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AGRICULTURAL GROWTH PROGRAM (AGP) - LIVESTOCK MARKET DEVELOPMENT (LMD):

COST-BENEFIT ANALYSIS OF THE MEAT VALUE CHAIN IN ETHIOPIA

FINAL REPORT

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FINAL REPORT

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ACRONYMS

AGP	Agriculture Growth Program
ADSCR	Annual Debt Service Coverage Ratio
CBA	Cost-Benefit Analysis
CF	Conversion Factor
CSA	Central Statistical Agency of Ethiopia
ENPV	Economic Net Present Value
EOCK	Economic Opportunity Cost of Capital
ETB	Ethiopian Birr (Currency)
FEP	Foreign Exchange Premium
FNPV	Financial Net Present Value
FtF	Feed the Future (Program)
GDP	Gross Domestic Product
GRAD	Graduation with Resilience to Achieve Sustainable Development
Ha	Hectare
kg	Kilogram
LMD	Livestock Market Development
MFI	Microfinance Institution
NCF	Net Cash Flow
NGO	Nongovernmental Organization
NPV	Net Present Value
ORDA	Organization for Rehabilitation and Development in Amhara
PLWHA	People Living With HIV/AIDS
PSNP	Productive Safety Net Program
PLI – II	Pastoralist Livelihoods Initiative – Phase II
QDSCR	Quarterly Debt Service Coverage Ratio
SNV	Netherlands Development Agency
US$	United States Dollar
USAID	United States Agency for International Development

EXECUTIVE SUMMARY

USAID Ethiopia was awarded a 5-year, US$38-million contract under the U.S. Government's Feed the Future (FtF) Initiative. The investment will serve as part of USAID's contribution to the government of Ethiopia's Agriculture Growth Program (AGP). The aim of the USAID Ethiopia Livestock Market Development (LMD) project is to foster growth and reduce poverty through improving the competitiveness of selected livestock value chains in target woredas for the benefit of a large numbers of smallholders. The LMD budget of US$38 million includes US$25.30 million for productivity and competitiveness improvements, US$2.50 million for nutrition enhancements, US$7.70 million for policy and enabling environmental improvements, and US$2.50 million for people living with HIV/AIDS (PLWHA).

Project Description: The objective of the meat value-chain analysis is to understand the situation at the farm level and to analyze a number of possible LMD interventions designed to improve the livelihood of the targeted households. Field visits were used to collect primary data that were compared with credible publications and, when necessary, suitably adjusted. The adjusted data were then used to construct cost-benefit analysis (CBA) models of the proposed interventions. These CBA models were designed to assess financial and economic outcomes of the interventions, such as the financial net present value (FNPV), the economic net present value (ENPV), and the annual debt service coverage ratios (ADSCRs). Taking into consideration the variety of climatic conditions and livestock-production systems in Ethiopia, the CBA models were built to be easily adjusted to predict outcomes of interventions made in different regions of Ethiopia by changing the key parameters of the interventions in each model's Table of Parameters. The models could then automatically recalculate all corresponding figures.

The key observations from the field visits were as follows:

1. Cattle fattening in the highlands of Ethiopia is usually done only by the better-off households due to the high level of initial investment required for the purchase of the animals.
2. The better-off households have relatively high landholdings of more than 1.5 hectares (Ha), which allow them to be less dependent on the market availability of hay and other types of roughage.
3. The quantity of livestock purchased for fattening depends on the quantity of crop residues available after households harvest their crops.
4. For this analysis, the intervention is assumed to consist of four rounds of fattening per year. In the first year, each round will involve fattening one animal. For the second and subsequent years, two animals will be fattened in each round.
5. The fattening period (the time interval between the purchase of the animals and their consequent sale) lasts between 2 and 3 months. Households examine market conditions (the availability of hay and improved feed for livestock) and the quantity of crop residues available after the harvest. The quantity of animals purchased for fattening is mainly based on these two factors.[1]
6. Households provide all necessary veterinary services to the animals right after the purchase takes place.
7. The mortality rate of cattle during the fattening period is reported to be almost zero. None of the interviewed farmers reported significant losses associated with animal mortality. It

[1] Financial resources are obviously another factor, but holding this variable constant allows better understanding of the ground-level behavior of the households.

is possible that a cow or bull may break a leg, for instance. In such cases, it will be immediately sold for slaughtering in the market.

8. Most of the observed households do not fatten cattle during the crop-production period. Fattening is usually performed after the harvest and before planting takes place to allow the households to have up to four rounds of fattening in a normal year.[2]
9. The households frequently exchange dung for the by-products of the local brewery and winery industries to minimize the cost of feeding.

At the time this analysis was conducted, the selection of LMD implementers was in progress. This analysis is based on possible interventions that could be undertaken in the meat value chain.

Strategic Context and Rationale: The USAID Ethiopia LMD is part of the wider strategy of FtF programs, which support investments in profitable and relatively easy-to-implement interventions in agricultural value chains. FtF's goal is to reduce poverty and hunger in a sustainable manner.

Two interventions are evaluated here for the LMD meat value chain: the baseline intervention[3] proposes a loan-based mechanism to allow the households to obtain the required financial resources for cattle fattening. This specific intervention has been chosen because it does not require much specific knowledge to be implemented at the household level. In addition, the labor requirements at the household level are relatively low. The second intervention is a 10 percent reduction of the cost of livestock feeding. The cost of the second intervention is unknown, so the analysis only derives the net benefits to the households that fatten livestock.

Financial and Economic Analysis Results: The main assumption in this analysis is that LMD households will have four rounds of cattle fattening per year, with one or two animals fattened per round. Each farmer will receive a loan sufficient to purchase one head of cattle in year one. After repaying the loan at the end of the year, each household will have access to a new loan sufficient for the purchase of two heads of cattle.

The usual policy of microfinance institutions (MFIs) in Ethiopia is to allow households to get three subsequent loans after each of the previous loans is repaid. The loan required for the purchase and fattening of three steers in year three has been calculated to be ETB 34,140 (Ethiopian Birr), or US$1,897, which is much higher than the usual loan amount available for Ethiopian households.[4] The third loan for the beneficiaries of LMD will be sufficient for the purchase and consequent fattening of two heads of cattle; hence, after the first year, it is assumed that two heads of cattle will be fattened in each round. In total, each household will be given three loans during the 3-year period.

The households will have to pay interest accrued on the current loans at the end of each fattening period. The principal will be repaid at the end of the year in full along with the interest accrued from the previous fattening period. The principal payment will occur only at the end of the year, because the households will need sufficient financial resources to purchase cattle for the subsequent fattening round; these financial resources will be provided at the beginning of the year through the next loan. A semi-annual repayment loan structure is not recommended, because it will leave the households unable to continue the fattening operation.

After the 3-year period, in theory the targeted households will have sufficiently built up their equity to maintain production without needing to borrow additional capital. The analysis reveals,

[2] A "normal" year is defined as a year when climatic conditions allow farmers to grow or purchase sufficient amounts of feed.
[3] The baseline intervention is defined as an intervention for which the main analysis is performed. The analysis of the second intervention is derived from the results of the CBA of the baseline intervention.
[4] In 2012, the maximum loan amount from MFIs was reported to be 15,000 ETB (US$833.34).

however, that the required equity level cannot be fully reached only from the cattle-fattening activity during the 3-year period.

Each loan will include a grace period of 3 months and an interest rate of 15 percent, compounded annually. The interest rate on the loan per fattening round (3 months) will be 4.77 percent. The ADSCRs for the three loans are presented in table A, below.

Table A. ADSCRs for the loans

Year	Loan amount (ETB)	Loan amount (US$)	ADSCR
1	**8,216.76**	**456.48**	**1.05**
2	**19,699.22**	**1,094.40**	**1.17**
3	**23,636.07**	**1,313.12**	**1.17**

The total amount of the loan will include funds sufficient to purchase cattle, pay for the feed required for fattening, and cover veterinary expenses. In addition, the loan will include a service charge of 1 percent, an insurance fee of 1 percent, a passbook fee of ETB 15, and a down payment of 10 percent that will be returned to the households upon repayment of the loan. An ADSCR value higher than 1 indicates the ability of the households to cover their debt obligations.

The analysis covers a 10-year period and shows that the cattle-fattening intervention will yield a positive FNPV of US$875.26 per household at a real financial discount rate of 12 percent. The FNPV of the 10 percent reduction of the cost of livestock-feeding intervention is US$345.68 per household using a 12 percent real discount rate.

The ENPVs of the interventions are also positive and equal to US$1,278.24 and US$362.20 per household, using a 12 percent economic opportunity cost of capital (EOCK), for the cattle-fattening and reduction of the feeding cost interventions, respectively.

The differences between financial and economic outcomes of the project result from the fact that the financial values do not include all externalities presented in the project. In this case, the differences occur because of two factors:

- Meat is an internationally tradable good. Internationally tradable goods, when exported, bring foreign exchange to the country. The foreign exchange premium (FEP) for Ethiopia is reported to be 6.5 percent (Kuo, 2011), so every incremental dollar earned on exports has a financial value of 1.065 times the market exchange rate. Transportation costs also occur when meat is exported from Ethiopia, and high tax rates are assessed on fuel required for transportation. Although these taxes on fuel are a component of the financial cost of transportation, they are not included in the economic cost of the project, so the resulting economic value of meat is 10 percent above the financial value.
- The financial cost of the inputs used for the cattle fattening, such as feed and veterinary expenses, differs from their true economic cost due to taxes.

The analysis shows that upon the implementation of the cattle-fattening intervention, each targeted household will observe an increase in its income of US$222.11 per year in 2013 and 2014 and an increase of US$252 in 2015 and until the end of the project, when financing comes only from the household's equity.

Beneficiary Analysis Results: The results of the analysis reveal that the income of the targeted households will increase. This annual increase in the income of the households is presented in table B, below.

Table B. Annual increase in the income of the households, including opportunity cost of family labor (in US$)

Year	Annual increase in income
2012	110.51
2013	222.00
2014	222.11
2015–2021	252.00

This annual increase in income includes the opportunity cost of family labor spent on the fattening activity. Each household's net income will be US$1,402.62 over the 10-year evaluation period. The other beneficiary of the intervention will be the Ethiopian government, for the following reasons:

- The government will benefit directly from the taxes collected on the inputs and outputs of the intervention. Salt, fuel (used to transport meat for exports), deworming drugs, and vaccines are importable to Ethiopia. The total tax rate applied to salt and fuel is higher than the FEP. The inflow of taxes on salt will reduce the economic cost below its financial cost and generate tax revenue for the government of Ethiopia. No taxes are applied to deworming drugs and vaccines when they are imported to Ethiopia, so the intervention's economic cost will be higher than the financial cost by the amount of the FEP.
- The government will also benefit indirectly, because meat is exported from Ethiopia. Exports allow the country to earn foreign exchange. The total amount of government benefits from the intervention over the 10-year period is estimated to be US$336.87.

Conclusions and Recommendations: The CBA of this intervention in the meat value chain shows a positive FNPV, suggesting that the benefits of implementing such an intervention will outweigh the costs. The households will be able to repay their loan obligations related to financing the investments for cattle fattening and will increase their annual income due to the intervention.

The analysis does reveal that the households will not be able to build a sufficient level of equity to repurchase a herd for fattening after the third year of the intervention. Therefore, farmers will need to find additional sources of financing or contribute income generated from other activities to continue the fattening operation. A risk will be associated with an increased number of debt defaulters for the third loan if MFIs are unwilling to continue providing new loans for those farmers who are unable to continue production without borrowing.

Repayment of the loan principal should occur just before the households get new loans from MFIs. A semi-annual loan-repayment structure is not recommended, because it will ruin the households' ability to continue production.

It is also recommended that institutions operating in Ethiopia be assisted in addressing feed issues. The cost of feed accounts for 60 percent to 70 percent of the total cost of livestock production. Feed shortages and high prices have a dramatic impact on the profitability of a commercial livestock operation.

Drought-mitigating activities should be carefully examined before implementation. During the 2007–2008 drought, a substantial amount of concentrate and roughage feeds was purchased by different governmental and nongovernmental organizations (NGOs) to address the critical feed shortages in pastoralist areas. This drought-mitigation intervention, coupled with a general feed shortage, dramatically increased the price of feed and resulted in a crisis in the animal feed supply throughout Ethiopia.

LMD MEAT VALUE CHAIN: COST-BENEFIT ANALYSIS

METHODOLOGY

Project Background

The growth rate of Ethiopia's real gross domestic product (GDP) in 2011 was 7.5 percent. Ethiopia, however, is still one of the poorest countries in the world. Currently, about 8 million Ethiopians, out of the total population of 93 million,[5] live with chronic food insecurity (The World Fact Book, CIA). These figures show that for several months of the year, a large portion of Ethiopian families cannot obtain enough food to avoid hunger. This situation is one of the main reasons that USAID Ethiopia supports various initiatives to increase food security for Ethiopia's most vulnerable inhabitants.

Cattle fattening is usually perceived by Ethiopian households as an income-generating activity for the period when they are not involved in crop-production activities. Some interviewed farmers reported that the opportunity cost of family labor involved in the fattening operations was the same as the opportunity cost of labor during the crop-production period, indicating that the households that already practice livestock fattening perceive it as a full-time activity that provides income to the family when crop production is not possible.

The livestock market development (LMD) is part of USG's broader Feed the Future (FtF) imitative agenda. The USAID Ethiopia LMD will foster growth and reduce poverty through improving the competitiveness of selected livestock value chains in the target woredas for the benefit of large numbers of male and female smallholders. The LMD will also reduce hunger through increasing income and creating jobs for rural households. The LMD budget of US$38 million includes US$25.30 million for productivity and competitiveness improvements, US$2.50 million for nutrition enhancements, US$7.70 million for policy and enabling environmental improvements, and US$2.50 million for people living with HIV/AIDS (PLWHA).

The LMD will be implemented in the Agriculture Growth Program's (AGP's) targeted 83 woredas within Ethiopia's four main regions (Oromia, SNNPR, Amhara, and Tigray). Meat and dairy rank among the top-priority commodities in each region. The LMD will focus on two key value chains: dairy and "live animals and meat," including hides, skins, and leather (a subset of the live animals and meat value chain).

To reduce poverty, the LMD will establish strong linkages with new USAID programs, such as the Productive Safety Net Program (PSNP), the Graduation with Resilience to Achieve Sustainable Development (GRAD) program, and the Pastoralist Livelihoods Initiative – Phase II (PLI – II) program. The LMD will pilot a strategy to "pull" very poor graduates from GRAD and PLI – II into value chain–specific market opportunities. This pilot will test the efficacy of USAID Ethiopia's FtF "Push-Pull" strategy in creating a "pathway out of poverty" for the chronically poor. The "Push-Pull" hypothesis posits that asset-building "Push" efforts by PSNP, GRAD, and PLI – II in vulnerable areas can help link those communities with more stable livelihoods through greater integration into stable value chains.

[5] As per the CIA's estimation from July 2012.

Commodity Background

Current Situation in Ethiopian Livestock Production

Ethiopian farmers have a long tradition of animal husbandry. It is estimated that Ethiopia possesses the largest number of livestock in Africa, comprising about 59 million cattle, 35 million sheep, and 31 million goats (Negassa, Rashid, and Gebremedhin, 2011). Given the total Ethiopian population of 93 million people, the per-capita livestock holding is still very low (about 1.3 animals per capita). The livestock holding per capita in Kenya, for example, is 1.43 animals. The number of livestock at the smallholder level also remains low. The majority of smallholders in Ethiopia are engaged in some sort of animal husbandry, but they usually do not specialize in any specific branch of livestock production. Ethiopia's small-scale farmers, including those who are chronically food insecure, treat their livestock as a resource that yields multiple benefits, including

- additional cash income that comes from the sales of live animals, wool, or hides/skins;
- natural fertilizer resource (manure);
- food in the form of milk and meat;
- a risk-management and safety-net resource when drought or crop failure occurs (a "walking bank"); and
- a hedge against inflation (a wealth-accumulation resource in the absence of available financial institutions, or a "walking savings account").

Main Obstacles in the Ethiopian Livestock Production

Ethiopia has the lowest livestock-production rate among the least-developed countries and one of the lowest anywhere in the world (Negassa, Rashid, and Gebremedin, 2011). There is not much specialization in the livestock sector, which lowers its productivity potential. Any observed productivity growth happens because of increases in the total number of animals, not because of increases in the efficiency of livestock-production methods. The commercial off-take rate is only about 8 percent for Ethiopia, which indicates that households keep animals for other purposes (such as prestige, social status, or liquid investment) rather than to sell them.

The highlands of Ethiopia are characterized by mixed crop and livestock systems. The livestock feed supply depends mainly on crop residues, natural pastures, and other agricultural by-products, such as thinning and leaf stripping from such crops as maize and sorghum or the enset leaves of sweet-potato vines, depending upon the locality. The contribution of natural pastures, however, has declined over time, as most of the available land is cultivated for crop production. The use of animal feed mixes (oilseed cakes, wheat bran, etc.) is still very low, mainly because of high prices and low availability. The use of agro-industrial by-products is also very limited due to the scattered settlement of the farmers.

Feed costs account for 60 percent to 70 percent of the total cost of livestock production. Feed shortages and the high price of feed ingredients negatively affect the productivity and profitability of commercial livestock operations.

There is a significant regional productivity difference as well as a productivity difference between various livestock breeds. Ethiopian small-scale farmers cater their livestock production largely to the domestic markets. The majority of sales are made in the local markets, usually without the establishment of advanced contractual agreements (Negassa, Rashid, and Gebremedhin, 2011).

Several factors influence the low livestock-productivity status quo in Ethiopia:

1. **Livestock feed and water shortages**
    - Overgrazing and reduction in grazing areas due to land fragmentation caused by increasing population and a growing number of livestock
    - Inconsistent quality of feed mixes (Ethiopia experiences problems with feed adulteration with such things as weed seeds and animal droppings that degrade the nutritional value of feed mixes and can also negatively influence livestock health)
    - Inadequate commercial feed supply (of the 15 animal feed mixers in Ethiopia, only 5 produce for the market, while the other 10 produce feed mainly for their own feedlots)
    - Erratic weather patterns that cause droughts and reduce water availability
    - Improper water-management policies (for example, coffee producers in some areas overuse water resources and thus diminish water availability for small-scale farmers)
    - Lack of awareness and skills in feed conservation (such as not producing silage and poor storage facilities)
2. **Diseases combined with weak or unavailable veterinary services**
    - High prices for veterinary services and lack of availability and accessibility
    - Poor access to modern animal medicines (unavailable supply)
    - Widespread use of traditional methods (herbs, medicinal plants) that are much less effective than commercial medicine, if they have any impact at all
3. **Predators and parasites**
    - The main livestock predators in Ethiopia: leopards, hyenas, and monkeys
    - Parasitic problems, such as ticks, mites, lice, and flies, that cause livestock weight loss and negatively interfere with the overall health of animals
4. **Poor market information and lack of marketing outlets**
    - Season-specific demand for livestock and varying quality requirements throughout the year
    - Livestock price estimations that are done by "eye-balling" the weight without using scales
    - Small-scale livestock producers who are dependent on price information from traders, which tends to exert downward pressure on prices if any collusion exists between area traders
5. **Poor livestock feeding and management at the farm level due to lack of training and financial resources to obtain improved livestock feed**
    - Lack of modern knowledge among the majority of Ethiopian farmers regarding livestock nutritional requirements and continued practice of traditional feeding methods using leftover crops residues and available grass, thus allowing households to keep animals for a long period of time (until they need to sell the animals) without investing financial resources
    - Low hay production, absence of knowledge of silage production, and insignificant use of commercial feed due to high prices and unavailability
6. **Low level of specialization in the livestock sector**
    - Ethiopian households that normally do not specialize in meat production and instead pursue traditional animal husbandry

Ethiopian Meat Consumption

The annual meat consumption per capita in Ethiopia is currently very low: For urban areas, it is about 7 kilograms (kg) of meat per person annually, while in rural areas it is just 2 kg per person annually. Meat consumption usually increases during the religious holidays and falls afterward. The peak meat-consumption periods are Easter, Christmas, Meskel, Eid al-Fetir, and Arafa. During these times, the demand for and supply of livestock in the market are high (Gemeda, 2009).

Nevertheless, with a steadily growing population and increasing per-capita income, Ethiopia's demand for meat is expected to increase, and thus opportunities are developing for investments in the livestock sector. For such opportunities to work, the commercial-feed sector needs to be better developed and achieve efficiencies (along with a change in trade policies) to lower the prices of the key inputs.

Project Description and Activities

LMD Intervention in the Meat Value Chain

The specific LMD intervention that is proposed for implementation in the livestock (meat) value chain consists of cattle fattening via locally available feed ingredients. This intervention is suitable for most of the woredas selected for the LMD. The feed ingredients, however, may be location specific, so some ingredients may be replaced with other types of feed suitable to provide the same nutritional value.

The second intervention analyzed in this study is the 10 percent reduction in the average cost of livestock feeding. The exact cost of the intervention is unknown, so the analysis derives the net benefits arising to the households if the cost of feeding is reduced due to the LMD project. The analysis of the second intervention is based on the results of the cattle-fattening intervention analysis.

The main five ingredients of the nutritional ration (used in the analysis) provided to cattle during the fattening period are as follows:

1. **Hay:** The households frequently rent land for forage production. The intensity of cropping is another factor that determines the area available for grazing and browsing. In the Ethiopian highlands, the better soils are used for cropping, while the steep slopes and the seasonally waterlogged foothills are allocated for grazing. Natural pastures are continuously decreasing due to the increasing human population and expansion of croplands. The protein content and digestibility of most grass species decline rapidly with advancing physiological maturity. The productivity of natural pastures in Ethiopia is very low and usually does not exceed 0.5 to 2 tons per hectare of dry matter per year. The knowledge of silage production is also limited.
2. **Crop residues:** Crop residues are an important source of roughage feed for livestock in the highlands of Ethiopia. These include cereal straws, such as tef, wheat, barley, maize, sorghum, field peas, chickpeas, and haricot beans. The principal crop residues used for animal feeding are the straws of cereals and pulses. Haricot beans residues are also a good source of protein for livestock. Cereal straws and stovers generally have low nutrient content, high fiber content, low digestibility, and low voluntary intake by

animals. The nutritional value of many cereal straws is close to medium-quality native grass hay.

3. **Wheat bran:** Wheat bran is the most common milling by-product used for livestock feeding in Ethiopia. It can be used as a source of energy and protein. Wheat bran is easily digestible. It contains 15 to 18 percent crude protein and has a digestibility level of 75 percent. It is also a good source of water-soluble vitamins, except niacin. Wheat bran can improve the feed intake, digestibility, and growth performance of animals when added to protein-source feeds.
4. **Oilseed cakes:** Oilseed cakes are the residues or cakes produced as by-products during the extraction of oil from the oilseeds. They include noug cake, cottonseed cake, groundnut cake, linseed cake, and sesame cake. This analysis uses noug cake as an ingredient in the daily fattening ration. The two methods of extracting oil from the oilseed are mechanical press and solvent extraction. Mechanical extraction leaves a substantial amount of oil in the residue. In Ethiopia, most of the oil-extracting factories use this mechanical method of extraction. The protein content of noug cakes is between 28 percent and 35 percent. Most oilseed cakes are low in the essential amino acids cysteine and methionine and usually have low lysine content.
5. **Brewery and winery by-products:** This is the last ingredient of feed ration commonly used, but farmers often exchange manure for these brewery and winery by-products, so the cost of the by-products can be measured by the value of the manure. For simplicity, the value of manure is excluded from the analysis with the cost of the by-products of the brewery industry. The brewery and winery by-products are important sources of supplementary feed in commercial livestock operations, particularly for households located close to commercial breweries, distilleries, and wineries. These by-products have moderately high levels of crude protein, energy, and digestibility content.

The details of the cattle-fattening intervention are outlined in table 1, below.

Table 1. LMD interventions in the livestock (meat) value chain

	Intervention
	Cattle fattening
Quantity of animals per one round, Year 1	1
Quantity of animals per one round, Year 2	2
Quantity of animals per one round, Year 3 and after	2
Fattening period	60 days
Fattening rounds	4 per year

Assumptions for the Selected LMD Interventions in the Meat Value Chain:

1. There are substantial domestic price fluctuations for meat due to the long fasting periods in Ethiopia. The price of meat is higher during the holiday periods and lower during the nonholiday periods. The targeted households will wait for better market prices, when applicable,[6] to sell fattened animals. In turn, animals will be purchased at the lowest price possible.
2. The by-products of brewery and winery industries are frequently used as a part of the feed ration to fatten cattle, but they are also often exchanged for manure. The value of

[6] A feeding cost is associated with holding an animal in an attempt to fetch a higher price, so households are assumed to do it only when the benefit of the activity outweighs the cost.

manure therefore can be viewed as the major cost of the by-products. Both line items are excluded from the analysis.

3. The average fattening period for cattle is reported to be 60 days.[7] After that period, the households sell fattened cattle and buy new animals for the next round of fattening. The households, however, may need some time to fetch a good market price. Therefore, the average fattening-round duration is assumed to be 90 days.
4. Ethiopian farmers usually engage in fattening for only 8 months of the year, with the remaining 4 months allocated to crop production. Therefore, this analysis assumes four fattening periods per year.
5. The cost of feed required for the weight gain is calculated based on the current market prices of the feed ingredients and adequate feed requirements.
6. The cost of hay used for the analysis represents the current market price of hay. Some farmers, however, rent their land for hay production, thus allowing them to minimize the cost of hay.
7. To participate in this intervention, each targeted household will obtain a loan for the initial purchase of a male animal. The level of this initial loan will be set to allow the initial purchase of the steer(s), feed, and veterinary drugs. The household engaged in this intervention for the first year of fattening will need to borrow ETB 8,216.76 (US$456.48). The loans necessary for the second and third year of the fattening intervention will be ETB 19,699.22 (US$1,094.40) and ETB 23,636.07 (US$1,313.12),[8] respectively.
8. The total value of the initial loan will include investment costs associated with borrowing: a service charge (1 percent), insurance (1 percent), a passbook fee (ETB 15), and upfront savings (10 percent). The loan will be given for 1 year, with the repayment schedule aligned with the seasonality of fattening activities and therefore somewhat flexible. The financing institution will take under consideration special circumstances, such as when prices of livestock fall seasonally, making it difficult to fetch a good price for fattened animals. The interest rate on the loan will be 15 percent, compounded annually.[9] The accrued interest will be paid at the end of the each fattening period, while the principal will be repaid at the end of the year.
9. For the purpose of this analysis, the following macrolevel assumptions have been made: The ratio of domestic inflation is 20 percent, the U.S. inflation rate is 2.5 percent, the real financial discount rate is 12 percent, the economic real discount rate is 12 percent, the foreign exchange premium (FEP) is 6.5 percent, and the exchange rate in 2012 is US$1 = ETB 18. Microfinance institutions (MFIs) charge a nominal interest rate of 18 percent, and the nominal market interest rate is 48 percent.

[7] The fattening period was obtained from the field visits. Some farmers, however, reported 90-day fattening periods.
[8] The US$ equivalent of the loan amounts was calculated using projected exchange rate for 2013 and 2014.
[9] The 15 percent interest rate was negotiated for the beneficiaries of GRAD project. It is assumed that the same interest rate could be obtained for the beneficiaries of LGP.

The list of parameters used for the cost-benefit analysis (CBA) of the cattle-fattening intervention of the LMD is presented in table 2, below.

Table 2. Parameters used in the CBA of the cattle-fattening intervention

Average fattening period (days)	90
Number of rounds per year	4
Number of animals per round (bulls)	
Year 1	1
Year 2	2
Year 3	2
Input Cost (ETB/animal)	
Cost of unfattened animal	6,000.00
Feed cost (ETB/kg)	
Hay	1.00
Straw	7.20
Wheat bran	4.00
Noug seed cake	3.00
Salt	5.00
Feed requirements (kg/round/animal)	
Hay	240.00
Straw	60.00
Wheat bran	100
Noug seed cake	100
Salt	3.00
Labor requirements	
Time required (hours/day)	2.00
Working day	8.00
Labor cost (ETB/day)	25.00
Full labor (days/round)	15
Veterinary services (ETB/round/animal)	
Deworming drugs	8.00
Vaccination	12.00
Rental value of animal shelter (ETB/animal/day)	1.50
Selling price (ETB/animal)	
Fattened animal	8,000.00

The purpose of this CBA is to determine whether this proposed intervention will yield benefits that outweigh its costs and to measure the resulting increase in the incomes of the LMD households in the target woredas.

PROJECT MODELING

The financial and economic feasibility of the proposed LMD interventions has been estimated using a cost-benefit model in which all revenues or resource inflows are treated as inflows and all expenditures or resource outflows are treated as outflows (Jenkins, Kuo, and Harberger, 2012). The analysis covers a 10-year time period.

To estimate the financial sustainability of the cattle-fattening intervention in the meat value chain, the Annual Debt Service Coverage Ratio (ADSCR) of the project over the life of the loans used to finance it is calculated with the Financial Net Present Value (FNPV) of the project.

The cash-flow statements in the financial analysis are constructed from the total investment/project and equity/household points of view.

The economic resource-flow statements are constructed by adjusting each of the line items in the cash-flow statements of the total investment point of view by the corresponding economic conversion factors (CFs).

INTERVENTION

The purpose of this modeling exercise is to estimate the net benefit of a USAID intervention in cattle fattening and to estimate the impact of this intervention on the income of the participating households. Cattle fattening is suitable for those who already engage in the activity as well as those who have not practiced it before. It is necessary to estimate the benefits of the intervention on an incremental basis. One needs to distinguish between what would be earned by the household through its existing practice as opposed to what would be earned due to the intervention. The cattle-fattening intervention will allow farmers either to increase the scale of their existing activity or to participate in a new activity, for those who do not currently practice fattening. The value of the benefits is the same for both types of participants, and the intervention does not affect the farmers' other activities.

In addition to the cattle-fattening intervention analysis, the net benefits arising to the households that practice cattle fattening are estimated if the average cost of livestock feeding were to decrease by 10 percent due to the LMD project.

CATTLE-FATTENING INTERVENTION SCENARIO

The proposed intervention will allow farmers to obtain funds required for the purchase and consequent fattening of cattle. It is assumed that such a small quantity of animals could be kept on marginal land, so no land costs are associated with the intervention. In some cases, the households could rent their cotes (animal shelters) to the traders, so a rental value for the cotes is included in the analysis. The details of the expenditures and revenues of the "with intervention" scenario are as follows:

- **Revenue:** The revenue for each household is the value of fattened animals at the end of the fattening period/round of 2 months. The baseline sale price is ETB 8,000 per fattened steer, which is treated as a cash inflow. The net cash flow is calculated by deducting all

expenses associated with the fattening operation from the cash inflow. The net cash flow, in the case of cattle fattening, is the income for the household.

- **Expenditures:** Under the existing production system, farmers purchase very young steers and keep them for a short period of time (2 to 3 months) with provision of feed for a weight gain. The steers are then sold to traders, who also may fatten the animals for an additional 2 to 3 months before they sell them in the domestic market. Traders sell animals either to local consumers or to abattoirs, which may also apply an intensive fattening program to the animals when necessary to meet export standards. The intervention scenario provides an adequate feed supply to allow four rounds of cattle fattening per year. The price of feed and the quantity required per animal per round is presented in table 2, above.

PREPARATORY TABLES IN CBA EXCEL MODEL

In the CBA Excel model that accompanies this report, tables 2 to 8 display preparatory information about the cattle-fattening intervention, including the required loans and projected incomes and expenditures related to the project analysis.

Table 2 of the CBA model presents domestic inflation per production period. The production period for the analysis is reported to be 60 days, but the households could expand the fattening period to 90 days in an attempt to fetch a higher domestic price. No more than four fattening periods will occur per year. The inflation rate over each 3-month fattening period is reported to be 4.66 percent. The domestic price index is used to adjust current prices to reflect the impact of inflation over the evaluation period. The expected exchange rate of ETB to US$ is derived by multiplying the current exchange rate by the relative price index. The relative price index, in turn, is the factor of inflation in Ethiopia and the United States.

Table 3 contains the projected nominal costs of the intervention inputs, such as the cost of feed, unfattened bulls, deworming drugs, vaccinations, the rental value of animal shelters, and the opportunity cost of labor. The cost is presented for one animal per fattening period. Nominal values are calculated by adjusting the present cost over the corresponding price index.

Table 4 presents the loan amounts for 2012, 2013, and 2014 that are necessary to purchase unfattened young bulls and all other inputs of the intervention. The total loan amount shown for each of the years also includes the charges that the MFIs will collect when they provide the loans, such as a service charge of 1 percent, insurance of 1 percent, a passbook fee of ETB 15, and upfront savings of 10 percent. The upfront savings will be returned to the household upon repayment of the loan. The required loan amounts are ETB 8,216.76 (US$456.48), ETB 19,699.22 (US$1,094.40), and ETB 23,636.07 (US$1,313.12) for 2012, 2013, and 2014, respectively.

Table 5 shows the calculated scheduled debt service on the loans at the interest rate of 15 percent. The repayment of the loans is tied to the nature of the farmers' current activities, so each loan will have four repayment periods of 3 months each. This type of repayment schedule will allow farmers, when necessary, to wait for better animal prices in the domestic market. A grace period of 3 months will be included, so the first repayment round will be the grace period. The households will be required to repay only the interest accrued at the end of each repayment period, with the principal to be repaid at the end of the fourth period (the end of the year) with the interest accrued over the last repayment period.

Table 6 depicts nominal revenues from the sale of fattened animals. It is assumed that farmers will purchase all the necessary production inputs at the beginning of the 3-month period and then sell fattened bulls at the beginning of the next period.

Table 7 presents the nominal costs associated with cattle fattening. The top three items will be the purchase of the unfattened bulls, noug seed cakes, and wheat bran. Their relative shares of cost for the first round in 2012 will be 79.6, 6.6, and 5.3 percent, respectively. The opportunity cost of labor will also be a significant production cost, amounting to 4.97 percent of the total. Any real decrease/increase in the price of unfattened animals will also proportionally change the prices for fattened animals. The main factor determining profitability will be the cost of feed ingredients required to fatten animals. A decrease in the price or the quantity required or the farmers' ability to substitute a cheaper option that provides the same nutritional benefits will increase financial returns to the households.

FINANCIAL ANALYSIS

Table 8 of the CBA model depicts the cash-flow statement from the total investment or project point of view in nominal values, which then determine whether the households will be able to repay the loans. The cash-flow statement from the total investment point of view is constructed without considering the source of financing. The loan, therefore, is not included in the cash-flow statement from the total investment point of view. The cash flow of the first fattening round in 2012 will be negative, because the revenues from the sale of the animals fattened during this round will be reported as cash receipts at the beginning of the second fattening round. An offsetting cash inflow is reported for the end of the project in 2022, but no cash outflows are reported, because during this period there will only be income from the previously fattened animals. The resulting net cash flows are used in table 9 to derive the quarterly debt service coverage ratios (QDSCRs).

Table 13 of the model presents the annual cash-flow statement from the total investment or project point of view. The cash inflows and outflows are derived by combining the respective fattening rounds of the net cash flows that will occur during the year. The cash-flow statement from the total investment or project point of view is constructed to determine the overall strength of the project and to assess whether the potential loans to the project will be secured. It also takes into account all the financial benefits and costs of the project to determine its financial feasibility, the need for loans, and the likelihood of repayment of the loans and interest.

Table 14 shows a cash-flow statement from the equity or owner point of view. It adds the loan to the net cash flows from the total investment point of view as cash receipts and subtracts the payments of interest and the loan principal repayment as cash outlays. Therefore, the only difference between the analysis from the owner point of view and the total investment point of view is the financing.

The net present value (NPV) of the cattle-fattening intervention, using a real discount rate of 12 percent, from the equity point of view is estimated at ETB 15,754.75 (US$875.26) per household. The FNPV of the 10 percent feeding cost reduction intervention is ETB 6,222.24 (US$345.28) per household. Therefore, these interventions definitely pass the USAID test of 12 percent real discount rate for funding.

The annual cash-flow statement of the cattle-fattening intervention is presented in table 3, below.

Table 3. Annual cash-flow statement (equity point of view, real ETB)

Line Items	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Receipts										
Revenue from livestock sales	32000.00	64000.00	64000.00	64000.00	64000.00	64000.00	64000.00	64000.00	64000.00	64000.00
Loan inflow	7323.00	14646.00	14646.00							
Expenditures										
Operating Cost										
Purchase price of livestock	24000.00	48000.00	48000.00	48000.00	48000.00	48000.00	48000.00	48000.00	48000.00	48000.00
Feed	5292.00	10584.00	10584.00	10584.00	10584.00	10584.00	10584.00	10584.00	10584.00	10584.00
Deworming medicine	32.00	64.00	64.00	64.00	64.00	64.00	64.00	64.00	64.00	64.00
Vaccination	48.00	96.00	96.00	96.00	96.00	96.00	96.00	96.00	96.00	96.00
Rental value of tent	360.00	720.00	720.00	720.00	720.00	720.00	720.00	720.00	720.00	720.00
Labor cost (ETB/round)	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00
Cost of livestock mortality	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feeding sunk cost	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Loan debt service	7601.79	15186.04	15183.95							
Total outflows	38833.79	76150.04	76147.95	60964.00	60964.00	60964.00	60964.00	60964.00	60964.00	60964.00
Net cash flows	489.21	2495.96	2498.05	3036.00	3036.00	3036.00	3036.00	3036.00	3036.00	3036.00
Net cash flows (real US$)	27.18	138.66	138.78	168.67	168.67	168.67	168.67	168.67	168.67	168.67
NPV @12% discount rate ETB	**15,754.75**									
NPV @12% discount rate $US	**875.26**									

FINDINGS

Financial Analysis

The financial analysis performed for the cattle-fattening intervention in the LMD meat value chain yields a positive FNPV of ETB 15,754.75 (US$875.26) from the equity point of view, using a real discount rate of 12 percent. The FNPV of the reduction in the feeding-cost intervention is ETB 6,222.24 (US$345.28) per household. These positive FNPVs suggest that the project will be sustainable, because over the life of the project, the financial benefits will outweigh the financial costs for the targeted households.

The prospect of successful implementation of this intervention in cattle fattening is also supported by the calculated values of the QDSCRs. Table 4, below, presents the values of the QDSCRs for this intervention. The QDSCRs are each higher than a value of 1, showing that the households will be able to repay their financial obligations.

Table 4. Quarterly debt service coverage ratios for cattle fattening

	Year 1	Year 2	Year 3
Round 1	n/a	n/a	n/a
Round 2	0.51	1.01	1.01
Round 3	0.27	1.06	1.06
Round 4	**1.05**	**1.17**	**1.17**

The QDSCRs of rounds 2 and 3 of year 1 are below the value of 1, meaning that the households will face insufficient cash flows to cover their loan obligations in these periods. However, the QDSCR of round 4 of year 1 is calculated by adding an unpaid fraction of the loan interest of the previous periods to the debt obligation of this period, and the QDSCR then is above the value of 1. This finding suggests that households will eventually be able to repay their debt obligations in full.

The QDSCRs for round 4 are the most significant indicator, because the households will repay the principal of the loan at the end of this round. The ADSCRs in this case can be represented by the QDSCRs for the fourth fattening round. The QDSCRs presented in table 4 are calculated without taking into consideration the opportunity cost of family labor. The opportunity cost of labor will be retained within the family and therefore can be treated as part of the cash flow available for debt servicing. When compensation for the opportunity cost of family labor is added to the net cash flows, the QDSCRs are as shown in table 5.

Table 5. Quarterly debt service coverage ratios for cattle fattening, including opportunity cost of family labor

	Year 1	Year 2	Year 3
Round 1	n/a	n/a	n/a
Round 2	1.51	1.52	1.52
Round 3	1.52	1.59	1.59
Round 4	**1.19**	**1.19**	**1.19**

When the opportunity cost of family labor is treated as a cash flow available to finance the debt, the QDSCRs are all above the value of 1, indicating that the households will have sufficient cash

flows to cover their loan repayment obligations. The annual increase in the income of the targeted households is defined by the sum of the net annual cash flow and the opportunity cost of labor. The projected annual increase in income is presented in table 6, below.

Table 6. Annual income increase at the household level due to intervention (US$)

Year	Net cash flow + opportunity cost of family labor
2012	110.51
2013	222.00
2014	222.11
2015–2022	252.00

The present value (using a 12 percent real discount rate) of the increase in the income of the households over the evaluation period will be ETB 25,247.16 (US$1,402.62). Hence, this analysis concludes with some confidence that both the level of income and the food security of the households engaged in this intervention will increase.

Economic Analysis

Differences emerge between the financial and economic outcomes due to the fact that the financial values do not include all the externalities that are present in the economy. In this case, the only externality will come from increased tax revenues from the direct taxation of inputs or indirectly via the FEP. Meat is an exportable commodity in Ethiopia. The FEP for Ethiopia is estimated to be equal to 6.5 percent (Kuo, 2011). Hence, every incremental unit of foreign exchange (dollars) earned from increased exports has an economic value to the country of 1.065 times the value of the revenues by the exporters when exchanging the foreign currency for local currency at the market exchange rate.

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 the appropriate economic conversion factors. If no distortions are present in the market, then the financial value of an item is used to measure its economic value.[10]

The differences between financial and economic outcomes of the project develop because of several factors. A substantial transportation cost is incurred to export meat from the country. Ethiopia applies a high tariff rate and other taxes on the imports of fuel that increase its financial cost. Taxes, in turn, represent a transfer of resources from consumers to the government. At the same time, fuel is internationally traded and requires foreign exchange that has an economic cost to the economy that is 6.5 percent greater than its financial cost. Overall, the economic cost of fuel is below its financial cost. Every incremental dollar spent on fuel required to transport meat for export has an economic cost of 79 percent of its financial cost. These figures also contribute to the differences between the financial and economic outcomes of the intervention. The total difference between the financial value of cattle and cattle's true economic value is 10 percent, where the economic value is greater.

Table 7 (table 16 of the model), below, depicts a resource-flow statement from the economy point of view.

[10] The list of CFs used for the purpose of this analysis is presented in table A in the appendix.

Table 7. Resource-flow statement (economy point of view, real ETB)

Line Items	CF	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Receipts											
Revenue from livestock sales	**1.10**	35187.89	70375.78	70375.78	70375.78	70375.78	70375.78	70375.78	70375.78	70375.78	70375.78
Expenditures											
Operating Cost											
Purchase price of livestock	**1.10**	26390.92	52781.83	52781.83	52781.83	52781.83	52781.83	52781.83	52781.83	52781.83	52781.83
Feed	**1.05**	5563.57	11127.14	11127.14	11127.14	11127.14	11127.14	11127.14	11127.14	11127.14	11127.14
Deworming medicine	**1.07**	34.08	68.16	68.16	68.16	68.16	68.16	68.16	68.16	68.16	68.16
Vaccination	**1.07**	51.12	102.24	102.24	102.24	102.24	102.24	102.24	102.24	102.24	102.24
Rental value of tent	**1.00**	360.00	720.00	720.00	720.00	720.00	720.00	720.00	720.00	720.00	720.00
Labor cost (ETB/round)	**1.00**	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00	1500.00
Cost of livestock mortality	**1.10**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feeding sunk cost	**1.05**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total outflows		33899.69	66299.37	66299.37	66299.37	66299.37	66299.37	66299.37	66299.37	66299.37	66299.37
Net cash flows		1288.20	4076.41	4076.41	4076.41	4076.41	4076.41	4076.41	4076.41	4076.41	4076.41
Net cash flows (real US$)		71.57	226.47	226.47	226.47	226.47	226.47	226.47	226.47	226.47	226.47

NPV @12% discount rate ETB	**23,008.31**
NPV @12% discount rate $US	**1,278.24**

Thus, the distortion-adjusted net resource flows, when discounted by the 12 percent real economic opportunity cost of capital (EOCK) for Ethiopia, yield an ENPV of ETB 23,008.31 (US$1,278.24). The ENPV of the reduction of feeding cost intervention is also positive and equal to ETB 6,519.60 (US$362.20) using the 12 percent real EOCK.

STAKEHOLDER AND BENEFICIARY ANALYSIS

An economic surplus in the economy is created by producing an output that has an economic value greater than the economic cost of the inputs, such as capital, land, and labor, that are used to produce the item. The proposed LMD intervention in the meat value chain will yield two groups of beneficiaries: the households engaged in the intervention and the government of Ethiopia.

The government of Ethiopia will benefit from an additional inflow of taxes coming from the tradable inputs used in the fattening operation. The production inputs can be divided into three groups:

1. **Nontradable inputs:** Hay and straw are internationally nontradable commodities. In this case, no economic externality is associated with nontradable commodities. The conversion factor used to adjust the financial cost of the inputs equals 1.
2. **Importable inputs:** Salt, fuel (used to transport meat for exports), deworming drugs, and vaccines are importable to Ethiopia. The total tax rate applied on salt and fuel is higher than the FEP. The inflow of taxes on salt and fuel reduces the economic cost below the financial cost and generates tax revenue for the government of Ethiopia. There are no taxes on deworming drugs and vaccines when they are imported to Ethiopia, so their economic cost is higher than their financial cost by the amount of FEP.
3. **Exportable inputs:** Wheat bran and noug seed cakes are exportable from Ethiopia. There are no taxes or subsidies applied on exports by the government of Ethiopia. The economic cost of the items is higher than the financial cost by the amount of FEP times the market exchange rate.

The indirect benefits to the government of Ethiopia, in this case, will be substantially determined by the taxes generated as a consequence of meat's being an exportable commodity for Ethiopia. The increase in exports and the existence of a substantial FEP in Ethiopia will result in an increase in tax revenues accruing to the government. The present value of the taxes accruing to the government over the 10-year period is ETB 6,063.66 (US$336.87). Table 8, below, presents the value of the stakeholder's gains.

Table 8. Stakeholder and beneficiary impacts of the project (in US$)

	Mono cropping
Economic NPV (FNPV + externalities)	1,278.24
• **Financial NPV (households)**	875.26
• **Externalities**	402.98
○ **Government**	336.87
○ **Financing contribution**	66.10

The financing contribution is the amount of the interest and other charges paid on the three loans provided by MFIs over and above a real cost of funds of 12 percent. This figure is just a transfer of resources between the households and the MFIs. USAID Ethiopia generally negotiates subsidized interest rates for households benefiting from aid programs. In the case of the GRAD project, the subsidized interest rate is 15 percent, which is 5 percent below the current level of inflation in Ethiopia. However, the additional fees charged by the MFIs to make them willing to provide loans more than offset the subsidy content of the interest rate paid on the loan. This calculation based on a real interest rate of 12 percent as the benchmark for the opportunity cost of funds.

The income accruing to household labor to compensate them for their opportunity cost is not included as an additional net benefit from the project in the beneficiary analysis (table 8). To measure the value added by the project, however, one would add the FNPV of the project plus the present value of the additional compensation for family labor. In this case, the added value of the project has a present value of ETB 25,247.16 (US$1,402.62) over the 10-year evaluation period.

SENSITIVITY ANALYSIS

A sensitivity analysis for the LMD cattle-fattening intervention uses the key variables that are prone to change and likely to influence the situation of the households engaged in the project, including the purchase price of unfattened steers, the sale price of fattened steers, the price of wheat bran and noug seed cakes, the quantity of wheat bran and noug seed cakes required per fattening period, the joint impact of the purchase and sale prices of the animals, and the joint impact of the price of unfattened steers and the required noug seed cakes per fattening period plus the impact of the livestock mortality rate. Details related to the sensitivity analysis are outlined in tables 9, 10, and 11, below.

Sensitivity Analysis Findings

1. **Price of unfattened steers:** The initial price of unfattened animals is a significant variable determining the financial outcome of the intervention. A decrease of ETB 200 (US$11.11) in the price of the unfattened steer will increase the FNPV of the intervention by 59.4 percent. The same decrease in price will allow the targeted households to earn ETB 6,136.02 (US$340.89) per year, versus ETB 4,536 (US$252) in the baseline scenario. On the other hand, an increase in the price by the same amount will decrease the FNPV by 59.4 percent.

   The significance of the variable should be analyzed also by taking into consideration the sale price of fattened animals. The numbers discussed above hold only if the households are able to negotiate better prices while purchasing unfattened animals without sacrificing the quality or live weight of the purchased animals.

2. **Price of fattened animals:** The increase/decrease in the price of the output of the intervention (price of fattened steers) will have the same effect as an equal decrease/increase in the price of unfattened animals. An increase of ETB 200 (US$11.11) in the sale price of fattened steers will allow the households to increase their annual income by ETB 6,136.02 (US$340.89). The break-even point for the sale price of the unfattened animals is reported to be ETB 6,336 (US$352), so the fattened animals cannot be sold for less than this amount if the operating costs of the intervention are to be covered.

3. **Price of wheat bran:** Wheat bran will amount to 5.3 percent of the total cost of the intervention, or 30.3 percent of the feeding cost. The significance of the variable can also be measured by its influence on project outcomes, such as the FNPV and the net increase in the income. An increase in the price of wheat bran from ETB 4 (US$0.22) to ETB 5 (US$0.28) will reduce the FNPV by 29.7 percent. The same increase in the price of wheat bran will reduce the annual income of the households from ETB 4,536 (US$252) to ETB 3,736.08 (US$207.56).

4. **Price of noug seed cakes:** The cost of noug seed cakes will contribute 6.6 percent of the total operating cost, or 37.80 percent of the feeding expenses. A decrease in the price of noug seed cake from ETB 5 (US$0.28) to ETB 4.25 (US$0.24) will increase the FNPV by 22.27 percent and will also increase the annual income of the households to ETB 5,135.94 (US$285.33) per year, versus ETB 4,536 (US$252) in the baseline scenario.

5. **Mortality rate of cattle:** The farmers in the highlands of Ethiopia did not report any significant losses due to the animal mortality. Under their current practice, farmers provide all the veterinary services immediately after purchasing their livestock. Animal mortality is associated not only with loss of the animal itself but also with the cost of feed and veterinary services that will be provided to the animal. The sensitivity analysis reveals the important impact of this variable: A 4 percent mortality rate will lower the FNPV to ETB 2,059.74 (US$114.43) and will result in an

annual income of ETB 2,186.18 (US$121.46), versus ETB 4,536 (US$252) in the baseline scenario (0 percent mortality rate). The significance of the variable indicates that the potential beneficiaries of the LMD fattening intervention should be trained to be able to make the proper selection of animals for fattening. The households should also be instructed on proper management and veterinary practices.

Table 9, below, presents the results of a sensitivity analysis that is based on the purchase and sale price of animals (jointly). With a purchase price of ETB 6,000 (US$333.33) per steer and a sale price of ETB 8,000 (US$444.44) per steer, the FNPV is positive at ETB 15,754.68 (US$875.26). The best-case scenario sets the purchase price at ETB 5,500 (US$305.56) and the sale price at ETB 8,500 (US$472.22), yielding an FNPV of ETB 62,459.64 (US$3,469.98). In the worst-case scenario, the purchase price is ETB 6,800 (US$377.78) and the sale price is ETB 7,500 (US$416.67), yielding a negative FNPV of –ETB 44,985.24 (US$2,499.18).

Table 9. Joint impact of purchase and sale price of cattle on FNPV (in US$)

LMD intervention in the meat value chain					
	Purchase price of unfattened bulls				
Sale price	**5,500**	**5,800**	**6,000**	**6,500**	**6,800**
7,500	879.65	99.92	–419.90	–1,719.45	**–2,499.18**
7,800	1,656.75	877.02	357.20	–942.35	–1,722.08
8,000	2,174.81	1,395.08	**875.26**	–424.29	–1,204.01
8,200	2,692.88	1,913.15	1,393.33	93.78	–685.95
8,500	**3,469.98**	2,690.25	2,170.43	870.88	91.15

Table 10, below, presents the sensitivity analysis for the FNPV that is based on the joint impact of the noug seed cake requirements per fattening round and the sale price of the fattened animals. Under the baseline scenario, with the noug seed cake requirements set at 100 kg per round and the sale price of the fattened steers at ETB 8,000 (US$444.44) apiece, the FNPV is positive, at ETB 15,754.68 (US$875.26). If the noug seed cake requirements decrease to 80 kg and the sale price of animals increases to ETB 8,500 (US$472.22), the FNPV reaches ETB 43,746.12 (US$2,430.34). In the worst-case scenario, the noug seed cake requirements are 120 kg per fattening round and the sale price of fattened animals is ETB 7,500 (US$416.67), yielding a negative FNPV of ETB –12,236.58 (US$679.81).

Table 10. Joint impact of sale price of livestock and noug seed cake requirements on FNPV (in US$)

LMD intervention in the meat value chain					
	Noug seed cake requirements kg/round				
Sale price	**80.00**	**90.00**	**100.00**	**110.00**	**120.00**
7,500	–159.99	–289.95	–419.90	–549.86	**–679.81**
7,800	617.11	487.15	357.20	227.24	97.29
8,000	1,135.17	1,005.22	**875.26**	745.31	615.35
8,200	1,653.24	1,523.29	1,393.33	1,263.38	1,133.42
8,500	**2,430.34**	2,300.39	2,170.43	2,040.48	1,910.52

Table 11, below, presents the impact of mortality rates of the animals on the FNPV of the intervention and the net cash flow of the households after the last loan is repaid. The baseline scenario constructed uses a 0 percent mortality rate because, during the field visits in the highlands of Ethiopia, farmers did not report any significant losses associated with animal mortality. Under the baseline scenario, the FNPV is ETB 15,754.68 (US$875.26). A mortality rate of 5 percent yields a negative FNPV of ETB –1,364.04 (–US$75.78) and results in a decrease in annual income of 96.74 percent.

Table 11. Impact of livestock mortality rate on FNPV and net cash flow (in US$)

Mortality rate	FNPV	Net cash flow, year 3 and after
0.00%	875.26	168.67
1.00%	685.06	136.03
2.00%	494.85	103.40
3.00%	304.64	70.76
4.00%	114.43	38.12
5.00%	–75.78	5.49
6.00%	–265.99	–27.15

RECOMMENDATIONS

The CBA of the intervention in cattle fattening and feeding-cost reduction shows positive FNPVs, suggesting that the benefits of the implementation of such interventions will outweigh the costs. The households will be able to repay their loan obligations related to financing the investments for cattle fattening and will be able to increase their annual incomes due to the intervention.

The analysis reveals that the households will not be able to build a sufficient level of equity after the third year of the intervention to repurchase the herd for fattening without loans. This result implies that farmers will need to find additional sources of financing to continue the fattening operation when the last loans are repaid under the USAID sponsorship. A risk is associated with an increase in the number of defaulters for the third loan. The MFIs might be able to continue providing new loans for those farmers who are unable to continue the fattening operation without borrowing.

It is also recommended that the aid institutions operating in Ethiopia address a number of feed issues. Feed costs account for 60 to 70 percent of the total cost of livestock production. Feed shortages and associated high prices have dramatic impacts on the profitability of such commercial livestock operations.

Any potential drought-mitigating activities should be carefully examined before implementation of such activities take place. During the 2007–2008 drought, a substantial amount of concentrate and roughage feeds was purchased by different governmental organizations and nongovernmental organizations (NGOs) to address the critical feed shortages in pastoralist areas. This drought-mitigation intervention coupled with a general feed shortage dramatically increased the price of feed and resulted in a crisis in animal-feed supply throughout Ethiopia.

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APPENDIX

Table A. Summary of conversion factors used for economic analysis of the intervention in cattle fattening in the LMD meat value chain

Summary of Conversion Factors	
Livestock	**1.10**
Roughage	**1.00**
Straw	**1.00**
Wheat bran	**1.08**
Noug seed cake	**1.08**
Salt	**0.76**
Deworming drugs	**1.07**
Vaccination	**1.07**
Rental value of cote	**1.00**
Labor cost (ETB/round)	**1.00**
Cost of livestock mortality	**1.10**
Feeding sunk cost	**1.06**