities. As such, the grain demand of the two varieties from brokers increased which led to a price hike per kg hence unaffordable to the processors	Sensitization sessions were increased to stakeholders and projects of County Governments to procure and issue certified seed of these two varieties to increase grain production and stabilize prices. Due to drought threat in Machakos and Makueni, farmers from Bomet County who were in CultiAf 1 were brought on board to undertake production as their area is medium potential zone
9	Currently, high transaction taxes imposed by government especially in Uganda threaten e-payment acceptability.	Engage Policy makers to waive taxes for agricultural related transactions to encourage more women and youth use it.
10	Suitable storage infrastructure especially where the aggregator is unable to immediately collect the harvest	Improvised temporary storage structures and conversion of lounge areas into stores.
11	Postharvest handling (storage pests - bruchids). Fast cooking beans are also easily bored by the bruchids which leads to not only losses, but also intolerable bean quality	Farmers trained on PHH and quality management.
12	Price speculation due to demand distortion caused by relief suppliers who got tender to support people that were affected by the COVID-19 pandemic. Beans were a major ingredient in the relief package. These speculators also compromised on quality.	An integrated approach was used that included the aggregator increasing the buying price, training on markets and marketing and advancing payment for the beans before semblance.

Overall assessment and recommendations

The project recommends engagements with policy makers to support scaling up of the precooked bean products and ICT based applications to farmers, processors and consumers given the benefits that can directly and indirectly be reaped from their complete adoption. From the study that identified a weak link between the processors and the producers and the opportunities therein, it is recommended that more processors that can buy beans directly from farmers be engaged.

All in all, the project was satisfactorily implemented, the cordial relationship and technical inputs from IDRC/ACIAR in a partnership mode other than donor way of relationship made the project implementation unique and immensely contributed to the success of the project.

Table 9: List of Annexes

S/N	Annex Number	Title	Type
1	Annex 108855-014	Switching from Cash to e-Transactions	Technical publications and reports
2	Annex 108855-015	MasterCard Farmer Network	Technical publications and reports
3	Annex 108855-016	Activity: refresher training for EADC and CEDO agents	Technical publications and reports
4	Annex 108855-017	CEDO MFN admin portal (current data)	Technical publications and reports
5	Annex 108855-018	Precooked bean product consumption and supply channels in Kenya	Technical publications and reports
6	Annex 108855-019	Diffusion, Seed Models, and Yields and Productivity of Bio-fortified Precooked Bean Varieties: A case of Nyota in Three Counties of Kenya	Technical publications and reports
7	Annex 108855-020	Training of Farmers, Stakeholder Meetings and Grain Production of Processor Demanded Bean Varieties	Technical publications and reports
8	Annex 108855-021	Precooked Bean Project Scaling Report Summary	Technical publications and reports
9	Annex 108855-022	Production and Pro-WEAI Study	Technical publications and reports
10	Annex 108855-023	Gender mitigation plans for precooked beans developed and deployed	Technical publications and reports
11	Annex 108855-024	Precooked bean value mapping of public-private partnerships actors and their roles	Technical publications and reports
12	Annex 108855-025	Factors influencing market outlets choices among smallholder bean farmers in Homabay County, Kenya	Technical publications and reports
13	Annex 108855-026	Assessment of the social and household dietary diversity in Uganda	Technical publications and reports
14	Annex 108855-027	Deconstructing leisure time and workload: case of women bean producers in Kenya	Peer reviewed journal publication
15	Annex 108855-028	Consumer intentions to buy nutrient-rich precooked bean snacks: Does sensory evaluation matter?	Peer reviewed journal publication
		Consumer demand heterogeneity and valuation of value-added pulse products: a case of precooked beans in Uganda, doi.org/10.18697/ajfand.9	Peer reviewed journal publication
		Market arrangements used by small scale bean farmers in Kenya: What needs to change for sustainable trade volumes?	Peer reviewed journal publication

		The potential and limits of farmers' groups as catalysts of women leaders The potential and limits of farmers' groups as catalysts of women leaders (tandfonline.com)	Peer reviewed journal publication
		Exploring retailer marketing strategies for value added bean products in Kenya https://ageconsearch.umn.edu/record/292436/	Peer reviewed journal publication
		Using the Learning Transfer System Inventory to test the effects of Trainee and training design characteristics on the transfer of agricultural training in Uganda https://onlinelibrary.wiley.com/doi/epdf/10.1111/ijtd.12202	Peer reviewed journal publication
16	Annex 108855-029	Distributing high-iron and zinc bean varieties to women farmers during COVID-19	Blog.
17	Annex 108855-030	Precooked beans set to reach more households in Africa	Blog.
18	Annex 108855-031	Engaging Kenyan youth in bean business to boost income	Blog
19	Annex 108855-032	Seed Revolving Fund: Women Uplifting Their Community in Kenya	Blog
20	Annex 108855-033	Effect of public private partnership on income generation: A case of precooked beans in Homa bay county, Kenya	Student thesis
21	Annex 108855-034	Effect of COVID-19 anti-contagion measures on businesses operated by informal food traders in urban markets of Kenya	Student thesis
22	Annex 108855-035	Household food consumption and coping strategies adopted during COVID-19 pandemic in informal settlements of Kenya: A case of Nairobi and Kisumu cities	Student thesis
23	Annex 108855-036	Analysis of demand and distribution of precooked beans among consumers in Kisumu County	Student thesis
24	Annex 108855-037	Effects of agricultural production shocks on smallholder farm household: A case of COVID-19 pandemic in Nakuru and Makueni, Kenya	Student thesis
25	Annex 108855-038	https://www.researchgate.net/publication/334270521_Exploring_retailer_marketing_strategies_for_value_added_bean_products_in_Kenya	Peer reviewed journal publication
26	Annex 108855-039	Bean story on page 50 on MYGOV – Kenya Government Newspaper normally inserted in 3 major daily newspapers	A newspaper article
27	Annex 108855-040	KALRO, Nakuru County collaborate in producing high yield bean variety https://www.kbc.co.ke/kalro-nakuru-county-collaborate/ https://www.the-star.co.ke/news/2021-03-25-farmers-in-nakuru-double-yields-thanks-to-new-bean-variety/ https://www.standardmedia.co.ke/farmkenya/crop/article/2001393802/kalro-partners-in-new-pre-cooked-	KBC news feature Star newspaper article Standard newspaper story

		bean-project https://www.kenyanews.go.ke/kalro-and-nakuru-county-embark-on-promoting-horticultural-farming/ https://www.youtube.com/watch?v=FvZtmWp_Kg https://www.youtube.com/watch?v=o4pGWXFS0MA	Kenya News Agency feature KBC news feature KBC news feature
28	Annex 108855-041	Analysis of Choice for Convenient Food Products by Generation X and Y Consumers in Urban Areas of Uganda: Implications for Precooked Beans Acceptability	Oral presentation at GS18 Summit
29	Annex 108855-042	Improving use of Mobile technologies by women bean farmers for economic empowerment in Uganda-A feasibility study	Oral presentation at GS18 Summit
30	Annex 108855-043	Enabling factors and barriers for scaling innovations	Oral presentation at the Cultivate Africa's Future Fund dissemination webinar.
31	Annex 108855-044	Challenges and opportunities in using the Pro-WEAI tool	Oral presentation at the Cultivate Africa's Future Fund Pro-WEAI learning series.
32	Annex 108855-045	Impact of COVID-19 on gender relations	IDRC COVID-19 learning and exchange workshop