Cost Benefit Analysis of Agricultural Interventions to Enhance the Production of Cowpea, Groundnuts, Maize and Soybeans Value Chains in Nigeria

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Development Discussion Paper: 2018-03

ABSTRACT

This report presents the results of the cost-benefit analysis (CBA) of a series of agriculture production and productivity enhancing interventions in Nigeria. More than 20,000 impoverished farmers have received assistance under this program. A CBA was undertaken to assess the financial and economic benefits of adopting best agricultural practices by these farmers in growing crops. While these interventions do improve the households' incomes across all VCs, the assistance alone for growing crops will not allow the households to move above the poverty line threshold. Households need to rely on other economic activities, including livestock husbandry, or non-farm employment to graduate from extreme poverty.

Acknowledgements

This analysis was completed through the financial support of USAID' through their "Learning, Evaluation, and Analysis Project (LEAP II). And its contract with the International Development Group. Contract Number: AID-OAA-I-12-00042/AID-OAA-TO-14-00046. The assistance of Abdoul Murekezi, during the completion of this report is greatly appreciated

Keywords: Nigeria, CBA, USAID, households.
Jel classification: D 61, D62, Q12, Q13.

1. EXECUTIVE SUMMARY

PROJECT DESCRIPTION

The Feed the Future (FtF), Nigeria Livelihoods project, supports 42,000 impoverished households growing their agriculture production and incomes, and improve nutrition, ensuring their move along the Pathway to Prosperity. It targets a total of seven Local Government Authorities (LGAs) in the three selected states; four LGAs in Sokoto, two in Kebbi, and one in FCT. The Livelihoods project has an implementation period of five years, with support from USAID and cost share from Catholic Relief Services (CRS) and partners. It involves four main components of cross-sectoral community-based interventions, also known as sub-Intermediate Result (IR), namely; agriculture production and productivity (IR1), income generation and education (IR2), nutrition and WASH (IR3), and governance and social safety net (IR4).

This report presents the results of the cost-benefit analysis (CBA) of the agriculture production and productivity component of the Livelihoods project (IR1). The total USAID investment cost in this component is USD 5,129,027[1]. More than 20,000 impoverished farmers have received assistance under this component. The CBA assesses the financial and economic benefits of adopting best agricultural practices by these farmers.

RESULTS

The CBA reveals that the project interventions result in a positive rate of return on USAID investment of 22.88%. This rate of return is significantly above the benchmark of 12 percent used in the analysis. The economic net present value (ENPV) from USAID's perspective is USD 2.37 million[2]. It should be noted that the economy of Nigeria benefits by USD 6.74 million, given that USAID bears full cost of the project. Table 1 below presents economic returns by value chain from both Nigeria and USAID perspective.

Table 1: Incremental Economic Net Present Value (USD)

Value Chain	ENPV per Beneficiary	Number of Beneficiaries	Aggregate ENPV
Cowpea	1,989	567	809,413
Groundnuts	609	556	234,760
Maize	467	591	216,669
Soybeans	32	686	15,333
Cowpea, millet, and sorghum	639	10,373	5,459,552
ENPV from Nigeria Perspective:			**6,735,727**
Present Value USAID Costs:			**4,362,021**
ENPV from USAID perspective:			**2,373,707**
IRR from USAID perspective:			**22.88%**

[1] The investment cost figure is made up of USAID's cash contribution of around 82%, and CRS' and partners' "in-kind" contribution of the remaining 18%.

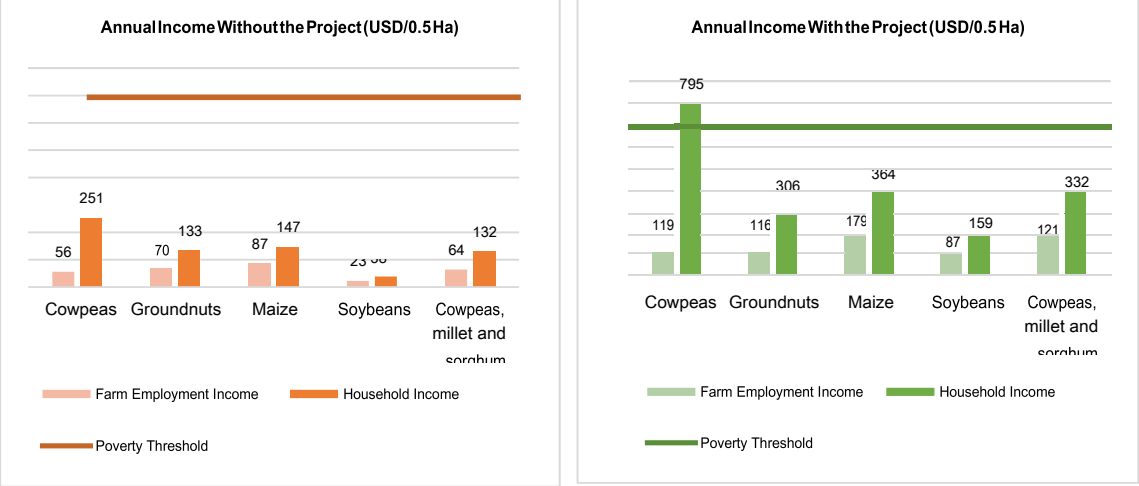
[2] These returns include both USAID's and CRS' and partners' returns according to their investment contributions of 82% and 18%, respectively.

The analysis reveals that the project is expected to improve the annual income of the farmers across all targeted crops. On average, the annual HHs income increases by an estimated USD 251.Figure 1 shows the family labor farm employment income and gross of labor households' (HH) income accruing in each value chain (VC) both prior to the project interventions and with project interventions.

One of the main objectives of the Livelihoods Project is to lift extremely poor households above the poverty threshold. This threshold is established at USD 795 per person per year and average household size in Nigeria consists of five family members. As can be seen from Figure 1, the HHs income is still below the extreme poverty threshold for all the crops except cowpeas. The annual income from the rest of the value chains is less than 50% of what is achieved by the farmers producing cowpeas.

While the agricultural component of the Livelihoods Project does improve the HHs income across all VCs, this assistance alone will not allow the HHs to move above the poverty line threshold. Households need to rely on other than land productive factors, including livestock, or non-farm employment to graduate from extreme poverty. USAID assistance that reduces the HHs costs, such as WASH component of the project, also does contribute to the improved welfare of the HHs.

Figure 1: Annual Income With and Without the Livelihoods Project (USD/0.5 Ha)



It should be noted that the strong results in the cowpea value chain are to a large extent driven by the 20% tariff protection resulting in the high domestic prices for the crop.

The agronomic practices introduced by the project have significantly increased the cost of production, with an average increase of 175%. The cost of production with improved agronomic practices ranges from USD 171 to USD 335 for soybeans and maize, respectively. On average the labor cost has increased by 131% indicating employment created by introducing enhanced agronomic practices. The cost of commercial inputs, in turn, increased by 285% on average. Increase in the labor cost and the cost of commercial inputs points out the importance of the market access to realize employment benefits, as well as to ensure sustainability of the project.

RISK ANALYSIS

In order to achieve the expected results presented above, a number of variables need to be closely monitored by USAID and the implementing partner. Three critical variables that significantly affect economic returns as well as income of the benefiting households that need to be closely monitored are:

1. ***Post-harvest losses:*** It was observed that on average, if post-harvest losses increase by 5%, the farmer's incremental net income would decrease by 14%. The greatest impact is in the maize value chain where approximately 19% of the incremental net income would be eroded.

2. ***Change in the expected yield:*** If the yield expected from adopting the best agronomic practices falls by 10%, the analysis shows that the farmers' incremental net income would be reduced by 26% on average, across all VCs.
3. ***Change in market price:*** A 10% fluctuation in the market price of the crops was observed to cause, on average, an 18% change in the farmers' incremental net income. Soybean and cowpea farmers' incomes will be the most affected by any changes in market prices while farmers intercropping cowpeas, millet, and sorghum would be the least affected.

RECOMMENDATIONS

In addition to the three variables above, the Livelihoods Project and USAID should closely monitor the availability of commercial inputs (fertilizers, certified seeds, etc.) and market access. The two are closely related as without ability to sell the produce, farmers will not be able to purchase the commercial inputs even when they are available:

1. ***Access to commercial inputs*** – Field visits revealed that the majority of farmers cannot access the fertilizers that were prescribed by best agronomic practices. In most cases, fertilizers and pesticides at best are obtained with a significant delay thereby reducing the yields. The average yields, although improved when compared to previous practices, are significantly lower than the potential yields. If the continuous supply of the certified seeds and fertilizers will not be ensured after the project is completed, the economic returns from the USAID perspective are likely to become negative. The results of a two-way sensitivity analysis on changes in adoption rate and expected yield affirms that the USAID returns would be reduced to USD -0.41 million if the yields from all crops decrease by 10% and the average adoption rate on all crops is reduced to 60%.

2. ***Market access*** – ensuring that the farmers can sell at least 17% (cowpeas) to 40% (soybeans) of their produce is essential for the long-term sustainability of the interventions. In the absence of the market access, farmers will return to the subsistence farming immediately upon completion of the Livelihoods Project assistance. In Nigeria, rural poverty is estimated at 90% and 80% of the poor mainly depends on agriculture or farm labor (Olive, 2006). Poor farmers are likely to divert their limited farm income towards basic needs such as feeding and medication rather acquiring improved seeds and fertilizers.

The sustainability of the interventions will be further strengthened if the Government of Nigeria, USAID, and other development partners will work on providing access to credit at the affordable rates. Although the Livelihoods Project has made significant progress on the promotion of Savings and Internal Lending Communities (SILCs), SILCs charge 10% monthly interest rate that is prohibitively high to finance agricultural inputs. SILCs are found highly beneficial by the households; however, such interest rates are justified only when a household faces an emergency such as sickness.

A review of the household expenditures on food in Nigeria reveals that beans and peas constitute a large share of food expenditure in both urban and rural areas. In urban areas, expenditures on beans and peas accounts for 8.98% of total food expenditures and ranks third after tubers/plantains and vegetables. Of the total rural food expenditures, beans and peas have a large share at 10.09%.[3] The field visits and discussions with farmers also shows that improved varieties of cowpeas introduced by the project have been found very beneficial. These varieties not only result in a higher yield but are also pest resistant and easier to cook.

[3] Consumption Pattern in Nigeria 2009/10, National Bureau of Statistics, March 2012.

Agricultural practices recommended by the project require households to spend from USD 73 to USD 157 every year on the commercial inputs, for the groundnuts and maize, respectively. This is in a situation where about 64% of population (more than 80 million people) live on less than USD 1.90 per day[4]. If timely market access is not ensured, it is recommended to design an exit strategy based on the agronomic practices that will allow farmers to achieve moderate increase in the yield without significant financial outlays.

The Naira was devaluated in November 2014 and January 2015 by 8% and 15%, respectively. This devaluation has significantly increased the costs of the fertilizers and other inputs. However, the majority of farmers in Nigeria do not apply fertilizers (average use of fertilizers is only 8kg/ha compared to 200kg/ha as global average). Labor and land being the main inputs, the devaluation boosted the profitability of some crops, such as cowpeas. Nigeria is both the largest consumer and producer of cowpeas accounting for more than 50 percent of the World production. The exchange rate devaluation has resulted in a spike of the cowpea price along with many other crops, making production attractive. Poor road infrastructure, however, prevents significant increases in the farmers' income, as the cost of the crop collection born by the traders is very high. In addition, the Central Bank of Nigeria increased interest rates, resulting in a prohibitively high cost of capital for the traders. Lastly, exchange rate volatility imposes additional risks on the local processing and exporting companies, with some of these companies temporarily stopping exports. While reduced exports may reduce the price of some crops in a short term, the companies that stopped exports, generally refocus toward processing crops for domestic urban markets. As a result of all these forces, the market is volatile with the prices for all major crops going up and down on a daily basis. Any measures that can assist farmers in getting access to a stable market, such as off-take contracts if well structured, will further increase the sustainability of project interventions.

[4] http://dailypost.ng/2016/09/05/nigeria-one-poorest-countries-world-80m-living-poverty-line-un-report/

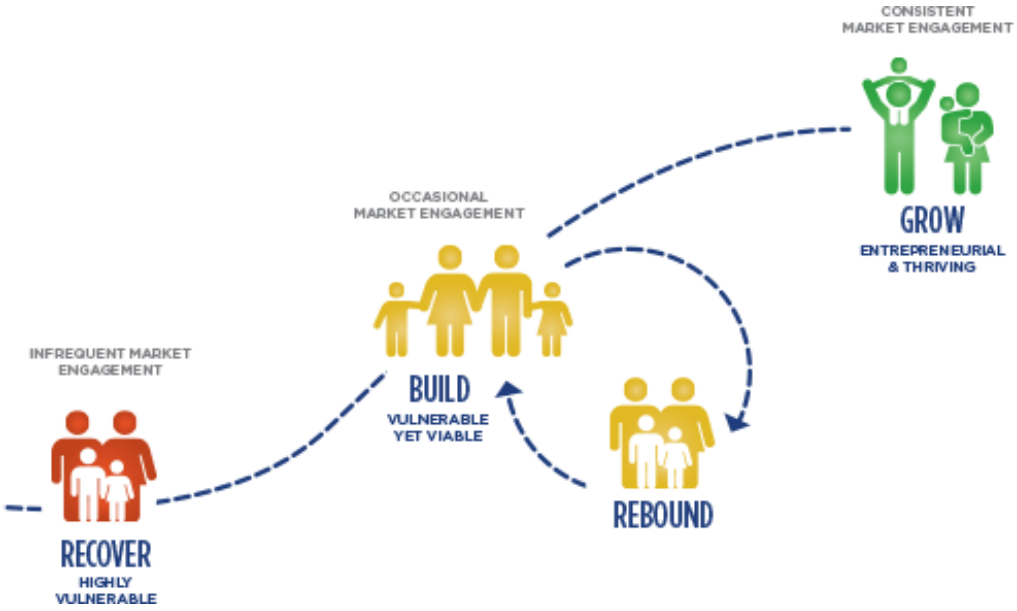
2. INTRODUCTION

The Feed the Future (FtF) Nigeria Livelihoods Project is a 5-year USAID-supported program that is implemented by Catholic Relief Services (CRS) in partnership with the Catholic Caritas Foundation of Nigeria (CCFN), Mercy Corps, the Federation for Muslim Women's Associations of Nigeria (FOMWAN) and Making Cents International. The project is based in rural communities in Northern Nigeria's Sokoto and Kebbi states, and the Federal Capital Territory (FCT). This paper presents the results of the cost-benefit analysis (CBA) conducted on the Intermediate Result 1 of the project "Increased Agricultural Production and Productivity".

2.1 PROJECT DESCRIPTION

IR1 is focused on the agricultural-led growth providing the foundation of the Livelihoods Project. The project aims to improve agricultural practices, including post-harvest storage for nutrient rich crops/livestock already being produced, and promotes a market-oriented approach to diversify production. This is accomplished by ensuring that all agricultural activities are adapted to specific agro-ecological and cultural contexts. The project uses a multi-sector approach aiming to assist more than 20,000 impoverished households (HHs) to increase their agriculture production and incomes as well as improve their nutrition. Using the Pathway to Prosperity Model to help farmers build sustainable livelihoods through a phase-by-phase process, the project undertakes cash transfers to help meet nutritional needs, recover assets, and overcome barriers to income-generating activities. To support sustainability, the project strengthens the institutional capacity of government systems to implement poverty reduction programs and reinforce accountability between the government and citizens.

Figure 2: Pathway to Prosperity Model[5]



[5] https://www.crs.org/our-work-overseas/program-areas/agriculture

2.2 DESCRIPTION OF INTERVENTIONS

The project employs a set of interventions to shift the farmers away from traditional farming practices toward the adoption of the best agronomic practices. These interventions generally span across three main areas namely: (i) best agronomic practices, (ii) use of certified seeds, and (iii) post-harvest management. Figure 1 presents the adoption rate of the farmers for each of the three set of interventions (see page 2 of the Executive Summary).

Figure 3: Interventions and Adoption Rates

In particular, the Livelihoods Project conducts a set of activities including but not limited to:

- Partnership with SCL Agro-Processing Limited and the development of an outgrower scheme
  - 24 representatives of the farmer groups were trained on best agronomic practices to increase the producer groups' yield of priority crops - soybeans, sorghum and maize.
- Training
  - Collaboration with Karite Oil Processing Limited to deliver a two-day (Training of Trainers (ToT), 15 field agents and 31 representatives;
  - Engaged TAK Integrated Agricultural Solution Ltd. to train 38 tractor operators, 14 tractor mechanics and 16 post-harvest operators total from all the project communities of Adamawa, Yobe and Borno states;
  - 38 Field Agents were trained on GPS mapping of the available mechanization services, irrigation facilities, post-harvest equipment and agro-input supply services and 65 Field Agents were trained on tractor hiring services, agro input business, and irrigation services.
- Established 50 demonstration farms in FCT (8), Kebbi (24) and Sokoto (18) to showcase good agronomic practices to farmers' groups.
- Use of improved seed variety, right spacing and the use and application of fertilizer.
- Established a new partnership with SCL Agro-Processing Company in FCT to become an offtake for soybeans, sorghum and maize produced by the project beneficiaries.

2.3 CBA COVERAGE AND RATIONALE

The Livelihoods Project has affected the production activities of more than 20,000 farmers. Table 2 below presents the crops grown by the farmers and land area affected by the project by year. As it can be seen from the Table 2, the majority of farmers prefer intercropping several crops together.

Table 2: Summary of CBA Coverage

			Land Area Affected by the Project over the Implementation Period (Hectares)			
No.	**Value Chain**	**No. of farmers**	**FY 2015**	**FY 2016**	**FY 2017**	**Total**
VC 1	Cowpea, Millet, Sorghum	10,373.00	1,037.30	1,607.82	2,541.39	5,186.50
VC 2	Cowpea, Soybean, Groundnut	1,684.00	168.40	261.02	412.58	842.00
VC 3	Groundnut, Sorghum, Millet	1,762.00	176.20	273.11	431.69	881.00
VC 4	Rice, Millet, Sorghum	3,937.00	393.70	610.24	964.57	1,968.50
VC 5	Cowpea	567.00	56.70	87.89	138.92	283.50
VC 6	Groundnut	556.00	55.60	86.18	136.22	278.00
VC 7	Maize	591.00	59.10	91.61	144.80	295.50
VC 8	Soybean	686.00	68.60	106.33	168.07	343.00
	Total	**20,156.00**	**2,015.60**	**3,124.18**	**4,938.22**	**10,078.00**

The CBA was conducted on the five cultivation practices of the following value chains:

1. Intercropping of cowpeas, millet and sorghum
2. Mono-cropping of cowpeas
3. Mono-cropping groundnuts
4. Mono-cropping maize
5. Mono-cropping soybeans

During the field visits it was observed that the farm budgets (cost of inputs and value of output) for the "cowpea, soybean, groundnuts" and "groundnuts, sorghum, millet" are very similar to the "cowpea, millet, sorghum" farm budgets resulting on similar income for the farmers. In this regard, the CBA was done for only cowpeas, millet, and sorghum but the results can be extrapolated to include the two similar cultivation practices. The analysis of the "rice, millet and sorghum" was excluded from this study given inability of the team to interview benefiting farmers during the field trip.

3. METHODOLOGY AND MODEL DESCRIPTION

3.1 METHODOLOGY

To quantify the benefits and impact(s) of the agriculture intervention from the HHs' and the Government of Nigeria's (GoN) perspectives, integrated investment appraisal (IIA) was used. IIA is a method of CBA that measures benefits and costs in financial and economic terms making it possible to identify, quantify and allocate costs and benefits to the appropriate parties. The analysis was done on an incremental basis, that is, what the financial and economic outcomes are under the traditional agronomic practices (referred to as "without" scenario) and what they would be when best agronomic practices are adopted ("with" scenario).

The financial and economic analysis was done on an assumed farm size level of one hectare per family and the incrementality was measured at an aggregate level, that is, the total area under cultivation for each value chain (VC).

3.2 MODEL DESCRIPTION

The analysis covers a 10-year period from 2015 to 2025, comparing annual "with-project" and "without-project" scenarios on an incremental basis. The base year is 2015 (the year the project started), and the real financial and economic discount rates are set at 12 percent. The model first derives nominal cash flows, which are then discounted according to price indexes (World Bank inflation and exchange rate data) to derive statements of real cash flows. From the incremental financial and economic cashflows, reconciliation statements were constructed to identify the externalities accruing to the GoN.

The Excel model is structured as a dynamic model, where a change in a parameter affects all outcomes. For instance, a reduction in yield of a crop that is otherwise imported to Nigeria will not only negatively affect returns to the farmers, but also will increase foreign exchange spending (through an increase in export) and therefore reduces the amount of indirect taxes collected by the government (loss of foreign exchange premium).

Despite the average land holding of 0.5 ha per benefiting farmer, the farm models were constructed on a per-hectare basis as the crop production costs and yields are usually expressed on a per-hectare basis.

4. AGRICULTURAL PRODUCTIVITY IMPROVEMENT COMPONENT (IR 1)

4.1 FINANCIAL ANALYSIS

Financial analysis was conducted using data collected from field studies and extensive literature review. Farm budgets for the prevailing traditional and best agronomic practices for each VC were put together through consultations with local farmers and agricultural experts. From these farm budgets and the expected impact of the best agronomic practices on yields, financial analysis was carried out. HHs will continue reaping the financial benefits of adopting the best agronomic practices. Table 3 outlines the aggregate financial net present value (FNPV) per VC.

Table 3: Aggregate Financial Results

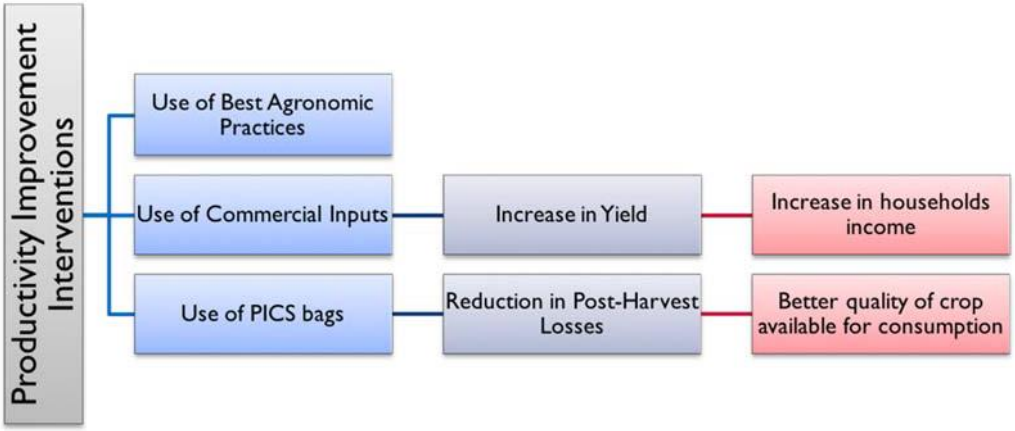
Incremental Financial Analysis			
Value Chain	**FNPV (USD/0.5 Ha)**	**Aggregate FNPV (USD)**	**IRR**
Cowpeas	2,438	959,316	44.17%
Groundnuts	553	213,424	32.30%
Maize	470	192,759	26.98%
Soybeans	109	51,779	17.69%
Cowpeas, millet, and sorghum*	717	6,196,236	34.42%

* The results for cowpeas, millet, and sorghum were very similar to when cowpeas, soybeans, and groundnuts are intercropped as well as groundnuts, sorghum, and millet. Taking this into consideration, the reported results for cowpeas, millet, and sorghum also include extrapolation for the abovementioned intercropping variations.

Benefits of Interventions

Farmers' Income. One of the main objectives of implementing this project was to lift some of the most vulnerable HHs in Nigeria out of poverty. This section highlights the impacts of the best agronomicpractices on the annual net income as well as the distribution in terms of HH income and farm employment for income for each value chain.

Figure 4: Benefits of Interventions

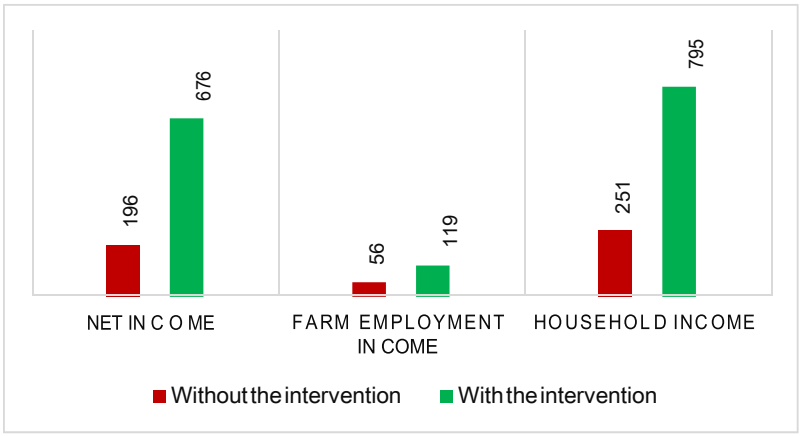


Cowpeas. Cowpeas are a major food source for both humans and animals. All the components of the cowpea (stems, vines, leaves, and pods) are consumed either before, during or after the development,

and maturation of the crop. The stems, leaves, and vines of cowpeas are used as livestock fodder. According to Agro-Nigeria, Nigeria is not only the largest producer, but it is also the largest consumer of cowpea, with cowpea production from Nigeria accounting for 61% and 58% of total African and World production respectively. However, insignificant quantities of Nigerian Cowpea are traded internationally.

Cowpeas are an important source of income among farming households. Farmers not only generate revenue from cowpeas, but its residue products are sold as animal feed. Farmers tend to obtain higher revenues from the sale of animal feed when stems, leaves, and vines are stored at harvest and sold during the dry season when they have a higher value in the market. As

Figure 5: Cowpeas Annual Income (USD/0.5 Ha)



summarized in Figure 5, with current traditional practices, the annual net income per 0.5 hectares is USD 196, farm employment income is USD 56, and the HH income totals to USD 251. By implementing the best agronomic practices, the net annual income per 0.5 hectares increases to USD 676. HH income per hectare potentially rises by more than 200% while farm employment income rises by an estimated 114% to USD 119.

Groundnuts. Nigeria is the largest producer of groundnuts. According to the latest data from the FAO, Nigeria's production is 3.5 million tons.[6] Nigeria also ranks as the third largest producer of groundnuts

[6] http://www.fao.org/faostat/en/#data/QC

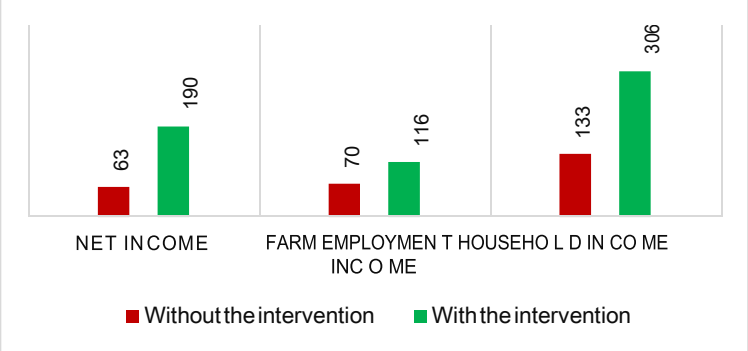
in the world after China and India. One of the states that plays a significant role in the production of groundnuts and which was part and parcel of the Livelihoods Project is the state of Sokoto.

Groundnuts are an important food source, providing essential fats, oils and protein. According to Healthline, each groundnut kernel has a composition of 44-56% oil and 22-30% protein. Groundnuts are widely consumed in Nigeria in various forms (cooked, roasted and as processed products such as groundnut oil). A variety of traditional dishes that use groundnut as their main ingredient are popular among locals, these include kuli-kuli, yayi, chin chin, donkwa, and groundnut soup.

Groundnuts are an input in a number of food processing industries and are used to manufacture groundnut derivative products such as oil and kuli kuli. There is a high demand for both products in the Nigerian market. As a result of a ban on the importation of refined vegetable oil into Nigeria, the oil processing industry demand continues to grow for locally grown groundnuts. Groundnuts and other oilseeds such as cotton seed, sunflower, coconut, sesame seed, and various other oilseeds (apart from soybeans and palm seeds) make up around 5% of the vegetable oil market. The byproducts of oil processing, namely groundnut cake can also be utilized as poultry feed.

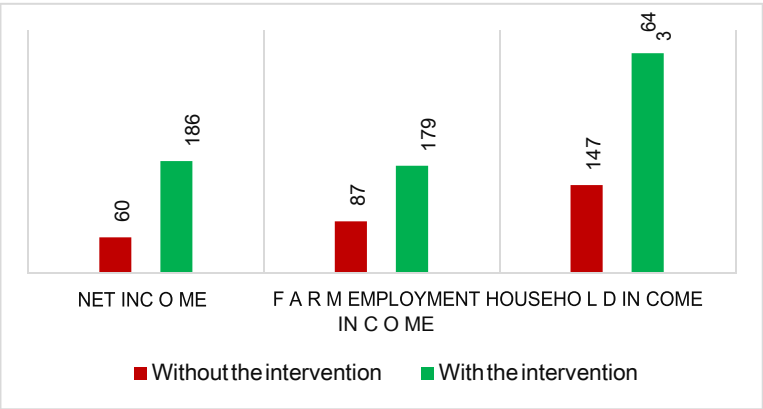
The market price at which farmers can sell their groundnuts is contingent upon their state. Shelled and unshelled groundnuts command different prices, with shelled groundnuts selling at a premium price, to compensate for cost of shelling. However, from the teams' field visit observations, the farmers prefer to sell unshelled groundnuts to avoid potential rejections from buyers from quality issues. An increase in yield due to best farming practices instituted by the Livelihoods Project further augments farmers' incomes. The annual HH income from groundnuts increases from USD 133 to USD 306 per 0.5 hectares while the annual farm employment income increases from USD 70 to USD 116.

Figure 6: Groundnuts Annual Income (USD/0.5 Ha)



Maize. In Nigeria, maize is known and called by different vernacular names depending on locality like *masara* in Hausa. Maize is an all-important crop which provides an avenue for making several types of foods. It also has some medicinal values and serves as raw-materials for many industries. The kernels are often used in cooking as a starch. Maize is also largely used as livestock feed and as a raw material for industrial products. It can be processed into maize flour and can be used to make hard or soft pap or serve as a replacement for wheat flour, to make cornbread and other baked products. It can be boiled or roasted on its cob and served as a snack like popcorn. Maize also constitutes a large share of poor consumers' expenditure.

Figure 7: Maize Annual Income (USD/0.5 Ha)



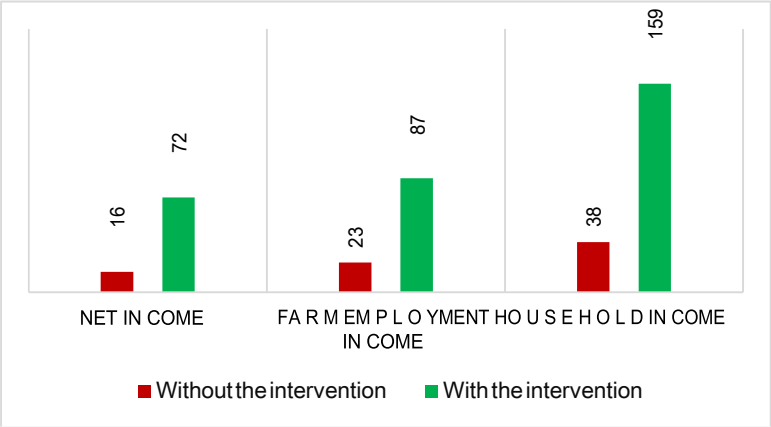
With the project, the net annual income rises from USD 60 to USD 186 per HH. The estimated yearly HH income increases from USD 147 to USD 364 while farm employment income rises from USD 87 to USD 179.

Soybeans. Soybeans are a good source of protein and vegetable oil. These two dietary nutrients represent 38% and 18% of the nutritious content per serving of soybeans. Relative to animal protein, soybeans provide a significantly cheaper source of protein, most especially for low income rural households whose purchasing power is constrained.

Various processed soya bean food products exist in the market such as soy flour, soy milk, soy oil, tofu (*awara*), and fermented condiment (*dawadawa*). There are other products that are targeted towards combating malnutrition such as soya bean fortified *gari* and cereal-based weaning food.

As a result of adopting best agronomic practices, HHs' annual income is expected to increase from USD 38 to USD 159 per 0.5 hectare. The farm employment annual income, currently an estimated USD 23, is expected to increase to USD 87 per 0.5 hectares. The annual net income from soybean production is expected to grow from USD 16 to USD 72 per 0.5 hectares.

Figure 8: Soybeans Annual Income (USD/0.5 Ha)



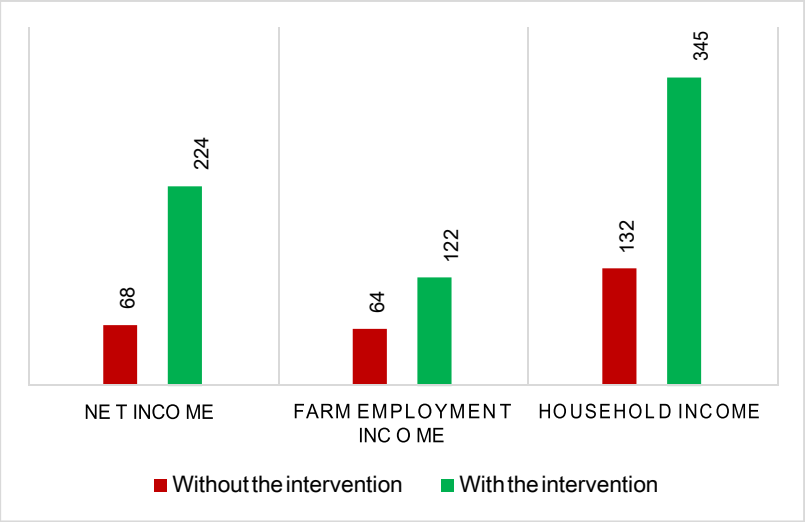
Cowpeas, Millet, and Sorghum

Millet. Nigeria is the third largest millet producing country in the world after India and China, and the leading producer in Africa followed Niger and Mali. The crop is favored due to its productivity and short growing season under dry, high-temperature conditions. The grain is used for making a thick dough *fura*, and a custard-like food *kwoko.* It can also be used to make millet juice, *kunu,* which is a is a popular drink consumed throughout Nigeria, but mostly in the north. Given that over the past years bread prices have gone up 30-35 percent, consumers are eating less wheat products and more of millet and sorghum.[7]

Sorghum. Sorghum is a local grain grown predominantly in the semi-arid, savannah and grassland areas of Northern Nigeria because it is drought tolerant and heat tolerant. It is nutritionally rich and serves as a staple food in most parts of northern Nigeria. Sorghum is used for fodder and food such as for porridge and sorghum flour. Increasing costs of imported barley have driven breweries to look to sorghum as an alternative for brewing beer, therefore, the grain has become a valuable ingredient used in the brewery industry.

7 https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Grain%20and%20Feed%20Annual_Lagos_Nigeria_4-21-2016.pdf

Figure 9: Cowpeas, Millet and Sorghum Annual Income (USD/0.5 Ha)



Sorghum and millet are intercropped with other crops such as cowpeas and groundnuts. Given that inconsequential differences in costs and income between the various intercropping combinations were observed, only the results of one of these mixtures (cowpeas, millet, and sorghum) is reported. With the project, the annual HH income rises from USD 132 to USD 345 per HH. The annual farm employment income rises from USD 64 to USD 122, therefore the annual net income rises from USD 68 to USD 224 per HH.

With the interventions, HH income is expected to rise across all the VCs covered by the project. HHs in North West Nigeria have more to spend on other food items such as fruits and milk and dairy products resulting in improved nutrition.

Incremental Costs of Interventions

This section summarizes the impact of the adoption of best agronomic practices and the total costs associated with the farmers' implementation of them. Table 4 below presents the total production cost in the "with" and "without" scenarios differentiating between the labor and commercial inputs cost.

Table 4: Cost of Inputs (USD/HH/0.5 Ha/Year)

	"Without Case"		"With Case"	
Value Chain	**Labor**	**Other Inputs**	**Labor**	**Other Inputs**
Cowpeas	55	31	119	127
Groundnuts	69	22	115	73
Maize	87	28	178	157
Soybeans	23	20	87	84
Cowpeas, millet and sorghum	64	46	121	93

Prior to USAID assistance, the annual production costs per 0.5 hectares with the current agronomic practices ranged from USD 43 to USD 115 for soybeans and maize respectively. The agronomic practices introduced by the project have significantly increased the cost of production, with an average increase of 175%. The cost of production with improved agronomic practices ranges from USD 171 to USD 335 for soybeans and maize, respectively. On average the labor cost has increased by 131% indicating that employment was created by introducing enhanced agronomic practices. The cost of commercial inputs, in turn, increased by 285% on average. The increases in the labor cost and the cost of commercial inputs highlights the importance of the market access to realize employment benefits, as well as to ensure sustainability of the project. The breakdown of costs between inputs and labor are summarized in Table 4 as well as in Figure 10 (with the project) and Figure 11 (without the project).

Figure 10: Breakdown of Total Production Costs With the Project (USD/0.5 Ha)

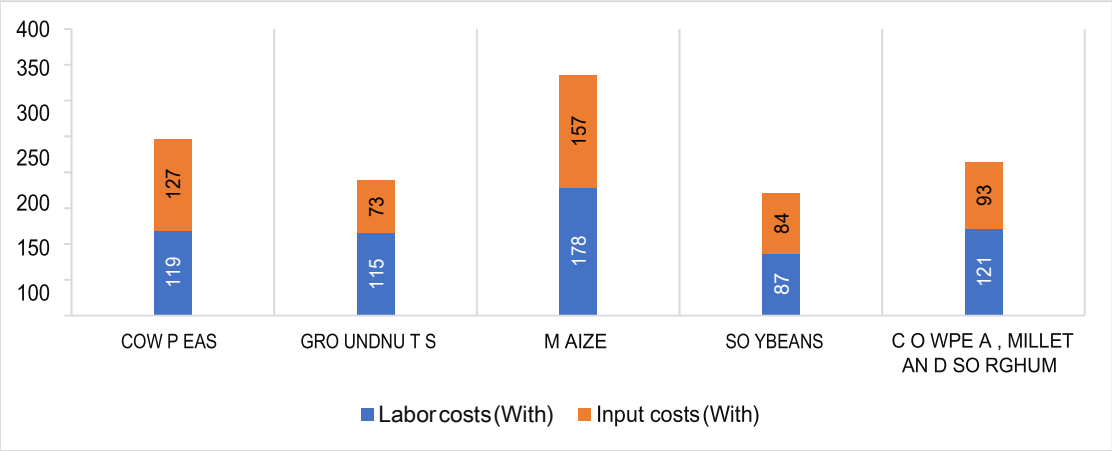
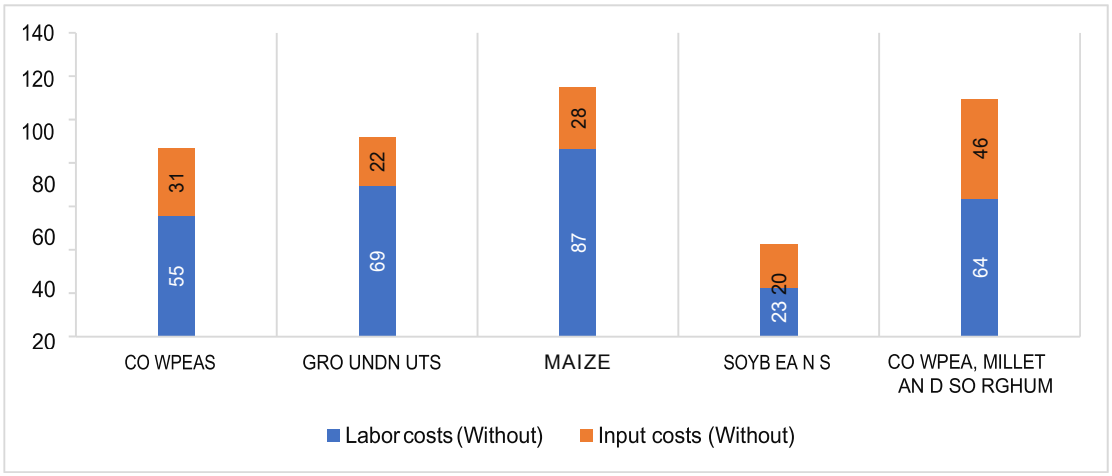


Figure 11: Breakdown of Total Production Costs Without the Project (USD/0.5 Ha)



On average, labor costs without the project are 67% of the total production costs per 0.5 hectares, ranging from 53% to 76% for soybeans and groundnuts respectively. Although the dollar amount spent on labor with the project increases, the actual proportion of labor expenditure in relation to the total production costs decreases, averaging 54%, ranging from 51% to 61% again for soybeans and groundnuts. This means that by adopting the best agronomic practices, the proportion spent on commercial inputs in relation to the total production expenditure increases, from an average of 33% to 46%. Without the project, commercial input expenditures in relation to total production costs range from 24% (groundnuts) to 47% (maize). These proportions increase to 39% (groundnuts) up to 49% (soybeans).

4.2 ECONOMIC ANALYSIS

The financial analysis is the foundation on which the economic analysis is built on. The economic evaluation examines costs and benefits of project activities regarding their broader impact on society. Market prices frequently do not correspond to the actual value of resources produced and consumed by a given activity due to distortions such as taxes and subsidies, or monopolies that may be present in the market. The analysis presented here, therefore, uses commodity-specific conversion factors (CSCFs) to adjust financial farm budgets to their economic equivalent.

Table 5 outlines the incremental economic outcomes resulting from adopting the best agronomic practices. The total incremental ENPV is USD 6.74 million and USD 2.37 million from the economy's and USAID's perspectives respectively.

Economic NPV (USD)		
Value Chain	Incremental	
	Per 0.5 Ha	Aggregate
Cowpeas	1,989	782,434
Groundnuts	609	234,760
Maize	467	216,668
Soybeans	32	15,333
Cowpeas, millet and sorghum	639	5,459,552
Total Incremental ENPV		**6,735,727**
USAID PV Investment Cost		**4,362,021**
ENPV USAID Perspective		**2,373,707**
EIRR USAID		**22.88%**

Table 6: Incremental Economic NPV by Value Chain (USD)

4.3 STAKEHOLDER ANALYSIS

The purpose of conducting a stakeholder distributive analysis is to determine who gains and who loses on account of the externalities generated by the project. This analysis is based on the externalities statement which is derived by subtracting the financial cash flow statement from the economic cash flow statement. The financial cash flow statement estimates the net financial benefit of a project to the beneficiaries (e.g. farmers), while the economic resource flow statement evaluates the project's effect on the overall economy of the country. The differences between these two net resource flows are externalities that are a consequence of the project interventions. In this case, the externalities accrue to the GoN due to taxes, tariffs, and the foreign exchange premium (FEP). It is, therefore, possible to estimate incremental tax revenues for the GoN due to the Livelihood Project's activities. These fiscal impacts are presented in the Table 6.

Table 5: Present Values of Incremental Fiscal Impacts (USD)

Value Chain	Fiscal Impact
Cowpeas	(176,882)
Soybeans	(36,446)
Cowpeas, millet and sorghum	(736,684)
Subtotal	**(950,012)**
Value Chains Resulting in Increased Government Tax Revenues	
Groundnuts	21,336
Maize	23,910
Subtotal	**45,246**
Total Impact on the Government Tax Revenues	**(904,766)**

The production of groundnuts and maize results in increased tax revenues for the government. These two crops are exportable and therefore increased output of these crops will increase foreign exchange earnings. The indirect taxes generated by the use of this forex will result a positive fiscal externality.

The case is opposite for the soybeans, cowpeas, millet, and sorghum that are imported to Nigeria. Increased domestic production of these crops results in reduced import duties collected for the GoN. The import duties on the crops are 20% for cowpeas, 10% for soybeans, and 5% for both millet and sorghum. The very high import duty on the cowpeas and high import duty on the soybeans indirectly demonstrate the GoN's policy to stimulate domestic production of these crops. This observation

suggests that the Livelihoods Project's interventions are consistent with the GoN agricultural policies. These foregone duties are partially outweighed by the duties collected from the increased use of imported inputs such as certified seeds and fertilizers. The net fiscal impacts are, however, negative.

4.4 SENSITIVITY AND RISK ANALYSIS

Risk Analysis

The need for risk analysis stems from the fact that uncertainty is an inseparable part of any activity. In the real world, more than one or two variables are subject to fluctuations at the same time over the life of the project. The results of the sensitivity analysis do not account for the uncertainties that arise from simultaneous changes in various variables of the project. It also fails to take into account the probability of those changes. The primary objective of the risk analysis is to simulate and analyze the variability in the financial and economic outcomes of the project, by expressing the uncertainty associated with the critical variables in terms of probability distributions.

Sensitivity Analysis

The objective of sensitivity analysis is to aid the process of identifying the source of uncertainty (risk) that the project faces, test the significance and impact of the identified critical variables on the project results, and help to find the appropriate mitigation measures to reduce the project's exposure. This kind of analysis is based on the ranges of fluctuations around the value of a specific benefit/cost item of the project, which captures its impact on the intended built-in financial or economic output indicator of the project. Through sensitivity analysis which is a deterministic analysis, we identify the critical variables. Critical variables are those variables whose small fluctuations within a specific pre-defined range cause a substantial deviation of the project's output such as the farmers' net income from their base case results.

Cowpeas. With the base case, the farmers' net income increases by an estimated USD 480 per 0.5 hectares. A 10% reduction in labor costs increases the farmers' net income to increase by only 1%. A 10% increase in the market price of cowpeas leads to an 9% increase in the farmers' net income per 0.5 hectares. In the base case, the land area under cowpea cultivation is half a hectare per farmer, increasing the area under cultivation by 25% will result in the farmers getting an additional USD 120 from the base case amount.

Groundnuts. For the recommended best agronomic practices, a 10% increase in the change in expected yield per 0.5 hectares results in the incremental farmers' net income rising from USD 127 to USD 160. If the post-harvest losses increase by 5% then the incremental farmers' net income per 0.5 hectares will decrease by 14%. If the farm size increases by 25%, the farmers will gain an additional USD 33 above the base case amount.

Table 7: Sensitivity Analysis of Risky Variables on Incremental Net Farmers' Income (USD/0.5 Ha)

	Sensitivity	Cowpeas	Groundnuts	Maize	Soybeans	Cowpeas, Millet and Sorghum
Base case scenario		**480**	**127**	**126**	**57**	**143**
Post-harvest losses	-5%	525	145	150	63	163
	+5%	440	110	100	50	123
Change in expected yield per 0.5 Ha (best agronomic practices)	-10%	390	95	80	35	128
	+10%	575	160	175	78	159
Change in market price	-10%	436	105	90	40	134
	+10%	524	150	160	73	153
Land area cultivated per farmer	-25%	360	95	95	42	107
	+25%	600	160	160	71	179
Change in labor costs	-10%	485	131	135	62	138
	+10%	475	123	115	51	148

Maize. With the base case, the farmers' net income increases by an estimated USD 126 per 0.5 hectares. A 10% reduction in labor costs increases the farmers' net income to increase by 8%. A 10% increase in the market price of maize leads to a further 29% increase the farmers' net income per 0.5 hectares. Increasing the area under cultivation by 25% will result in the incremental net farmers' income rising from the USD 126 to USD 160 (27% more than the base case).

Soybeans. In the base case, the farmers' net income increases by an estimated USD 57 per 0.5 hectares. A 10% increase in labor costs decreases the incremental farmers' net income per 0.5 hectares to USD 51, approximately 10% less than the base case. A 10% decrease in the market price of maize leads to an estimated 30% decrease in the incremental farmers' net income per 0.5 hectares. Increasing the area under soybean cultivation by 25% will increase the incremental farmers' net income per 0.5 hectares from USD 57 to USD 71.

Cowpeas, Millet and Sorghum. For the recommended best agronomic practices, a 10% increase in the change in expected yield per 0.5 hectares results in the incremental farmers' net income rising from USD 143 to USD 159. If the post-harvest losses increase by 5% then the incremental farmers' net income per 0.5 hectares will decrease by 14%. If the farm size decreases by 25%, the farmers will lose an additional USD 36 below the base case amount.

Sensitivity Analysis from USAID's Perspective

The sensitivity analysis was also conducted to assess the impact of risky parameters on ENPV from USAID's perspective. The first test, presented in Table 6, shows the impact of the risky variables by changing it only for one VC while Figure 12 shows the impacts of by altering the risky variables across all VCs.

Table 8: Sensitivity Analysis of Key Project Variables on ENPV USAID Perspective (M' USD)

	Sensitivity	Cowpeas	Groundnuts	Maize	Soybeans	Cowpeas, millet, and sorghum
Base case scenario	**2.37**					
Change in expected yield per Ha (best agronomic practices)	+10%	2.00	2.34	2.33	2.35	1.58
	-10%	2.76	2.41	2.42	2.39	3.17
Change in market price	-10%	2.14	2.35	2.41	2.38	2.29
	+10%	2.61	2.39	2.34	2.37	2.46
Change in labor costs	-10%	2.41	2.38	2.37	2.38	2.52
	+10%	2.34	2.37	2.38	2.37	2.22

Change in expected yield (best agronomic practices)

Overall, a change in the expected cowpeas, millet, and sorghum yield has the greatest impact on the ENPV from USAID's viewpoint because a 10% decrease in the expected yield will lead to a 34% decrease in the ENPV. The next VC whose expected yield fluctuations have a significant impact on the ENPV is cowpeas. A 10% decrease in the expected yield will lead to a 16% decrease in the ENPV. For groundnuts, maize and soybeans, a 10% fluctuation in expected yield leads to only 1-2% change in the ENPV from USAID's point of view.

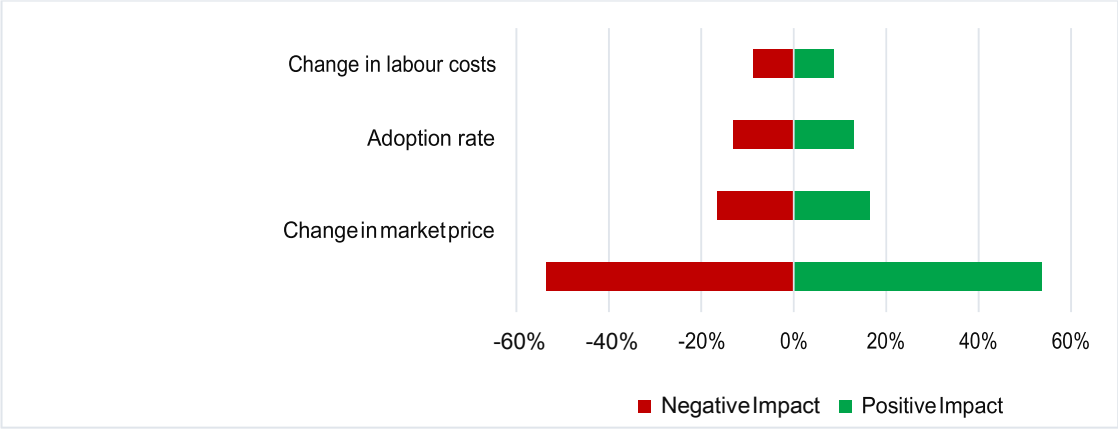
Change in market price

Pertaining to the changes in market prices of each commodity, keeping the other prices constant, fluctuations in cowpea prices have the greatest impact on the ENPV. A 10% movement of cowpea prices in any direction will result in an equal reaction from the ENPV. In the case of soybeans, a 10% change in the current market price will result in an insignificant change in the ENPV.

Impact of risky variables on the ENPV from USAID's perspective

The visual illustration in Figure 12 shows the magnitude impact of the change in labor costs, the adoption rate, change in market prices, and changes in the expected yield per Ha on the ENPV from USAID's perspective. Yield changes have the greatest impact, followed by changes in the market price with changes in the labor costs having the least impact.

Figure 12: Impact of Risky Variables on ENPV, USAID Perspective



5. CROSS-CUTTING ISSUES

CROP YIELDS

Rainfall patterns can affect the rain-fed agriculture on which the majority of farmers in Nigeria depend on. For instance, increased occurrence of drought may lead to reduced agricultural productivity and food security. A recent FEWSNET study that analyses trends in terms of total seasonal rainfall over the 1981-2015 period suggests a rainfall increase over time of more than 100mm in the North and Northeast. It also finds a drying trend, albeit small, in selected parts of the South, Central region, and some parts of the Cross River State (FEWSNET, 2016). The trend of rainfall in the targeted project areas is not therefore a major risk factor of crop productivity.

FARMER ADOPTION RATE OF IMPROVED TECHNOLOGIES

The majority of farmers in Nigeria do not apply fertilizer. It is estimated that farmers in Nigeria apply eight kilograms per hectare, which is far less than the 200kg/ha world average (Aster, 2007). Interventions of the Nigeria Livelihoods Project, which include extension of improved agricultural practices, use of improved seeds and agro-chemicals, are expected to increase the yields of the targeted crops. Observations from field visits suggest that few farmers buy these inputs.

Results from the Nigeria Livelihoods Project 2016 survey suggest that compared to 2015 the number of farmers who have applied improved technologies such as improved varieties, seed treatment, fertilizers, and herbicides along with cultivated areas under the various technologies have reduced (USAID, 2016).

The low adoption of improved technologies may be due to various factors including hunger and poverty. In Nigeria, rural poverty is estimated at 90% and 80% of the poor mainly depends on agriculture or farm labor (Olive, 2006). Poor farmers are likely to divert their limited farm income towards basic needs such as feeding and medication rather acquiring improved seeds and fertilizers.

CURRENCY DEVALUATION

The Naira has devaluated in November 2014 and January 2015 by 8% and 15%, respectively. The devaluation of the Naira has negatively impacted farmers by making imported agricultural inputs such as fertilizers more expensive. Poor farmers cannot afford to acquire these inputs, which limit their application and diminish agricultural productivity.

FUNDING FOR RESEARCH AND TECHNOLOGY DEVELOPMENT

Funding for agricultural research and technology development from the Federal Government as a share of total budget for agriculture has been declining over time. The Federal Government has consistently spent less than 5% of its total annual budget on agriculture, which is far below the recommended 10% from the 2003 Maputo Summit of African Head of States (Youngsters Foundation, 2010).

On-going research and development is always needed to keep current crop varieties to stay ahead of changes in consumer preferences, new environmental challenges such as climate change, and resistance to new pests and diseases. For instance, to respond to unpredictable rainfall patterns and draught, research efforts are needed to develop drought resistant and short duration high yielding crops and disseminate them to farmers. Key strategic partners in this process such as the 15 federal agricultural research institutes require adequate funding to achieve this goal.

6. CONCLUSIONS AND RECOMMENDATIONS

This cost benefit analysis revealed that the project interventions result a positive rate of return on USAID investment of 22.88%. This rate of return is significantly above the benchmark of 12 percent used in the analysis. The ENPV from USAID perspective is USD 2.37 million. It should be noted that the economy of Nigeria benefits by USD 6.74 million, given that USAID bears the full cost of the project.

The analysis also revealed that the project is expected to improve the annual income of the farmers across all targeted crops. The incremental annual household income per 0.5 hectares is USD 544 from cowpeas, USD 173 from groundnuts, USD 218 from maize, USD 121 from soybeans, and USD 201 from cowpeas, millet, and sorghum.

USAID assistance in the cowpea value chain is expected to lift the households' income (including family labor farm income) above the poverty threshold to USD 795; however, considering the average household size of five for North West Nigeria, this income is still insufficient to alleviate poverty. Households need to rely on productive factors other than land, including livestock, or non-farm employment to graduate from the extreme poverty. USAID assistance that reduces the HHs costs, such as WASH component of the project, also does contribute to the improved welfare of the HHs. The annual income from the rest of the value chains is less than 50% of what is achieved by the farmers producing cowpeas. It should be noted that the strong results in the cowpeas value chain are to a large extent driven by the 20% tariff protection resulting in the high domestic prices for the crop. This tariff protection also imposes an external risk factor to the sustainability of the activities in the cowpeas value chain.

The agronomic practices introduced by the project have significantly increased the cost of production, with an average increase of 175%. The cost of production with improved agronomic practices ranges from USD 171 to USD 335 for soybeans and maize, respectively. On average the labor cost has increased by 131% indicating employment created by introducing enhanced agronomic practices. The cost of commercial inputs, in turn, increased by 285% on average. Increase in the labor cost and the cost of commercial inputs points out the importance of the market access to realize employment benefits, as well as to ensure sustainability of the project.

The incremental tax revenues for the GoN arising from the Livelihoods Project's activities were also estimated. It was observed that groundnut and maize production results in increased government tax revenues while the cowpea, soybean and cowpea, and millet and sorghum interventions led to reduced tax revenues. Increased domestic production of these crops result on reduced import duties collected for the GoN. There are very high import duties on cowpeas (20%) and a high import duty on soybeans (10%) indirectly, demonstrating the GoN's policy to stimulate domestic production of these crops. This observation suggests that the Livelihoods Project's interventions are consistent with the GoN agricultural policies.

It was also observed that changes in the expected yield from adopting the best agronomic practices as well as changes in the market prices of the targeted crops had the greatest impact on the ENPV from USAID's perspective. From the famers' point of view, the study revealed that the land area under cultivation, post-harvest losses, market price fluctuations as well as yield variations with the project were observed to have the greatest impact on the famer's incremental net income.

In addition to the above-mentioned variables, the Livelihoods Project and USAID should closely monitor the availability of commercial inputs (fertilizers, certified seeds, etc.) and market access. The two are closely related as without ability to sell the produce, farmers will not be able to purchase the commercial inputs even when they are available.

1. ***Access to commercial inputs*** – Field visits revealed that the majority of farmers cannot access the fertilizers prescribed by best agronomic practices. In most cases, fertilizers and pesticides at best are obtained with a significant delay thereby reducing the yields. The average yields, although improved when compared to previous practices, are significantly lower than the potential yields. If continuous supply of the certified seeds and fertilizers will not be ensured after the project is completed, the economic returns from the USAID perspective are likely to become negative. The results of a two-way sensitivity analysis on changes in adoption rate and expected yield affirms that the USAID returns would be would be negative if the yields from all crops decrease by more than 10% and the average adoption rate on all crops is reduced to more than 60%. This is illustrated in the table below.

Table 9: Sensitivity Analysis of Adoption Rate and Change in yield (best agronomic practices) on ENPV (USAID) (M' USD)

	Sensitivity	Adoption rate									
		100%	90%	**80%**	70%	60%	50%	40%	30%	20%	10%
Change in expected yield (best agronomic practices)	-20%	0.41	(0.07)	(0.54)	(1.02)	(1.50)	(1.98)	(2.45)	(2.93)	(3.41)	(3.88)
	-10%	2.23	1.57	0.91	0.25	(0.41)	(1.06)	(1.72)	(2.38)	(3.04)	(3.70)
	0%	4.06	3.22	2.37	1.53	0.69	(0.15)	(0.99)	(1.84)	(2.68)	(3.52)
	10%	5.89	4.86	3.84	2.81	1.79	0.76	(0.26)	(1.29)	(2.31)	(3.34)
	20%	7.72	6.51	5.30	4.09	2.89	1.68	0.47	(0.74)	(1.95)	(3.15)

2. ***Market access*** – Ensuring that the farmers can sell at least 17% (cowpeas) to 40% (soybeans) of their produce is essential for the long-term sustainability of the interventions. In the absence of the market access, farmers will return to the subsistence farming immediately upon completion of the Livelihoods Project's assistance. In Nigeria, rural poverty is estimated at 90% and 80% of the poor mainly depends on agriculture or farm labor. Poor farmers are likely to divert their limited farm income towards basic needs such as feeding and medication rather acquiring improved seeds and fertilizers unless market access in not ensured.

Agricultural finance is critical for the farmers as well as the sustainability of the interventions and the Livelihoods Project has made a significant progress on promotion of Savings and Internal Lending Communities (SILCs). SILCs charge 10% monthly interest, a rate that is prohibitively high to finance agricultural inputs. SILCs are found highly beneficial by the households; however, such interest rates are justified only when a household faces an emergency such as sickness. Nigeria, in its Agriculture Promotion Policy (2016-2020), indicated the need to enhance availability of credit for all farmers at affordable rates. USAID and other development partners should consider finding ways to support this policy.

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