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**COST-BENEFIT ANALYSIS OF THE
RED HARICOT BEANS VALUE CHAIN IN ETHIOPIA**

**GRADUATION WITH RESILIENCE TO ACHIEVE
SUSTAINABLE DEVELOPMENT - GRAD PROJECT**

FINAL REPORT

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**United States Agency for International Development
Learning, Evaluation, and Analysis Project
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BEANS VALUE CHAIN**

FINAL REPORT

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U.S. Agency for International Development/Ethiopia

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ACRONYMS

ADSCR	Annual Debt Service Coverage Ratio
AGP	Agriculture Growth Program
CARE	Nongovernmental Organization, Implementing Organization
CF	Conversion Factor
CRS	Catholic Relief Services
CSA	Central Statistical Agency of Ethiopia
ENPV	Economic Net Present Value
EOCK	Economic Opportunity Cost of Capital
ETB	Ethiopian Birr (Currency)
FAO	United Nations Food and Agriculture Organization
FEP	Foreign Exchange Premium
GRAD	Graduation with Resilience to Achieve Sustainable Development
FNVP	Financial Net Present Value
FtF	Feed the Future (Program)
IFPRI	International Food Policy Research Institute
Ha	Hectare
kg	Kilogram
MFI	Microfinance Institution
NCF	Net Cash Flows
NGO	Nongovernmental Organization
NPV	Net Present Value
ORDA	Organization for Rehabilitation and Development in Amhara
REST	Relief Society of Tigray
RUSACCO	Rural Saving and Credit Cooperatives
SNV	Netherlands Development Agency
SNNPR	Southern Nations, Nationalities, and Peoples Region
US\$	United States Dollar
USAID	United States Agency for International Development

EXECUTIVE SUMMARY

Project Description: The *Graduation with Resilience to Achieve Sustainable Development* (GRAD) project proposed by the United States Agency for International Development (USAID) started in 2012 and implemented in 16 woredas around Ethiopia. The project has 5 years lifetime. The selected woredas are located in Amhara, Oromia, Southern Nations, Nationalities, and Peoples Region (SNPPR), and Tigray. The GRAD project aims to graduate 50,000 chronically food insecure households out of 65,000 that are targeted. Each of the selected households will need to achieve an increase in its yearly income of US\$365.00 to successfully graduate from the program. Four commodity value chains have been chosen for this project's interventions: honey, pulses, meat, and vegetables.

The implementers of the project include CARE, the Relief Society of Tigray (REST), the Organization for Rehabilitation and Development in Amhara (ORDA), Catholic Relief Services (CRS), the Netherlands Development Agency (SNV), and Tufts University. These well-known organizations are engaged in food-security and value chain–development projects in Ethiopia and other developing countries throughout the world.

To facilitate the proper implementation of the project and flow of necessary financial resources for the targeted households, USAID Ethiopia established a US\$2-million loan – guarantee fund that will be available to the microfinance institutions (MFI) and rural saving and credit cooperatives (RUSACCO) that will be in charge of providing loans to the participating chronically food-insecure households. Such financial assurance will diminish the risk associated with micro lending and will help facilitate the flow of funds.

Strategic Context and Rationale: The USAID Ethiopia GRAD project is part of the wider strategy of Feed the Future (FtF), which supports investments in viable and potentially easy to engage in and profit from agricultural value chains. The GRAD project also hopes to promote gender equality and the inclusion of women to the selected interventions.

The intervention in red haricot beans value chain, designed to provide loan to the GRAD households sufficient for the purchase of improved seeds and fertilizers. The suggested intervention will be introduced first in Loka Abaya woreda in the SNNPR region.

Financial and Economic Analysis Results: The intervention in the red haricot beans value chain is constructed around the provision of loans that are adequate for the purchase of improved seeds and fertilizer. The loans will be offered at a preferential (subsidized) interest rate of 15 percent. The loan structure will allow households to make repayments after the harvest period. In case of unforeseen circumstances households might be given some flexibility to faze loan repayments over a longer period of time. The main group of GRAD households have small landholdings of approximately one quarter of a hectare. The amount of investment required to purchase inputs for red haricot beans cultivation is estimated to be ETB688.75. The corresponding loan amount is equal to ETB786.40.¹

Ethiopian farmers cultivate haricot beans by intercropping it with maize, wheat, barley and other cereals. The priority is usually given to the cereals, meaning that most of the land is allocated for the maize. Households sometimes face difficulties selling haricot beans due to the limited demand in the local markets for the product. In Ethiopia haricot beans are perceived as a food for poor.

¹ Loan amount includes a service charge, an insurance, a pass book fee and an up-front saving of 10 percent.

The analysis is carried out over eleven year period. Intervention in red haricot beans yields a positive financial net present for both intercropping and mono cropping cultivation system. The FNPV in case of the mono cropping scenario is equal to \$US 397.84 using 12 percent real financial discount rate. The intercropping with maize scenario yields FNPV of US\$12.03 also at 12 percent real discount rate.

The mono cropping scenario, although it has much higher financial returns, is very unlikely to be adopted by the households with land holding limited to 0.25 hectare, because of the very high risks in the case of crop failure. The financial returns on the intercropping scenario, however, are related to the corresponding yields of both commodities. The FNPV value of 13.98 US\$ is calculated under the assumption that yield decrease of red haricot due to intercropping will be equal to 67 percent of what can be attain when the beans are mono cropped. Such big yield decrease presents when farmers focus their effort on maize cultivation, giving second priority to the red haricot beans. The corresponding maize yield decrease is 24 percent under the system. Having adequate level of knowledge may actually allow farmers to reduce yields decrease to only 5 or 10 percent. For instance if farmers will manage to attain yield reduction of maize equal to only 5 percent with intercropping, FNPV will increase to US\$173.00.

The economic net present value is also positive in the both cases. It is equal to US\$ 435.38 in the mono cropping scenario and to US\$29.51 in case of intercropping red haricot beans with maize. The difference between financial and economic outcomes of the project is due to the fact that the financial values do not include all externalities presented in the project.

Beneficiary Analysis Results: Based on this analysis, it is expected that the GRAD project will increase the yearly income of targeted households. The net increase in income over the eleven years period is estimated to be US\$397.84 in case of mono cropping and US\$12.03 in case of the intercropping with maize. The net annual increase in the income of the households is estimated to be US\$9.59 for the intercropping scenario and US\$70.14 for the mono cropping scenario. The other beneficiary of the project is government:

- Government will benefit directly from the taxes collected on the inputs and outputs of the intervention. The indirect benefits to the government will arise because red haricot beans are exported from Ethiopia, which allows country to earn foreign exchange premium. The present value of the amount that government benefits from the intervention over the eleven years period is estimated to be US\$14.43 for intercropping and US\$34.04 for mono cropping.

Conclusions and Recommendations: The projected FNPVs and ENPVs show that both proposed interventions in the red haricot beans value chain (mono cropping and intercropping with maize) will yield positive results and will benefit targeted households and the economy as a whole. Even though the mono cropping intervention shows higher potential financial and economic NPVs, intercropping red haricot beans with maize is also likely to be successful and might be preferred by the participating households, because it would decrease the risks associated with crop failure. Neither of the proposed interventions (mono cropping or intercropping) will be able to achieve the target increase in income of US\$365.00 /per year/per household. Therefore, it is recommended that the intervention in the red haricot beans value chain be “packaged” together with an intervention from another commodity value chain proposed by the GRAD project.

THE RED HARICOT BEANS GRAD VALUES CHAIN: COST-BENEFIT ANALYSIS

METHODOLOGY

Project Background

The United States Agency for International Development (USAID)/Ethiopia started implementation of the *Graduation With Resilience to Achieve Sustainable Development* (GRAD) project in Ethiopia in 2012. The project is a part of USAID's Feed the Future (FtF) agenda and aims to support improvements in the value chains of several commodities (honey, pulses, meat, and vegetables) to increase the food security² of the targeted Ethiopian households. The GRAD project will include a special emphasis on strengthening the livelihoods of chronically food-insecure households in Highlands Areas, improving household and community resilience, and strengthening an enabling environment to promote scale-up and sustainability.

The project has a 5-year lifespan. During this period the GRAD project will target 65,000 food-insecure Ethiopian households that can be categorized as either chronically food insecure (58,500 households) or "Ultra Poor"³ (6,500 households). Of the participating 65,000 households, the GRAD project intends to graduate 50,000 households from chronic food insecurity by increasing their yearly income by US\$365/year/household. The GRAD project also plans to include another group of 10,000 Ethiopian households that are either food-sufficient households (6,000) or food-secure households (4,000). These households will act as role models for the chronically food-insecure and "Ultra Poor" groups that are the project's main target.

Sixteen *woredas* located in four regions of Ethiopia—SNNPR, Tigray, Amhara, and Oromia⁴—will be included in the GRAD project. The project's *woredas* were selected on the basis of this proximity to the AGP (Agriculture Growth Program) and the presence of active local markets that bring opportunities for engagement in commodity trading. This geographical selection criterion is supposed to guarantee that the households have the potential to market the commodities that they produce, if the intervention goes as planned. The GRAD project also intends to facilitate market linkages in order to connect these households with commodity traders at the local level. This in turn will facilitate the sale of commodities and foster income inflows to the households. The GRAD project is also expected to correct shortcomings experienced in the PSNP Plus project in order to allow each targeted household to increase its yearly income by US\$ 365 (or 1 USD per day).

² "Food security" is defined as access to sufficient food by all members of the household for an active and healthy lifestyle in a normal or moderately bad year (per GRAD Technical Proposal).

³ Ultra Poor households include female-headed households and landless youth.

⁴ A full list of the GRAD-selected *woredas* can be found in table A in the appendix. Please note that according to the table, in Tigray an intervention is planned for fava beans. CARE has decided to postpone this intervention due to the problems the organization encountered during its baseline survey. During the conversation that the LEAP team had with the vice chief of party on August 18, 2012, it was confirmed that the fava beans intervention at this point has been terminated, so the LEAP team has not performed a CBA of this commodity.

The implementer of this project, CARE will cooperate with technical partners in order to assure the project's proper implementation. These cooperating partners are REST (Relief Society of Tigray), ORDA (Organization for Rehabilitation and Development in Amhara), CRS (Catholic Relief Services) and SNV (Netherlands Development Agency) and Tufts University. All these organizations are well known NGOs that are engaged in various projects in Ethiopia related to food security improvement and commodity value chains development.

USAID will establish a loan guaranteed fund of US\$2 million to ensure that the microfinance institutions (MFIs) and rural saving and credit cooperatives (RUSACCOs) will have sufficient access to lending capital to develop a flexible lending scheme for the GRAD households. This fund will also help to reduce the risks of these institutions associated with loan defaults of the targeted households.

The GRAD project plans to emphasize non-gender-biased participation and inclusion of women in the proposed interventions for the commodities value chains. Ethiopian women are typically disadvantaged in terms of access to agricultural inputs, so the GRAD project plans to correct these issues whenever possible.

The four commodity value chains selected for the GRAD project have been chosen because of their simplicity in terms of the knowledge required for their implementation and the rather low initial start-up costs necessary to engage in their production. These commodities also offer the potential for future, post – GRAD production increases and marketing. Demand for these commodities is growing in both, domestic and export markets; creating, the possibility for increases in commodities sales and income generation for the households participating in the GRAD project.

Commodity Background

Pulses Production in Ethiopia

The agricultural production in Ethiopia is highly dependent on rain. The production of pulses is not an exception due to the low availability of irrigation.⁵ The quantity of pulses produced is to a large extent based on the small-scale farmers who grow relatively small quantities of commodities and sell them to local traders.

In Ethiopia, twelve varieties of pulses are cultivated, which are divided into “highland pulses” (chickpea, fava bean, field pea, grass pea, lentil, lupine, fenugreek) and “low land pulses” (haricot bean, soya bean, cowpea, pigeon pea, and mung pea). The biggest share of Ethiopia's pulses production is taken by fava (36 percent) and haricot beans (17 percent) (IFPRI 2010).

The total planted area of pulses in Ethiopia in 2011–12 (in the long rainy season, Meher⁶) was 1,616,809.37 hectares (Ha), or 13.38 percent of the total cropped area in Ethiopia, with total production

⁵ Even if irrigation is available in the areas where pulses are cultivated, farmers usually do not use it for production purposes.

⁶ Ethiopia has two rainy seasons: Belg, short rainy season (March–April/May) and Meher, long rainy season (June–August). Farmers in general concentrate their planting and cropping during the rainy seasons, because rains are more reliable during that time.

yields of 2,316,201.24 metric tons (MT). Of this total, 331,709.15 Ha were planted with haricot beans. The total production of haricot beans was 387,802.311 MT, with an average yield of 1.17 MT/Ha (CSA 2012).

Amhara, Oromia, and SNNPR are the three regions that produce the majority of haricot beans.

Red haricot beans are usually grown on a rotation basis or intercropped with cereals, such as maize, wheat, or sorghum (especially in the short rainy season, Belg). Chronically food-insecure households that possess 0.25 Ha (or less) of land especially favor the intercropping intervention. It mitigates the risk associated with a crop failure and usually enables a household to harvest at least a part of the crop even when a drought or flooding occurs. Such intercropping of cereals and beans does improve the soil’s fertility and decreases the amount of fertilizer necessary for crop production.⁷

Current Market Situation in the Ethiopian Red Haricot Beans Sector

The overwhelming majority of red haricot beans produced in Ethiopia is marketed and consumed domestically. Ethiopians value red haricot beans because of their high nutritional value (“meat for poor”) and cultural suitability.⁸ Domestic producers’ prices for red haricot beans vary within the year according to the harvesting patterns, with lower prices around the harvesting season and much higher prices in the off-harvest season. SNNPR producer prices for red haricot beans in 2010–11 are presented in table 1, below:

Table 1. SNNPR producer prices for red haricot beans in 2010–11 (in ETB/kg)

SNNPR	Harvest season	Off-harvest season
Red haricot beans	4.50	7.20

*Source: SNV Value Chain Analysis Draft Report, 2012.

Current Problems Observed in the Red Haricot Beans Sector in Ethiopia

Red haricot beans share nearly identical production problems, as white haricot beans do. Among many of the problems associated with the unstable weather patterns—including droughts and floods that interact with each other and directly influence the status quo in the Ethiopian red and white haricot beans sector—a couple non-climate-related barriers withhold this sector from achieving its potential. The most important issues include the following:

1. Rather low productivity/Ha of land

The average productivity rate for haricot beans is 1.17 MT/Ha (CSA 2012). At the same time, the observed productivity of experimental plots goes up to 2.9–3.5 MT/Ha (IFPRI 2010).⁹ This relatively low productivity rate in red haricot beans is closely related to

⁷ Pulses are able to grow in the symbiosis with nitrogen-fixing bacteria (*Rhizobium*) and produce nitrogen, which has qualities similar to the chemical fertilizer.

⁸ Ethiopians value beans, because they are a good source of protein. People use them to prepare vegetarian dishes necessary during the numerous fasting periods associated with two most common religions in Ethiopia: Islam and Orthodox Christians.

⁹ These maximum yields are for monocropping (without intercropping with cereals).

- low use of chemical fertilizers (phosphates)¹⁰;
- small plots for cultivation associated with population growth and land fragmentation;
- limited access to improved seed varieties; and
- poor land-management techniques (poor land preparation and suboptimal crop rotation) and nutrient-depleted poor soils prone to waterlogging.

2. Low availability of improved seeds¹¹

The varieties of red haricot beans that are most suitable for Ethiopia's climate and soil and have been most tested for productivity include Red Melka, Red Wolaita, Nasser, Ibbado, and Hawassa Dume. These seeds do particularly well in the soil and climate of the SNNPR region in the Rift Valley. They produce higher yields, and are more resistant to disease and drought. Nevertheless, the seeds for these varieties are in short supply. Because the majority of farmers are not able to obtain these seeds, they plant conventional ones that are lower yielding and less disease-resistant.

3. Problems with quality of improved seeds¹²

Even if improved seeds are available in some areas of Ethiopia, their quality tends to be inferior due to frequent mixing of types of seeds (improved with unimproved ones, different varieties of improved seeds mixed together, healthy seeds mixed with disease-infected seeds, and so forth) and lack of proper labeling to indicate which variety farmers are purchasing.

4. Low access to fertilizers and pesticides

Small-scale farmers have limited access to fertilizers and pesticides due to their low availability at the local level, lack of the knowledge regarding the type and quantity of fertilizer (pesticide) needed for the production of red haricot beans, and the scarcity of financial resources.

5. Lack of training regarding proper cultivation of red haricot beans

Small-scale farmers use traditional methods of land preparation and are unaware of improved methods that have the potential to positively influence their red haricot beans yields (e.g., optimal quantity of plowing and weeding, proper seed-bed preparation, planting density, and so forth).

¹⁰ There is a widespread belief among farmers and even some of the local consultants that beans do not require any fertilizers, so their application is unnecessary. This mistaken belief might result from the lack of training and misconceptions about the types of fertilizers available. It is possible that farmers are not aware of the existence of other fertilizer types (phosphates) besides DAP and UREA, which are widely used as fertilizers for cereals.

¹¹ It must be emphasized that such improved seeds require a "package approach." Improved seeds alone are usually not better than conventional ones if the land is not managed properly and if the levels of fertilizer are not applied at the right time and in the right quantity.

¹² It has been confirmed that there is an illegal trade in red haricot beans via Moyale that also negatively affects the quantity and quality of beans produced by farmers in SNNPR (they buy mixed seeds of lower quality, which lowers the incentives for farmers to increase the quality of their red haricot beans).

6. Problems with obtaining microloans for the purchase of seeds¹³

The microcredit institutions are reluctant to provide microcredits for seeds, because they see farming as a risky business. Small-scale farmers have almost no access to such financial resources; consequently, their access to inputs necessary to improve their crop yields is limited.

7. The inclusion of red haricot beans in the mandatory commodity exchange

The Ethiopian government included red haricot beans in the mandatory commodity exchange in 2010–11, which resulted in the break of direct business relationships between producers, traders, and exporters.

8. Lack of current, reliable statistics for the beans sector

Statistical surveys are pursued infrequently, every 3 to 5 years. This data are usually collected by the United Nations Food and Agriculture Organization (FAO). Some statistics could potentially be important for commercial purposes, but usually they are not collected.

9. Inefficient marketing system, lack of market information regarding export-market preferences for different varieties of beans, and poor storage systems

Farmers are often unaware of the preferences for certain varieties of beans in the export markets. Without such information, they end up with excess quantities of less-desired crops that cannot be exported. In addition, small-scale farmers usually do not have storage facilities that allow them to safely store beans when needed, so they experience significant post – harvest losses.¹⁴

10. Cyclical changes in price patterns in the world market and changing export opportunities¹⁵

Like all other commodities traded internationally, pulses are influenced by commodity cycles, and Ethiopian red haricot beans are no exception. Their prices are influenced by the commodity's demand and supply in the given year in the world market. Domestically, prices fall if there is a bumper crop in the world, and the FOB and domestic price rise if there is a shortage elsewhere in the world.

Project Description and Activities

In recognition of the potential that red haricot beans present in terms of increasing food security among chronically food-insecure Ethiopian households, the GRAD project has included the red haricot beans value chain in its agenda. The planned interventions in this value chain will take place in the Loka Abaya *woreda*, in the SNNPR region.

¹³ The sole availability of loans for the purchase of improved seeds will not benefit small-scale farmers if loan repayments are not properly scheduled (according to harvesting seasons) to ensure their ability to repay the loans and to decrease their risk of defaulting.

¹⁴ Farmers report that the way they store beans is very traditional: They put them in ash in locally made clay containers and cover the tops with manure to deter pests.

¹⁵ For instance, the price of red beans from 2009–10 showed a very high increasing trend that reached a range of 1,000–1,200 Birr/qt, but in 2012 prices decreased, ranging from 600–720 Birr/qt, following the blocking of illegal trade via Moyale to Kenya (SNV 2012).

GRAD Intervention in the Red Haricot Beans Value Chain

Under existent cultivation practices farmers usually intercrop haricot beans with maize, wheat, barley and other cereals. This allows them to minimize the risks associated with a single crop failure. The priority is given to the cultivation of cereals, and to maximize the yields of the cereals even if this decreases the yield of haricot beans. The modeling exercise was done for the two existing practices of red haricot beans cultivation:

1. Intercropping of maize and red haricot beans
2. Mono cropping of red haricot beans

The GRAD intervention for the red haricot beans value chain is to provide access to financing needed to purchase inputs for haricot beans cultivation, such as improved seeds and fertilizers. The financing will be provided in the form of loan at an interest rate below the market rate.

Details of the investment expenditures necessary for the planned interventions (mono cropping and intercropping with maize) in the red haricot beans value chain are presented in tables 2 and 3, below.

Table 2. Total investment expenditures for mono cropping in the red haricot beans value chain (in ETB)¹⁶

MONO CROPPING (ETB/0.25ha)	
Input	Intervention in red haricot beans
Improved seeds	300.00
Fertilizer	388.75
Total	688.75

Table 3. Total investment expenditures for intercropping with maize in the red haricot beans value chain (in ETB)

INTERCROPPING WITH MAIZE (ETB/0.25ha)	
Input	Intervention in red haricot beans
Improved seeds	180.00
Fertilizer	388.75
Total	568.75

Assumptions for the Selected GRAD Interventions in the Red Haricot Beans Value Chain

1. Each GRAD-targeted household engaged in the red haricot beans value chain will receive a loan necessary for the purchase of improved seeds and fertilizer. The size of the loan will vary according to the type of intervention (mono cropping or intercropping with maize). The total amount of loan includes a service charge of 1 percent of the total investment, an insurance fee of

¹⁶ The investment expenditures presented in tables 2 and 3 do not include expenditures associated with obtaining the loan (down payment, loan insurance, etc.). These additional loan-related expenditures are discussed in the assumptions for the selected GRAD interventions section of this report.

1 percent, a pass book fee of ETB15.00 and an up-front saving of 10 percent. The up – front saving will be returned to the household upon repayment of the loan, with no interest accrued. The total amount of loan for mono cropping intervention is ETB786.40 and ETB652.00 for the intercropping with maize intervention.

2. The loan necessary for purchasing the required inputs will be provided at the nominal interest rate of 15 percent, which is far below the current market interest rate. The market interest rate is estimated to be 48 – 50 percent in Ethiopia. This loan will have a repayment period of 6 months, with a grace period of 5 months,¹⁷ and each household will make one loan payment/year (post-harvest).
3. There are a large number of inter-cropping cultivation practices. Each practice results in different combination of the intercropped crops yields. This modeling exercise assumes that there will be 24 percent yield decrease of maize and 67 percent yield decrease of haricot beans due to intercropping as compared to mono cropping of the each crop.
4. For the base line scenario it is assumed that there will be no draught for the entire evaluation period. The effect of the draught occurrence is tested in the sensitivity analysis. The assumption of no draught for the base case was done because there is no exact information in what years it may occur. Currently Ethiopia faces on average two draught seasons in five years period. Having a base line with at least one draught in every five years by itself gives five possible scenarios. The level of draught, in addition, is another question which makes incorporating such extreme weather patterns in to the model even more difficult. The draught, however, will affect farmers with or without USAID Intervention (unless intervention is designed to provide irrigation). Due to this reason, although draught reduces returns on the investment, the intervention still may bring positive impact at the household level.
5. For the purpose of this analysis, the following macrolevel assumptions have been established: Domestic inflation is 20 percent, the U.S. inflation rate is 2.5 percent, the real financial discount rate is 12 percent, the real economic discount rate is 12 percent, the foreign exchange premium (FEP) is 6.5 percent, the exchange rate in 2012 is US\$1 = 17.50 ETB, the land-tax rate is 85 ETB/year, and the MFI (nominal) interest rate is 18 percent.

¹⁷ This type of loan structure will allow farmers to borrow money before planting and then repay the loan after harvesting.

Table 5. Parameters for analysis of mono cropping in the red haricot beans value chain¹⁸

Parameters	Without intervention	With intervention
Household size	5 people	5 people
Area under red haricot beans	0.25 Ha	0.25 Ha
Rental value of land	800.00 ETB/Ha/year	800.00 ETB/Ha/year
Land tax	85.00 ETB/year	85.00 ETB/year
Red haricot beans yield	700.00kg/Ha	1,600.00 kg/Ha
Red haricot beans price	5.00 ETB/kg	7.00 ETB/kg
Red haricot beans production disposition		
Loss	5%	5%
Consumption	20%	20%
Marketed	75%	75%
Input costs		
Red haricot beans seeds	7.00 ETB/kg	12.00 ETB/kg
DAP	15.55 ETB/kg	15.55 ETB/kg
Input requirements per 0.25 Ha		
Red haricot beans seeds	12.50 kg	25.00 kg
Fertilizer (DAP)	0	25.00 kg
Opportunity cost of family labor (ETB/day)		
Plowing	15.00 ETB	15.00 ETB
Planting	30.00 ETB	30.00 ETB
Fertilizer application	30.00 ETB	30.00 ETB
Weeding	15.00 ETB	15.00 ETB
Harvesting	15.00 ETB	15.00 ETB
Threshing	15.00 ETB	15.00 ETB
Packaging	15.00 ETB	15.00 ETB
Activities time allocation (Person/Days/0.25 Ha)		
Plowing	4	4
Planting	1	1
Fertilizer application	0	1
Weeding	8	8
Harvesting	5	10
Threshing	3	5
Packaging	1	2
Transporting	0.1 ETB/kg	0.1 ETB/kg

¹⁸ Parameters for red haricot beans used in the analysis were based on information from CSA (household size), field interviews in July 2012 (land tax, area under haricot beans, rental value of land), and the SNZ and CARE 2012 report *Red Beans Value Chain Analysis, Draft Report*. Parameters presented in tables 5 and 6 are based on two varieties of red beans: Hawassa Dume and Nasser.

Table 6. Parameters for analysis of intercropping with maize in the red haricot beans value chain

Parameters	Without intervention	With intervention
Household size	6 people	6 people
Area under haricot beans and maize	0.25 Ha (only maize)	0.25 Ha
Rental value of land	800.00 ETB/Ha/year	800.00 ETB/Ha/year
Land tax	85.00 ETB/year	85.00 ETB/year
Average household consumption		
Maize	250 kg/year	250 kg/year
Red haricot beans	0	50 kg/year
Mono cropping annual Productivity & Prices		
Maize yield	2,400.00kg/Ha	2,400.00 kg/ha
Red haricot beans yield	700.00kg/Ha	1,600.00 kg/Ha
Maize price	4.00 ETB/kg	4.00 ETB/kg
Red haricot beans price	5.00 ETB/kg	7.00 ETB/kg
Yield decrease due to Intercropping		
Maize	24%	24%
Red haricot beans	67%	67%
Losses		
Maize	8%	8%
Red haricot beans	0%	5%
Input costs		
Maize seeds	30.40 ETB/kg	30.40 ETB/kg
Red haricot beans seeds	7.00 ETB/kg	12.00 ETB/kg
UREA	13.00 ETB/kg	13.00 ETB/kg
DAP	15.55 ETB/kg	15.55 ETB/kg
Input requirements (kg/0.25 Ha)		
Maize seeds	12.50 kg	12.50 kg
Red haricot beans seeds	0	15.00 kg
UREA	25.00 kg	25.00 kg
DAP	25.00 kg	25.00 kg
Opportunity cost of family labor (ETB/day)		
Plowing	15.00 ETB	15.00 ETB
Planting	30.00 ETB	30.00 ETB
Fertilizer application	30.00 ETB	30.00 ETB
Weeding	15.00 ETB	15.00 ETB
Harvesting	15.00 ETB	15.00 ETB
Threshing	15.00 ETB	15.00 ETB
Packaging	15.00 ETB	15.00 ETB
Activities time allocation (Days/0.25 Ha)		
Plowing	4	4
Planting	2	3
Fertilizer application	1	1
Weeding	8	8
Harvesting	3	5
Threshing of red beans	0	3
Packaging of red beans	0	1
Transporting of red beans	0	0.1 ETB/kg

PROJECT MODELING

The financial and economic feasibility of the GRAD red haricot beans intervention has been estimated using a practical framework as outlined by Jenkins, Kuo, and Harberger in “Cost Benefit Analysis for Investment Decision”. Following this methodology, all revenues or potential revenues have been treated as cash inflows and all expenditures or potential expenditures as cash outflows. The analysis is carried out for a period of eleven years.

To estimate the financial sustainability of the intervention in the red haricot beans value chain, the annual debt service coverage ratio (ADSCR) of the project over the life of the loans used to finance it has been calculated together with the financial net present value (FNPV) of the project.

The economy resource flow statements have been constructed by adjusting each of the line items in the cash-flow statements of the total investment point of view by proper economic conversion factors (CFs). These conversion factors have been derived by dividing the separately calculated economic value of a unit of an item by its financial price.

INTERVENTION

The purpose of the project model is to estimate the net benefit of USAID intervention and to estimate the net impact of this intervention on the income of the family. There is a need to first understand the revenues and expenditures of the existent cultivation practices adopted by the households. Next, one needs to compare these values with revenues and expenditures under the GRAD suggested practice. This comparison will allow evaluating whether the incremental benefit of GRAD intervention is worth the cost. This is carried out by building “with” and “without” scenario with respect to revenues and expenditures profiles and then constructing an incremental cash flows statement for the entire evaluation period of eleven years.

(a) “Without” Intervention Scenario (Case of intercropping of red haricot beans and maize)

The existent cultivation practice of Ethiopian farmers is to intercrop and rotate different crops. The main landholding is usually allocated for the maize, wheat, barley and other cereals production. The base line (or “without” scenario) analysis built making assumption that households cultivate only maize. The households land holding is limited to one timad¹⁹. The details of the expenditures and incomes for the “without” intervention scenario are as follows:

Revenue: The revenue for the households is the value of maize whether it is sold or consumed at home. The maize yield is 600 kg/timad. There is a post – harvest loss of 8 percent, which reduces the total quantity harvested to 552 kg/timad. At the current price of 4 ETB/kg this translates into 2,208.00 ETB of potential revenues. About 250 kg of maize, however, is consumed at home allowing a farmer to sell 302 kg of maize per harvest.

Expenditures: The full list of expenditures is presented in table 6 above. The expenditures are divided into two groups: inputs cost and activity costs. Inputs cost are maize seeds, UREA and DAP. This group of

¹⁹ Timad is equal to 0.25 hectare.

expenditures represents real cash outflows of the household. Activity costs are the opportunity cost of labour and land. This group of expenditures is not a cash outflow of the household but is the value of their opportunity cost. There is also a land tax of 85 ETB/ha/year.²⁰

(b) “With” Intervention Scenario (Case of intercropping of red haricot beans and maize)

The intervention in red haricot beans will change the pattern of land utilization. The households will start intercropping maize with red haricot beans. The priority, however, still will be directed toward maize cultivation. The decrease in yield of maize per hectare is assumed to be 24 percent because of intercropping. There is a corresponding decrease in the yield/ha of haricot beans by 67 percent from the mono cropping. The details of the expenditures and incomes for the intercropping intervention scenario are as follows:

Revenue: The revenue for the family is the value of maize and red haricot beans whether it is sold or consumed at home. The base case maize yield is 600kg per quarter of hectare. There is a 24 percent decrease in the yield of maize due to intercropping practice. This translates to the yield equal to 456 kg/timad. There is 8 percent post – harvest loss, which also reduces yield to 419.52 kg of maize per 0.25 hectare. The value of the maize harvested, when sold at current market price of 4 ETB is equal to 1,678.00 ETB. A quarter of metric ton of maize is consumed at house allowing the family to sell 169.52 kg of maize.

The yield of red haricot beans using improved seeds is equal to 400kg/timad under the mono cropping cultivation practice. Due to intercropping the yield falls by 67 percent leaving the farmer with 132 kg of red haricot beans per harvest in addition to the maize. The post – harvest loss of beans is estimated to be 5 percent. This translates into 125.4 kg/harvest. Good quality red haricot beans are able to fetch price of 7 ETB/kg at the local market. At such price level total value of haricot beans produced is amounted to ETB 877.80. The family consumption of red haricot beans is assumed to be 50kg from each harvest, allowing farmers to sell the rest 75.4 kg.

Expenditures:

The full list of expenditures is presented in table 6 above. The expenditures are divided into two groups: input costs and activity costs. Input costs are maize seeds, red haricot beans seeds, UREA and DAP. The quantity of fertilizers used, however, doesn’t change because of the intervention. The reason is that farmer’s attention is toward maize cultivation; hence the fertilizing practice does not change. This group of expenditures represent real cash outflows of the household. Activity costs are the opportunity cost of labour and land. There is also no increase in the rental value of land because of haricot beans cultivation.

(c) “Without” Intervention Scenario (Case of red haricot beans mono cropping)

Some Ethiopia households, specifically those with a land holding of more than one timad, may allocate a quarter of hectare for the red haricot beans mono cropping cultivation. Under the existent mono cropping practice, because of the limited availability of improved seeds, the haricot beans yield is only 700 kg/ha. This translates into 175 kg/timad. The details of the expenditures and revenues for the “without” intervention scenario are presented below:

²⁰ The land tax in Ethiopia is calculated based on number of factors, such as soil fertility and etc. The rate used in the analysis is the most frequent one mentioned by the households during interviews.

Revenue: The revenue for the family is the value of the red haricot beans output. The base case market price of the beans is 5.00 ETB/kg. Such price exists on the domestic market during the harvesting period. Majority of the households sell beans during the harvesting period, perhaps because of the losses associated with long storage of the beans. The post – harvest loss of the haricot beans is equal to 5 percent. The total quantity harvested those amounted to 166.25 kg/timad. The in – house consumption of red haricot beans is reported to be 20 percent of the quantity harvested. The total value of the production, including in – house consumption, is 831.25 ETB.

Expenditures: The complete list of expenditures is presented in table 5 above. The expenditures are divided into two groups: inputs cost and activity costs. Inputs costs are red haricot beans seeds and DAP. Activity costs are opportunity costs of labour and land. There is also a land tax of 85 ETB/ha/year.²¹

(d)“With” Intervention Scenario (Case of red haricot beans mono cropping)

The proposed by USAID intervention will give farmers access to improved seeds and capital required for the purchase of the seeds. This will allow farmers to more than double the yield of the haricot beans. The resulted yield is reported to be 1,6 MT/ha, which translates into 400 kg/timad. The loss rate assumed not to remain at the level of 5 percent, allowing farmers to harvest 380 kg/timad.

Revenue: The better quality of seeds will allow farmers not only to increase haricot beans yield, but also to fetch a better price in the market. The price will increase up to 7.00 ETB/kg, because of the better quality of the beans. The total value of production is estimated to be 2,660 ETB/kg. The family consumption is assumed to be 50 kg per year.

Expenditures: The complete list of expenditures is presented in table 5 above. The expenditures are divided into two groups: inputs cost and activity costs. Input costs are improved red haricot beans seeds and DAP. Activity costs are opportunity cost of labour and land. Transportation costs also may remain within the family. Households usually use donkeys to transport beans from the field to the market.

PREPARATORY TABLES

In the CBA model, tables 2 to 10 are preparatory information about haricot beans cultivation and projected expenditures and value of production both for “with” and “without” intervention.

Table 2 contains total investment cost required for the red haricot beans cultivation. The total investment cost is estimated to be 688.75 ETB. Table 2 is the basis for the Table 3, of the model, where total amount of the loan is derived. The total amount of loan, in addition to the investment cost, includes a charge of 1 percent, an insurance of 1 percent, a pass book fee of 15 ETB and up – front saving of 10 percent of the total investment required. Up – front saving is returned to the household upon repayment of the loan with no interest accrued on the saving. Resulted amount of the loan is equal to 786.40 ETB.

Table 4 presents domestic inflation per production period (6 months) that is estimated to be 9.54 percent at resulted domestic price index. Domestic price index is used to adjust current prices to reflect impact of inflation over the evaluation period. The expected exchange rate of the Ethiopian Birr to the US dollar is derived by multiplying current exchange rate and relative price index. Relative price index, in turn, is the factor of inflation in Ethiopia and US.

²¹ The land tax in Ethiopia is calculated based on number of factors, such as soil fertility and etc. The rate used in the analysis is the most frequent one mentioned by the households during interviews.

Table 5 depicts the projected loan schedule. The haricot beans cultivation begins during the month of May. Harvesting season is usually at the beginning of the month of November. The monthly interest rate is estimated to be 1.17 percent²². The households assumed to take loan just before the beginning of the production cycle in May, and repay principal and interest accrued after they harvest and sell haricot beans in the month of November. The households will have 5 month of grace period.

Table 6 presents production round based nominal input and operating costs for both, “with” and “without” scenarios. The nominal values are derived by adjusting current values over the corresponding price index. It is assumed that the households will bear all the production related costs at the beginning of the period (6 month). The production, however, will be sold at the beginning of the next period.

Table 7 presents annual production in kilograms for both “with” and “without” case. The table is the base for the Table 8 were the total value of production in nominal terms is derived.

FINANCIAL ANALYSIS

The modeling exercise was constructed for the 11 years evaluation period. Tables 11 and 12 of the model present the cash flow statement from the total investment or project point of view in nominal and real values for both, “with” and “without” scenarios.

The mono cropping case without scenario yields in real terms a financial net present value (FNPV) of ETB 1,070 or US\$ 61 with real discount rate of 12 percent. The case, when red haricot beans are intercropped with maize, yields a financial net present value of ETB 3,844 or US\$220. To estimate the addition to the family welfare, because of the intervention, one has to examine the difference between “with” and “without” scenarios. Those tables 11 and 12 of the CBA model are required for consequent construction of the incremental cash flow statements from the total investment or project point of view presented in Table 13 of the CBA model. The incremental analysis of the mono cropping scenario yields a positive Financial Net Present Value (FNPV) of ETB 7,023 or US\$401 using real discount rate of 12 percent. This represents significant improvement over previous “without” situation. The intercropping case results on incremental FNPV being equal to ETB264 or US\$ 15. Tables 7 and 8, below, present the incremental cash flows for mono cropping and intercropping scenarios, respectively:

²² Annual interest rate is equal to 15 percent

Table 7. Incremental cash flow statement – Total investment or project point of view for mono cropping scenario (Real ETB)

Line Items	Year<<<<	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	PV
<u>Receipts</u>													
In-house Consumption		365.75	365.75	365.75	365.75	365.75	365.75	365.75	365.75	365.75	365.75	365.75	2,432.32
Marketed Beans		1,463.00	1,463.00	1,463.00	1,463.00	1,463.00	1,463.00	1,463.00	1,463.00	1,463.00	1,463.00	1,463.00	9,729.28
Total Inflows		1,828.75	12,161.60										
<u>Expenditures</u>													
Inputs Cost:													
Seeds		212.50	212.50	212.50	212.50	212.50	212.50	212.50	212.50	212.50	212.50	212.50	1,413.17
DAP		388.75	388.75	388.75	388.75	388.75	388.75	388.75	388.75	388.75	388.75	388.75	2,585.27
Land		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Activity Costs:													
Plowing		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Planting		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fertilizer application		30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	199.51
Weeding		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Harvesting		75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	498.77
Threshing		30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	199.51
Packaging		15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	99.75
Transportation		21.38	21.38	21.38	21.38	21.38	21.38	21.38	21.38	21.38	21.38	21.38	142.15
Land Tax		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Outflows		772.63	772.63	772.63	772.63	772.63	772.63	772.63	772.63	772.63	772.63	772.63	5,138.13
Net Cash Flows		1056.13	1056.13	1056.13	1056.13	1056.13	1056.13	1056.13	1056.13	1056.13	1056.13	1056.13	7,023.47
Net Cash Flows, REAL USD		60.35	401.34										

NPV @12% discount rate ETB	7,023
NPV @12% discount rate \$US	401

Table 8. Incremental cash flow statement – Total investment or project point of view for intercropping scenario (Real ETB)

Line Items	Year<<<<	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	PV
Receipts													
Marketed Maize		-529.92	-529.92	-529.92	-529.92	-529.92	-529.92	-529.92	-529.92	-529.92	-529.92	-529.92	-3,524.09
In-house Maize Consumption		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Marketed Beans		527.80	527.80	527.80	527.80	527.80	527.80	527.80	527.80	527.80	527.80	527.80	3,509.99
In-house Beans Consumption		350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	350.00	2,327.58
Total Inflows		347.88	2,313.48										
Expenditures													
Inputs Cost:													
Maize Seeds		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Red beans Seeds		180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	1,197.04
UREA		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DAP		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Activity Costs:													
Plowing		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Planting		30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	199.51
Fertilizer application		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weeding		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Harvesting		30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	199.51
Threshing of Red Beans		45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	299.26
Packaging of Red Beans		15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	99.75
Transporting of Red Beans		8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	54.53
Land		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Land Tax		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Outflows		308.20	2,049.60										
Net Cash Flows		39.68	263.88										
Net Cash Flows, REAL USD		2.27	15.08										

NPV @12% discount rate	
ETB	264
NPV @12% discount rate	
\$US	15

Table 14, in the CBA, depicts the cash flow statement from the total investment point of view excluding home consumption. Home consumption, although it definitely has value for the households, does not represent a monetary outflow and those should be excluded from the analysis to properly assess ability of the households to serve their debt obligations. The same rationale holds for opportunity cost of family labor. In this case labor expense should be added back to the net cash flow over the period since money actually stay within the family and can be used to cover debt obligations. The Table 14 is again constructed on incremental basis. This allows the households to repay loans without requiring a contribution of financial resources from other activities.

The Annual Debt Service Coverage Ratio (ADSCR) for the mono cropping scenario is estimated to be 1.22. The ADSCR above one usually indicates ability of the households to cover their debt obligations. In the intercropping case the ADSCR is only 0.30, which is below the value of one. In case of intercropping, however, farmers will now have additional 50 kg of haricot beans consumed at by the family.²³ This 50 kg was excluded from the cash flow used to calculate ADSCR. The value of the 50 kg of red haricot beans is equal to 350 ETB. When this value is added back ADSCR increases to 0.84.

Table 15 of the CBA model presents cash flow statement in real terms from the equity point of view. The only difference between total investment and equity point of view is financing. The cash flow statement from the total investment project of view is constructed to assess the overall attractiveness of the project. The cash flow statement from the equity point of view, in turn, determines the returns to the households taking into consideration the source of project financing. The resulted FNPV from the equity point of view is US\$397.84 in case of mono cropping and 12.03 in the case of intercropping.

ECONOMIC ANALYSIS

Differences arise between the financial and economic outcomes due to the fact that the financial values do not include in all the externalities that are present in the economy (e.g., government). To show the true economic impact on the Ethiopian economy of the proposed intervention, the economic values are derived by adjusting the financial values by appropriate economic conversion factors. If no distortion is present in a market then the financial value of an item is used to measure the economic value of an item. The values of the ENPVs for each scenario are presented in table 9, below:

Table 9. ENPV for each intervention

ENPV (in US\$)	Mono cropping	Intercropping with maize
Red haricot beans	435.38	29.51

The proposed intervention will increase Ethiopian red haricot beans production. Ethiopia currently exports red haricot beans. Increased exports will benefit Ethiopian economy by bringing foreign exchange to the country. The foreign exchange premium for Ethiopia was estimated to be equal to 6.5 percent (Kuo, 2011). The foreign exchange premium of 6.5 percent means that every incremental dollar earned on exports has economic value of 1.065 dollar. If there are no other distortions this connotes that every incremental kg of haricot beans produced should be attributed with the positive externality of 6.5 percent. Table 10 and 11 presents the resource flow statement from the economy point of view:

²³ In the “without” case scenario the households didn’t produce red haricot beans. If they were to purchase such quantity they had to pay 350ETB.

Table 10. Incremental Resource flow statement Economy point of view for mono cropping scenario (Real ETB)

Line	Items	CF	Year<<<<	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	PV
	Receipts														
	In-house														
	Consumption	1.07		390.90	390.90	390.90	390.90	390.90	390.90	390.90	390.90	390.90	390.90	390.90	2,599.58
	Marketed Beans	1.07		1,563.60	1,563.60	1,563.60	1,563.60	1,563.60	1,563.60	1,563.60	1,563.60	1,563.60	1,563.60	1,563.60	10,398.32
	Total Inflows			1,954.51	1,954.51	1,954.51	1,954.51	1,954.51	1,954.51	1,954.51	1,954.51	1,954.51	1,954.51	1,954.51	12,997.90
	Expenditures														
	Inputs Cost:														
	Seeds	1.07		227.11	227.11	227.11	227.11	227.11	227.11	227.11	227.11	227.11	227.11	227.11	1,510.35
	DAP	1.06		410.32	410.32	410.32	410.32	410.32	410.32	410.32	410.32	410.32	410.32	410.32	2,728.70
	Land	1.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Activity Costs:														
	Plowing	1.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Planting	1.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fertilizer application	1.00		30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	199.51
	Weeding	1.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Harvesting	1.00		75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	75.00	498.77
	Threshing	1.00		30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	199.51
	Packaging	1.00		15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	99.75
	Transportation	1.00		21.38	21.38	21.38	21.38	21.38	21.38	21.38	21.38	21.38	21.38	21.38	142.15
	Land Tax	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total Outflows			808.81	808.81	808.81	808.81	808.81	808.81	808.81	808.81	808.81	808.81	808.81	5,378.73
	Net Cash Flows			1145.70	1145.70	1145.70	1145.70	1145.70	1145.70	1145.70	1145.70	1145.70	1145.70	1145.70	7,619.16
	Net Cash Flows, REAL USD			65.47	65.47	65.47	65.47	65.47	65.47	65.47	65.47	65.47	65.47	65.47	435.38

NPV @12%	
discount rate	
ETB	7,619
NPV @12%	
discount rate	
\$US	435.38

Table 11. Incremental Resource flow statement Economy point of view for intercropping scenario (Real ETB)

Line	Items	CF	Year<<<<	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	PV
	Receipts														
	Marketed Maize	1.02		539.93	539.93	539.93	-539.93	-539.93	-539.93	-539.93	-539.93	-539.93	-539.93	-539.93	-3,590.68
	In-house Maize Consumption	1.02		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Marketed Beans	1.07		564.09	564.09	564.09	564.09	564.09	564.09	564.09	564.09	564.09	564.09	564.09	3,751.35
	In-house Beans Consumption	1.07		374.07	374.07	374.07	374.07	374.07	374.07	374.07	374.07	374.07	374.07	374.07	2,487.64
	Total Inflows			398.23	2,648.32										
	Expenditures														
	Inputs Cost:														
	Maize Seeds	1.02		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Red beans Seeds	1.07		192.38	192.38	192.38	192.38	192.38	192.38	192.38	192.38	192.38	192.38	192.38	1,279.36
	UREA	1.06		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	DAP	1.06		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Activity Costs:														
	Plowing	1.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Planting	1.00		30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	199.51
	Fertilizer application	1.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Weeding	1.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Harvesting	1.00		30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	199.51
	Threshing of Red Beans	1.00		45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	299.26
	Packaging of Red Beans	1.00		15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	99.75
	Transporting of Red Beans	1.00		8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	54.53
	Land	1.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Land Tax	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total Outflows			320.58	2,131.91										
	Net Cash Flows			77.65	516.40										
	Net Cash Flows, REAL USD			4.44	29.51										

NPV @12% discount rate	
ETB	516
NPV @12% discount rate	
\$US	29.51

STAKEHOLDER AND BENEFICIARY ANALYSIS

A surplus is also created in the economy by employing capital, land, and labour and paying financial prices for these inputs that are greater than the value of their opportunity costs. The GRAD interventions yield two groups of beneficiaries: the households engaged in red haricot beans cultivation and the Government of Ethiopia.

The FNPV represents the benefits accruing to the households. In this case it has a positive value of US\$ 400.19 for mono cropping scenario and US\$ 13.98 in the case of intercropping. The greater economic values are due to additional benefits arising from additional tax revenue accruing to the government. The financing contribution of USAID is a transfer of resources from USAID to the farmer. This financial subsidy created through the submarket interest rates does not affect the ENPV of the project. It is accounted for as a direct subsidy provided to households by the lower than market interest rates, and is included as a benefit in the calculation of the FNPV of the households.

The Ethiopian government benefits from the additional inflow of taxes that accrues directly through the taxation of inputs purchased by the farmers and also indirectly because of the presence of a foreign exchange premium (FEP) accruing on the foreign exchange earnings of the project. This foreign exchange premium is simply a measure of the increase in indirect tax revenue in the economy that occurs when the project generates additional foreign exchange. The values of stakeholder gains under each of the interventions are presented in table 12, below:

Table 12. Stakeholder and Beneficiary Impacts of Project (in US\$)

	Mono cropping	Intercropping
• Financial NPV (Households)	397.84	12.03
○ Government	34.04	14.43
○		

SENSITIVITY ANALYSIS

The variables, for which the sensitivity analysis for red haricot beans has been conducted, include the cost of improved red haricot beans seeds, red haricot beans and maize yields due to intercropping, price of red haricot beans, the cost of fertilizer and the occurrence of droughts (for mono cropping). The variables were chosen to test their significance on the participating household's income.

Mono cropping Intervention in the Red Haricot Beans Value Chain

The joint impact of the red haricot beans price and red haricot beans yields in the mono cropping scenario is presented in the table 13, below. Similarly the joint impact of the cost of red haricot beans seeds and fertilizer (DAP) prices on the FNPV are presented in table 14. Table 15 outlines the joint impact of yield and the selling price of red haricot beans on the net cash flows (NCF) in the year 2 and until the end of the evaluation period. Lastly, table 16 presents the sensitivity analysis for the occurrence of droughts and their impact on red haricot beans production under the mono cropping case.

Table 13. Mono cropping joint impact of red haricot beans price and yield on FNPV (in US\$)

Yield (in kg/ha)	Price (in ETB)				
	5.00	6.00	7.00	9.00	10.00
1,000.00	-156.31	-66.06	24.19	204.70	294.95
1,200.00	-67.87	40.44	148.74	365.35	473.65
1,500.00	64.81	200.19	335.57	606.32	741.70
1,600.00	109.03	253.44	397.84	686.65	831.05
1,800.00	197.48	359.93	522.39	847.30	1,009.76
2,400.00	462.82	679.43	896.04	1,329.25	1,545.86

Table 13, above, shows that the FNPV is sensitive to the joint impact of the fluctuations in the prices of red haricot beans and beans yield. Under the assumed mono cropping scenario, with the selling price of red haricot beans at 7.00 ETB/kg and yield equal to 1,600 kg/ha, the FNPV is US\$397.84. The situation will change if the price and yield of red haricot beans will increase. The best case, if the selling price of red haricot beans increases to 10.00 ETB/kg and the yield increases to 2,400 kg, FNPV is US\$1,545.86. The FNPV will reach 831.05 US\$ if price of red haricot beans will reach 10ETB/kg holding yield constant.²⁴ On the other hand, if the selling price of red haricot beans drops to 5.00 ETB/kg, with yield staying the same at 1,600 kg/ha, the FNPV will drop to US\$109.03.

²⁴ Price 10ETB/kg was proposed by SNV in the GRAD investment proposal. Such price exist before the blockage of illegal trade with Kenya. The blockage has resulted on sudden drop of prices to the level of 5-7ETB/kg.

Table 14. Mono cropping joint impact of the cost of red haricot beans seeds and the DAP price on FNPV (in US\$)

	Cost of seeds (in ETB)				
ETB)					
	451.09	441.50		403.12	374.33
	441.50	431.90		393.52	364.74
	403.12	393.52		355.14	326.36
	374.33	364.74		326.36	297.57

Table 14, above, shows the effects of changing the costs of red haricot beans seeds and the price of fertilizer (DAP). Under the assumed scenario, with the cost of red haricot beans seeds at 12.00 ETB/kg and the cost of DAP at 15.55 ETB/kg, the FNPV is US\$397.84. The situation looks different when the prices of seeds and fertilizer rise. In this situation, at the upper level of tested ranges, with the red haricot beans seeds price at 18.00 ETB/kg and the cost of fertilizer at 20.00 ETB/kg, the FNPV drops to US\$297.57. On the other hand, if the price of seeds drops to 10.00 ETB/kg and the price of DAP decreases to 12.00 ETB/kg, the FNPV increases to US\$451.09.

Table 15. Mono cropping joint impact of the yield and selling price of red haricot beans on NCF in year 2 and after (in US\$)

	Price (in ETB)				
kg/ha)					
	-22.98	-9.41		31.31	44.88
	-9.68	6.61		55.46	71.75
	10.27	30.63		91.70	112.06
	30.22	54.65		127.94	152.36
	70.12	102.69		200.41	232.98

Table 15, above, presents the sensitivity analysis conducted on the joint impact of the yield and price of red haricot beans on a household's net cash flow (NCF)²⁵. Under the assumed scenario, with the selling price of red haricot beans at 7.00 ETB/kg and the yield at 1,600 kg, the annual NCF, after year one, is US\$60.35. If the selling price of red haricot beans increases to 10.00 ETB/kg and the yield stays the same, the NCF increases to US\$125.49. On the other hand if the selling price of red haricot beans decreases to 5.00 ETB/kg and the yield stays at the assumed level of 1,600 kg, the NCF also decreases to US\$16.92. The maximum NCF level under the tested scenarios for red haricot beans selling prices and yields can be achieved when the selling price of red haricot beans is 10.00 ETB/kg and the yield is 2,400 kg. In this case, the NCF rises to US\$232.98.

²⁵ Net cash flow in this case represents additional annual income to the household

Table 16. Mono cropping number of droughts within 5 years and their influence on FNPV (in US\$)

Number of droughts in 5-year period	FNPV
0	397.84
1	260.14
2	150.37
3	52.36

Table 16, above, outlines the sensitivity analysis conducted on the frequency of droughts in Ethiopia within a 5-year period and their influence on the FNPV of the mono cropping intervention. Under the assumed scenario, no droughts occur within that period of time, so the FNPV reaches US\$397.84.

Nevertheless, taking under consideration the climatic conditions of Ethiopia, it is possible that at least one drought will occur during each 5 years over the evaluation period. If one drought occurs the FNPV becomes US\$ 260.14. If two droughts occur within 5 years (which is possible, taking under consideration the historical data of drought occurrence in Ethiopia), the FNPV of the mono cropping intervention drops to US\$150.37.

Another important assumption made in order to assess effect of draught is the yield of red beans during the draught season. It was assumed that in “without” intervention case yield will drop from 700 kg/ha to 50 kg/ha. In the “with” case scenario, the yield will drop from 1600 kg/ha to 100 kg/ha. It is possible, however, to attain higher yields if farmers will have access to improved varieties of red haricot beans that are draught resistant. One can insert corresponding yield into the model and see the change on the FNPV in the sensitivity part of the analysis.

Intercropping With Maize Intervention in the Red Haricot Beans Value Chain

Tables 16–18, below, outline the sensitivity-analysis scenarios for intercropping red haricot beans with maize. Table 16 presents the joint impact of decreased yields of red haricot beans and maize on the FNPV. Table 17 outlines the joint impact of these decreased yields on the NCF in year 2 and after.

Table 16. Intercropping with maize joint impact of maize and red haricot beans yield decrease due to intercropping on FNPV (in US\$)

Red haricot beans yield decrease	Maize yield decrease				
	30%	24%	20%	15%	10%
60%	31.38	81.73	115.29	157.24	199.20
65%	-18.40	31.95	65.51	107.46	149.42
67%	-38.31	12.03	45.60	87.55	129.50
70%	-68.18	-17.84	15.73	57.68	99.63
75%	-117.96	-67.62	-34.05	7.90	49.85

Table 16, above, outlines the sensitivity analysis for the impact of decreases in the yields of red haricot beans and maize on the FNPV. Under the expected scenario, with a decrease in the maize yield of 24 percent and a decrease in the red haricot beans yield of 67 percent (due to intercropping both commodities), the FNPV is US\$12.03. If the decrease in the maize yield drops to 10 percent and the decrease in the red haricot beans yield stay the same at 67 percent, the FNPV rises to US\$129.50. Under the most optimistic scenario (based on selected ranges), if the decrease in the maize yield drops to 10

percent and the decrease in the red haricot beans yield drops to 60 percent, the FNPV increases to US\$199.20. On the other hand, if the decrease in yield of maize is 30 percent and the yield of red haricot beans decreases by 75 percent, the FNPV becomes negative, reaching –US\$117.96.

The yield decrease of the both intercropped commodities is subject to the level of knowledge of the households. Some studies report that it is possible to maintain same yield of maize (as when maize is mono cropped) with decrease of 20 – 30 percent in the yield of pulses. Adequate training on intercropping technology may help farmers to achieve better intervention outcomes.

Table 17. Joint impact of maize and red haricot beans yield decrease on NFC in year 2 and after (in US\$)

Red haricot beans yield decrease	Red haricot beans yield				
	30%	24%	20%	15%	10%
60%	5.18	12.75	17.79	24.10	30.41
65%	–2.31	5.26	10.31	16.62	22.93
67%	–5.30	2.27	7.31	13.62	19.93
70%	–9.97	–2.22	2.82	9.13	15.44
75%	–17.28	–9.71	–4.66	1.65	7.95

Table 17, above, presents the sensitivity analysis of the joint impact of yield decreases in red haricot beans and maize on the NCF. Under the assumed scenario, with a maize yield decrease of 24 percent and a red haricot beans yield decrease of 67 percent (due to intercropping), the NCF is US\$2.27. But if the maize yield decrease drops by only 10 percent and the red haricot beans yield decrease drops by 60 percent, the NCF increases to US\$30.41. On the other hand, if the maize yield decrease rises by 30 percent and the red haricot beans yield decrease by 75 percent, the NCF becomes negative, reaching –US\$17.28.

RECOMMENDATIONS

Both intervention scenarios—mono cropping and intercropping with maize—that have been analyzed show positive financial and economic NPVs, the mono cropping scenario will produce higher NPV values. Nevertheless, it should be emphasized that for chronically food-insecure households the intercropping with maize scenario, regardless of the projected NPVs might be more attractive. Intercropping red haricot beans with maize allows for better mitigation of risks. This is very important in Ethiopia, where the weather patterns are erratic and crop failures are frequent. This scenario could ensure higher level of food security for the households; with time and the experience they gain, it is possible that the households will figure out the perfect balance between intercropping patterns and cost-minimizing levels of fertilizer. This configuration in turn could result in higher production levels of the intercropped commodities, decreases in the amount of money spent on fertilizer, and ultimately higher levels of income and food security for the GRAD-targeted households. With the adequate technology knowledge (that can be transferred to the households through training program), the decrease in the yield of maize that is intercropped may be greatly reduced. Corresponding decrease in the yield of red haricot beans will still be high, perhaps between 55 – 70 percent of mono cropping yield. If this will be the case the FNPV of the intercropping scenario will reach US\$ 335. Increase in annual incomes in this case may increase up to the US\$ 50.5.

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APPENDIX

Table A. GRAD-selected *woredas* and their choice of commodities (per CARE plan)

Region	<i>Woreda</i>	Type of value chains selected for GRAD <i>woredas</i>
SNNPR	Shebedino	Fattening (shoats and cattle), vegetables (potato and onion), honey
	Awassa Zuria	Shoats fattening, red pepper, vegetables (potato and onion)
	Loka Abaya	Shoats fattening, pulse (beans) , honey
	Hawale Tula	Vegetables (potato and onion), fattening (shoats and cattle), honey
	Mareko	Red pepper, fattening (shoats and cattle), onion
	Meskan	Red pepper, fattening (shoats and cattle), vegetables (onion and tomato)
Tigray	Alamata	Vegetables (onion and tomato), cattle fattening, honey
	Ofla	Shoats rearing, honey, vegetables (garlic and pepper), fattening (shoats and cattle), pulse (fava beans)
	Enda Mehoni	Vegetables (potato and garlic), shoats rearing, cattle fattening, honey, pulse (fava beans)
	Raya Azebo	Shoats rearing, fattening (shoats and cattle)
Amhara	Lay Gayint	Cereals (malt barley), pulse (white pea beans), potato, shoats fattening
	Libo Kemkem	Cattle fattening, honey, onion
Oromia	Arsi Negele	Shoats fattening, pulse (white pea beans) , red pepper
	Ziway Dugda	Pulse (white pea beans) , vegetables (tomato and onion), shoats fattening
	Shala	Shoats fattening, pulse (white pea beans) , potato
	Adami Tulu	Red pepper, pulse (white pea beans) , shoats fattening

Table B. The FtF indicators proposed for monitoring and evaluating the GRAD project

Results	Indicator	Target
Overall objective: To graduate chronically food-insecure households from food support	Graduation of chronically food-insecure households from food aid by increasing their yearly household incomes	50,000 households with increase in yearly income of US\$365 by year 5
Result 1: Enhanced livelihood options for chronically food-insecure households	4.5-2 Number of jobs attributed to FTF implementation (RiA)	Higher is better
	3.1.9.1-3 and 4.7-4 Prevalence of households with moderate or severe hunger (RiA)	Lower is better
Result 2: Improved community and household resilience	3.1.9-16 Prevalence of underweight children under 5 years of age (R)	Lower is better
	3.1.9-13 Prevalence of underweight women (R)	Lower is better
	3.1.9-4 and 3.1.9.1-4 Prevalence of exclusive breastfeeding of children under 6 months of age (RiA)	Lower is better
	3.1.9-11 Prevalence of stunted children under 5 years of age (R)	Lower is better
	4.5.2-14 Number of vulnerable households benefiting directly from USG assistance (S)	Lower is better
Result 3: Strengthened enabling environment to promote scale-up and sustainability	4.5 Women's Empowerment in Agriculture Index Score (R)	Higher is better
	4.5.1-27 and CBLD-5 Score, in percent, of combined key areas of organization capacity among USG direct and indirect local implementing partner levels	Higher is better
	4.5.2-38 Value of new private-sector investment in the agriculture sector or food chain leveraged by FTF implementation (RiA)	Higher is better

Table C. CFs used in the economic analysis of GRAD interventions in the red haricot beans value chain

<i>Summary of CFs</i>	
Red beans	1.07
Red beans seeds	1.07
Maize	1.02
Maize seeds	1.02
Transportation	0.84
Labor	1.00
Land	1.00
UREA	1.05
DAP	1.05