

A COST-BENEFIT ANALYSIS OF LOCAL PRODUCTION OF READY TO USE THERAUPETIC FOODS IN UGANDA

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Abstract

The prevalence of malnutrition, vitamin-A deficiency, and anemia is high in Uganda. Of children under 5 years of age, 33 percent are stunted and 5 percent wasted. The rate of anemia among women and children is as high as 50 percent. The aim of this study is to identify if a 5 year off-take contract would result a sufficient incentive for the private sector to establish a factory for Ready to Use Therapeutic Food (RUTF) production. The base-line analysis revealed that the financial incentive for the investment would exist if the off-take price is at the RUTF's world price level. The proper structure of the deal would also result on significant benefits arising to more than 4,000 HIV/AIDs infected farmers supplying pea nuts to the factory. The government of Uganda would also benefit by US\$1.54 mill over the 10-year life of the project.

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JEL Classification: D24, D31, D61, D62, E22, E23, F35, H42

LIST OF ACRONYMS

ADSCR	Annual debt service coverage ratio
CIF	Cost, insurance, and freight
CIT	Corporate income tax
EIRR	Economic internal rate of return
ENPV	Economic net present value
FIRR	Financial internal rate of return
FNPV	Financial net present value
FtF	Feed the Future
IMAM	Integrated management of acute malnutrition
kg	Kilogram
LLCR	Loan Life Coverage Ratio
MoH	Ministry of Health
RUTF	Ready to Use Therapeutic Food
TASPIN	Therapeutic and supplementary products for improved nutrition
UGX	Ugandan shilling
US\$	U.S. dollar
VAT	Value added tax

EXECUTIVE SUMMARY

Project Description: USAID/Uganda will begin to implement the Therapeutic and Supplementary Products for Improved Nutrition (TASPIN) project in 2012, with the purpose of supporting the promotion of domestically produced Ready to Use Therapeutic Food (RUTF). USAID will accomplish this goal by purchasing 386,659 kilograms (kg) of RUTF per year for 5 years. The budget for this project is US\$ 22,000,000, spread over the period 2012–2017.

The project's first objective is to promote the domestic production of RUTF. Within this project's 5-year time frame, the indicator of success will be the establishment of a financially and economically viable domestic producer of RUTF that meets international regulations and standards. To be economically and financially viable in the future, the manufacturer must be able to produce a safe product at internationally competitive prices. After 5 years, the local production of RUTF may result in substantial cost savings to the government or its development partners.

The nutritional impacts do not arise from geographical location (domestic or foreign) of the production of the RUTF; they are achieved through the RUTF distribution system's effectiveness and proper training of health-center workers and caregivers on the use of RUTF to fight malnutrition, within the stipulated national policies and the integrated management of acute malnutrition (IMAM) guidelines of the government of Uganda. A cost-effectiveness analysis of the use of RUTF in the treatment of acute malnutrition of children is available in a companion study.

Strategic Context and Rationale: The USAID/Uganda Feed the Future (FtF) strategy prioritizes investments in agriculture and nutrition as well as activities that integrate the two sectors. The prevalence of malnutrition, vitamin-A deficiency, and anemia is high in Uganda. Of children under 5 years of age, 33 percent are stunted and 5 percent wasted. The rate of anemia among women and children is as high as 50 percent and 24 percent, respectively (UDHS, 2011), with the incidence of vitamin A deficiency among women and children as high as 20 percent and 19 percent, respectively (UDHS 2006).

The promotion of RUTF illustrates the integration of nutrition and agriculture. On the side of agricultural productivity, increasing 4,000 farmers' access to the end market due to the demand for inputs by the project should lead to stabilization and, in some cases, a significant increase in their incomes. Furthermore, treating acute malnutrition with RUTF as one of the key inputs would reduce the burden of malnutrition in Uganda.

Financial and Economic Analysis Results: The basic assumption of this analysis is that the factory will operate for at least 10 years where the real weighted average cost of capital for the enterprise is 12 percent. Using these parameters, the project yields a financial net present value (FNPV) equal to US\$ 1.01 million, with a financial internal rate of return (FIRR) of 24 percent over the period. The economic net present value (ENPV)¹ is US\$ 2.64 million, and the economic rate of return (EIRR) is 40 percent. Analyzing only the first 5 years of the project life yields FNPV of US\$ 174,135 and ENPV of US\$ 1.04 million, with a FIRR of 15.6 percent and an EIRR of 31.9 percent, respectively. It will be profitable for the producer to enter into the USAID purchase agreement for RUTF, even if the factory is not able to produce beyond the 5-year term of the agreement, but the returns will be much lower. The USAID product-purchase agreement

¹Economic net present value is the difference between the present value of economic benefits and the present value of economic costs, including opportunity costs.

has the potential to be a cost-effective mechanism for developing a local manufacturing facility for this RUTF. Additionally, the program offers a strong incentive for the producer to position itself to produce and to sell its product even after the USAID support is withdrawn and to expand its market beyond USAID and perhaps even beyond Uganda.

Beneficiary Analysis Results: The project is expected to directly and indirectly increase government revenue. The present value of government revenue over the 10-year life of the project is expected to be about 1.54 million US\$, which is sufficient to finance the total government expenditures made over 10 years for about 3,133 Uganda residents. The factory itself will employ 28 unskilled workers (17 women and 11 men). In addition, approximately 4,000 farmers—nearly 70 percent women and 30 percent men—will benefit directly from the project’s purchase of groundnuts. Many of these farmers are living in poverty or with HIV/AIDS. Including the farmers’ affected family members increases the total number of project beneficiaries to approximately 24,000. A potential future reduction in the price of RUTF of up to US\$ 1.00/kg would still maintain the financial viability of the private producer.

Conclusions and Recommendations: The high ENPV and EIRR suggest that the economic benefits to Uganda of this project will likely significantly outweigh the costs. The USAID purchase price of the project’s output is set to be competitive, based upon the historical price of US\$ 5.00/kg for imported RUTF. At this selling price, the domestic producer’s financial return will be sufficient for it to develop an internationally competitive RUTF production facility. USAID’s purchase contract will greatly reduce the risk faced by the owners in the development of the factory. The key challenge for the domestic producer will be meeting the quality standards and international regulations for RUTF production.

PRODUCTION OF THERAPEUTIC AND SUPPLEMENTARY PRODUCTS FOR IMPROVED NUTRITION: COST-BENEFIT ANALYSIS

METHODOLOGY

Project Background

USAID is one of the major donors supporting nutrition programs in Uganda and contributing to the Uganda Nutrition Action Plan 2011–2016. The support includes food fortification programs, vitamin A and other micronutrient supplementations, integrated management of severe malnutrition, scale-up of essential nutrition facilities at the community level, and provision of nutritional technical assistance, including support to enhance an enabling policy environment in Uganda.

A major innovation in the treatment of acute malnutrition in children and adults was the introduction of RUTF in line with the Ministry of Health (MoH) IMAM guidelines. Health centers can distribute RUTF to designated caregivers of malnourished children on a periodic basis in an outpatient setting for the treatment's duration. This innovation has greatly reduced the transaction costs to the caregivers and the health centers by reducing the need for feeding facilities to accommodate the children and their caregivers. Additionally, RUTF's low moisture content allows it to be stored easily without easily decaying.

The USAID-supported NuLife project was implemented to provide nutritional care to those infected with or affected by HIV/AIDS. Local production of RUTF was started as a component of that project. Through a competitive bidding process, RECO Industries was selected to produce RUTF, and by July 2009 the product had become available under the brand name RUTAFa. But even with the availability of locally produced RUTF, until now the majority of RUTF consumed in Uganda has been imported.

The primary objective of the TASPIN project is to carry this innovative program a step further by substituting domestically produced RUTF for imported RUTF. An important feature of this project is the local sourcing of the groundnuts used to make RUTF. As the manufacture supply chain becomes more efficient over time, it is anticipated that the cost of domestic production will be reduced, resulting in a lower procurement cost for the government or its development partners.

The project may also generate two side benefits. The first benefit will arise from increased market access and income for the farmers who will supply groundnuts to the producer. For many of these farmers, the opportunity cost of their labor may be substantially less than what they will earn from growing groundnuts to supply this project. The second side benefit will be improvement in the reliability and availability of RUTF supply to local health centers that work toward fighting acute malnutrition among women and children under the age of 5 in Uganda.

The domestic production of RUTF is part of a broader set of USAID FtF activities that include providing therapeutic food and other support for the outpatient treatment of severely malnourished children and adults in the North Central and South Western regions of Uganda. For the purposes of carrying out an ex-ante analysis of the TASPIN project, it is helpful to consider the domestic production of RUTF as a

complementary but separable project to the other USAID interventions that supply RUTF along with technical assistance to institutions using it in the treatment of acute malnutrition.

One such USAID-sponsored intervention is the proposed SPRING project, whose objective is to assist in scaling up the IMAM model to identify and to treat children and adults who are severely malnourished using RUTF. This program will be carried out in the South Western region of Uganda.

The cost-effectiveness of using RUTF as a key component in the treatment of acute malnutrition will be determined through a cost-effectiveness analysis of the SPRING intervention. Hence, appraisal of the two primary elements of the TASPIN project—the domestic manufacture of RUTF and the use of RUTF as a component of the treatment of acute malnutrition of children and adults—is carried out through two different techniques. First, a cost-benefit analysis is carried out to evaluate the financial and economic sustainability of substituting domestically produced RUTF for imported RUTF. Second, a cost-effectiveness analysis is conducted for the SPRING project to assess the economic feasibility of using RUTF as a component of the treatment of acute malnutrition in Uganda. Interested readers should refer to “USAID Field Support Mechanism for Malnutrition Prevention and Treatment Activities in Southwest Uganda ‘SPRING’ Project: A Cost-Effective Analysis, Final Report” (Optimal Solutions Group, LLC and Cambridge Resources International Inc, 2012).

The TASPIN project embodies a private-sector, incentive-based strategy for assisting in the development of an internationally competitive factory for the production of RUTF. Through a competitive process, USAID will offer a 5-year contract for the purchase of a fixed annual amount of RUTF that complies with precise international specifications and product standards. This contract will allow USAID to remove the market risk from the private producer so it can concentrate on enhancing the essential cost and quality-control aspects of the manufacturing process that will be critical to its long-term sustainability. The cost-benefit analysis that follows is an integrated financial, economic, and beneficiary appraisal of the establishment and operation of the factory. The analysis covers operation periods of 5 and 10 years. The 10-year example includes the first 5 years, when the USAID purchase contract is in place, and a subsequent 5 years, when the producer will be selling commercially to development organizations in Uganda and perhaps abroad².

Project Description and Activities

The expected quantity of purchases, costs, and patients for this USAID FtF project activity was is detailed in the following table.

Table 1. Costs and quantities of RUTF purchases and patient numbers

USAID purchases of domestically	Year 1	Year 2	Year 3	Year 4	Years 5	Total
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² A number of malnutrition prevention programs are now being put in place in Uganda that hopefully will reduce the incidence of malnutrition in the country. At the present time, however, the volume of imports of RUTF into Uganda and neighbouring countries is multiples of the expected production of this one plant, hence, it is expected that there will be a ready market for the product both in Uganda and the region should USAID discontinue its purchases of RUTF from this factory in the subsequent 5 years of the factory's operation.

produced RUTF (US\$)						
Quantity RUTF (kg)	257,773	386,659	386,659	386,659	386,659	1,804,409
RUTF cost (US\$)	1,288,865	1,933,295	1,933,295	1,933,295	1,933,295	9,022,045
Patient numbers	16,678	25,017	25,017	25,017	25,017	116,746

Within this project's 5-year time frame, the indicator of success will be the establishment of a financially and economically viable producer of RUTF that can manufacture a safe and internationally certified product at competitive prices. The nutritional impacts do not depend on the location of the RUTF's production but on the effectiveness of the system for distributing RUTF and for educating the health center workers and caregivers on its use RUTF to fight malnutrition. In the future, producing RUTF locally may result in substantial cost savings to the government or to development partners who are able to purchase high-quality RUTF domestically.

Four main streams of project beneficiaries were identified for this the analysis:

1. The Ugandan company that will produce the RUTF should obtain a major share of the project benefits to undertake this investment. Because the project encourages domestic production, the Ugandan economy will benefit from the necessary additional employment.
2. The government will also benefit directly from increased corporate income tax (CIT) contributions and indirectly through tax revenues that will result from the savings in foreign exchange that would otherwise be spent on the purchase of imported RUTF. Instead, the foreign exchange saved by USAID's purchase of locally produced RUTF could be used to import other items and therefore to pay the normal indirect taxes levied on such imported goods.³
3. If domestic production were to eventually lower the cost of procuring RUTF as compared to importing it, a greater quantity of RUTF could be purchased for the same allocated government or donor cost. As a result, more people—specifically women and children—can benefit from malnutrition treatment.
4. The pool of farmers who sell their groundnuts produce as inputs for the manufacture of RUTF will benefit from increased market demand.

PROJECT MODELING AND ASSUMPTIONS

Producer Costs and Benefits

³ The government will not lose tariff revenue from import substitution, because RUTF is not subject to import duties. Although USAID purchases of RUTF are exempt from value-added tax (VAT), in general, the firm is a VAT-registered taxpayer. Hence it is able to credit the VAT paid on some inputs against its other VAT liabilities.

To determine the financial and economic feasibility of this intervention at the producer level, a project model was built that estimated the manufacturing facility's cash flows. All revenues or potential revenue items were treated as cash inflows, and all expenditures or potential expenditure items were treated as cash outflows (Jenkins, Kuo, and Harberger, 2011).

The cash-flow statements were initially constructed from the viewpoint of total investment—that is, the viewpoint of the financial institutions (banks) providing the loans to finance the investment. For this project, the local producer will make its own financing arrangement with a private bank, because its relationship with USAID/Uganda will be limited to the purchase agreement. The project cash flows were also estimated from the factory owner's point of view and from an economic viewpoint.

The economy resource flow statements were mainly derived by adjusting each of the line items in the cash-flow statements of the total investment point of view according to their respective economic conversion factors. Essentially, conversion factors were derived by dividing the separately calculated economic value of a unit of an item by its financial price. The economic value of a unit of output was determined directly by the economic cost of the imported RUTF, which in 2012 had a procurement or financial price (cost, insurance, and freight [CIF] plus local delivery) of US\$ 5.00/kg (interviews with UNICEF).

The financial sustainability of an intervention was examined by estimating the annual debt service coverage ratio (ADSCR) of the project over the life of the loans used to finance the project and by calculating the financial net present value (FNPV) of the project from the factory owner's perspective.

As a result of the project, the local farmers will experience an increase in demand for their production of groundnuts, which will help stabilize the income of these farmers. The other RUTF components, such as vitamins, minerals, stabilizers, milk powder, sugar, edible oils, and some packaging materials, are international tradable goods and will ultimately either increase imports or decrease exports of these items, so no net impact is expected for domestic suppliers.

The following assumptions were used to generate this analysis, which covers the project's entire 10-year time frame:

1. The financial price of the RUTF delivered to the health centers has a fixed nominal cost of US\$ 5.00/kg for the first 5 years of the project's life, based upon the current imported price of RUTF delivered to the health centers in Uganda. Over this 5-year period, USAID FtF purchases a total of 1.8 million kg of RUTF, based upon the proposed contractual agreement between USAID and the domestic producer for RUTF. The producer cannot increase the price to compensate for the accrued inflation over this period in the international price of the product until after the initial 5-year period has passed. The analysis assumes that the nominal market exchange rate of US\$ to the Ugandan shilling (UGX/US\$) will adjust itself over time to reflect the difference between domestic rates of inflation and U.S. rates of inflation.
2. The quantity of output sold is fixed for the first 5 years of the project at the volume specified by the contractual agreement between USAID and the selected domestic producer. The producer should be able to least sustain the same level of sales in years 6 to 10 after the contract with USAID expires. The amount produced and sold is not assumed to increase above this level, although the short-run marginal

cost of production (excluding capital costs and overheads) is approximately US\$ 3.17/kg, which is substantially less than the initial financial contract price.

3. A value-chain analysis for groundnuts' cultivation in Uganda shows that approximately 50 percent of the value of farm sales is attributed to the value-added labor input required for production (USAID 2008). The farmers who supply groundnuts to this project are from some of the most disadvantaged rural households in the region; a significant number are individuals living with HIV/AIDS (NuLife 2011). Their opportunity cost of labor may be significantly less than the compensation they receive for growing this crop. Because they are likely to experience a substantial increase in income, their opportunity cost is assumed to be only 60 percent of the labor compensation they receive from farming groundnuts. A reasonable estimate of the net labor benefit these farmers receive is 20 percent of the factory's procurement cost of the groundnuts.
4. The project entails the use of existing facilities plus new investments in machinery, equipment, and motor vehicles. The total capital cost of the plant is US\$ 1,641,254. Of this amount, the existing buildings and land retained for use by the new facility are valued at US\$ 250,000.
5. The financing of this project is partially through a bank overdraft in local currency and a leasing arrangement for the amount of the equipment purchased. Because of the difficulty of obtaining the financial terms of the lease, the leasing arrangement has been converted into an approximately equivalent term loan in US\$ with a nominal interest rate of 14.3 percent. This loan for the equipment is for a term of 5 years, to be repaid in equal installments over 4 years, with the accrued interest paid annually.
6. A local currency overdraft covers the project's entire 10-year period and bears a nominal interest rate of 30 percent. Any factory that bids for the USAID purchase contract covering the first 5 years will then be able to sell RUTF to the government or other organizations at home and abroad in years 6–10. The endeavor's commercial viability is a central aspect of the analysis. Because of the lack of preciseness concerning the nature of the financing of the endeavor, the FNPV of the project is calculated based on the total investment point of view (after taxes, but before financing), using a weighted average cost of capital of 12 percent. To calculate the ENPV, a real discount rate of 12 percent is used to reflect the economic opportunity cost of capital. The foreign exchange premium is based on the estimate by Kuo (2011) for Uganda.

FINDINGS

Using the basic assumptions of this analysis, a financial and economic analysis is carried out. The project will yield a substantial NPV and a high IRR. Some of the key findings are presented in the following table:

Table 2. Summary of key findings on NPV and IRR (10-year life of project)

Financial analysis	US\$ 1.01 million
FNPV	UGX 2.49 billion

FIRR	23.9%
Economic analysis	US\$ 2.64 million
ENPV	UGX 6.47 billion
EIRR	40.2%

The FNPV will be nearly US\$ 1.01 million, using a benchmark of 12 percent return to total invested capital. The FIRR will be 24 percent. This project will generate an ENPV of US\$ 2.64 million, or an EIRR of 40 percent. If this production facility is able to produce RUTF at an acceptable quality, the project will make a very significant contribution to Uganda's economic welfare with a relatively modest amount of investment.

The difference between the financial and economic benefit will stem from three sources. The first will be the reduction in real price due to the interaction of the rate of U.S. inflation and the fixed nominal US\$ price for the RUTF. Additional value-added tax and CIT revenues will be the second major source of economic benefit, accounting for US\$ 0.74 million in present value. Lastly, the economy will also benefit from taxes that are indirectly generated due to the increased availability of foreign exchange.

Table 3 provides the key financial and economic findings for the project based on a 5-year life span. The base-case analysis used a 10-year period to better reflect the project's potential. The objective is to develop a sustainable, long-term production facility that will function well beyond year 5, when the USAID purchase agreement will expire. The question here is whether the project would be attractive or perceived as too risky to private-sector investors if it were to operate only for 5 years.

Table 3. Summary of key findings on NPV and IRR (5-year life of project)

Financial NPV	US\$ 174,135
Economic NPV	US\$ 1.04 million
FIRR	15.6%
EIRR	31.9%

If the project lasts only 5 years, the FNPV will be US\$ 174,135, with an FIRR of 16 percent, which is still higher than the 12 percent discount rate. The ENPV will also remain positive, at US\$ 1.04 million. The EIRR will be 31.9 percent.

Table 4 describes the ADSCRs, an indicator that is particularly important to understand the project's ability to generate sufficient cash flow to repay loans needed for the initial investment. A potential problem will arise in the first full year of operation, when the ADSCR is only 1.21. During this year, the RUTF producer will be building up its working capital, particularly inventories of finished goods and cash balances for making purchases of inputs. Consequently, the margin of cash over and above what will be needed to service the loan and the interest on the overdraft will be rather low. However, given the security

of the USAID purchase contract, the ADSCR of 1.21 in the first year will likely be adequate, and once the debt is paid off, the annual debt service coverage ratios will increase dramatically. On the other hand, after year 4 (the fifth year of operation), the producer will face greater market uncertainty due to the expiration of the USAID purchase contract.

Table 4. Annual debt service coverage ratios

Year	1	2	3	4	5	6	7	8	9
ADSCR	1.21	1.57	1.61	1.69	14.91	19.12	22.65	26.83	8.69
LLCR	2.68	3.38	4.44	6.80	15.79	16.05	15.12	12.87	8.69

Once the domestic producer reliably meets the sanitary and quality requirements necessary to sell to a wider market (including such organizations as UNICEF or buyers from other countries in the region), the price of domestically produced RUTF may decrease. For example, in 2008, the cost of the same type of RUTF imported into Zambia was US\$ 6.10/kg (Bachmann 2009). If the domestic supply were sufficient to drive the domestic price of RUTF to below the import parity price, the Ugandan government and its development partners would be able to save costs and then use the excess funds to purchase more RUTF to serve more participants at the same cost or allocate these funds for other high-priority activities.

STAKEHOLDER AND BENEFICIARY ANALYSIS

The project will yield at least four groups of beneficiaries: the domestic RUTF producer, direct and indirect labor the producer will need to employ, groundnut farmers, and recipients of government services made possible by increased tax revenues.

Domestic Producer

The domestic producer who takes on the challenge of producing the RUTF will earn an estimated FIRR of 24 percent. At a 12 percent discount rate, the producer will gain a FNPV of US\$ 1.01 million, assuming that the RUTF price of US\$ 5.00/kg (2012 prices) can be maintained for the entire 10-year period of operations.

Direct and Indirect Labor

Within the RUTF factory, 18 employees will staff two shifts for the production line, and 10 more will be employed to perform managerial and administrative duties and to deliver the product to local health centers. Collectively, these 28 employees will receive a net benefit of US\$ 83,378. Because their economic opportunity cost will be less than the wages they will receive, each worker will earn in present-value terms about US\$ 2,978 more than he or she would earn elsewhere.

Table 5. Labor benefits

Number of laborers	PV of labor benefits	PV of benefit per worker
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Total	28	83,378	2,978
Male	11	33,351	2,978
Female	17	50,027	2,978

Recipients of Government Expenditures

When RUTF is purchased from abroad, the foreign exchange is paid to a foreign supplier. When donor agencies purchase RUTF from a domestic producer, additional foreign exchange revenue will result. Substituting imported RUTF with domestically produced RUTF will increase foreign exchange, which will in turn allow more imports of other goods and services into the country. Indirect tax revenues, such as import tariffs, will increase. The government will also collect CIT from the domestic producer. The sum of additional direct and indirect tax revenues will be an estimated US\$ 1.54 million.

Comparing this estimated figure to Uganda's total government expenditures (including military spending) on a per-capita basis illustrates this project's value to society. The government of Uganda currently spends approximately US\$ 75 annually on a per-capita basis.⁴ At a 12 percent discount rate, the value of such expenditures for the 10 years being analyzed will be US\$ 492. As table 6 shows, the increase in government revenues arising from this one manufacturing process will pay for all the government expenditures made on behalf of 3,133 Ugandans. Given the very low expenditures that the government of Uganda typically makes on social services, such as health (US\$ 18/year/capita), one can appreciate the important social contribution such a private-sector operation will make through the taxes the producer will pay directly and will generate through increasing the availability of foreign exchange.

Table 6. Benefits for potential government services recipients

Amount of government revenues	PV of government spending/capita for 10 years	Number of beneficiaries of government services
US\$ 1.54 million	492	3,133

Groundnuts Farmers

The local RUTF producer will procure groundnuts from approximately 4,000 farmers, 70 percent of whom are women living in poverty and/or with HIV/AIDS. Farmers will earn a predictable and stable income by supplying groundnuts, even if they work on land allocated to them by the domestic producer rather than owning their farms.

Based on a USAID study on the groundnuts value chain in Northern Uganda, the estimated share of the value-added farm labor is 50 percent of the value of groundnut production (USAID 2008). In this analysis, the economic opportunity cost of the farmers supplying groundnuts to the project should not exceed 60 percent of the farmers' valued added. Hence the labor market externality will be 20 percent of the value of

⁴ Source: World Bank Development Indicators, <http://databank.worldbank.org/ddp/home.do?Step=12&id=4&CNO=2>.

groundnuts purchased for the project. The groundnuts procurement cost will be US\$ 2.58 million in present-value terms, with the value of labor market externality estimated to be US\$ 0.52 million, or US\$ 129 per farmer.

Table 7. Groundnuts farmer benefits

	Number of farmer-suppliers benefiting	PV of farmer benefits	PV of benefits per farmer
Total	4,000	515,052	129
Male	1,200	154,516	129
Female	2,800	360,537	129

SENSITIVITY ANALYSIS

A sensitivity analysis was conducted on some of the key variables of the financial and economic analysis to determine how the stakeholder impacts would be altered if these variables were changed.

Future Price of RUTF

Because the future prices of RUTF will essentially be negotiated and not market based, it is important to consider a series of price scenarios that might arise from year 5 onward after the proposed USAID purchase agreement is completed.

Table 8. Impacts of RUTF price on financial and economic performance

Price (Years 5–9)	FNPV	FIRR	ENPV	EIRR
5	1,014,736	24%	2,639,483	40%
3.0	–165,216	9%	799,896	26%
3.5	144,069	14%	1,259,793	31%
4.0	434,291	18%	1,719,690	35%
4.5	724,514	21%	2,179,586	38%
5.0	1,014,736	24%	2,639,483	40%
5.5	1,304,958	26%	3,099,379	42%
6.0	1,595,181	28%	3,559,276	45%
6.5	1,885,403	30%	4,019,173	46%

If the price of RUTF remains US\$ 5.00/kg for 10 years, the FNPV obtained by the private investor will be 1.01 million US\$. Table 8 presents the new financial and economic NPVs for different price levels of

RUTF that the domestic producer may receive after the fifth year. Even if the producer's price decreases by 30 percent, to US\$ 3.50/kg, the FNPV will remain positive at US\$ 144,069. Furthermore, the ENPV will also be positive at US\$ 1.26 million, with an EIRR of 31 percent. In other words, there is room for downward adjustment for RUTF prices for years 5 to 9 so that more people can be treated for malnutrition for the same intervention budget. A further reduction in price, however, will render the project financially unattractive to the domestic producer and cause production to cease.

The impact of reduced RUTF price on various stakeholders is reported in table 9. Because wage rates and the groundnut procurement price will be fixed, the benefits for labor and farmers will not vary with changes in RUTF price. By contrast, government tax revenues will be sensitive to changes in RUTF price. As the domestic producer's earnings drop, so will the amount of the producer's CIT payments.

Table 9. Impacts of RUTF price on stakeholder benefits

Price (Years 5–9)	CIT	Indirect taxes	Labor benefit	Farmers
0	735,015	806,353	83,378	515,052
3.0	222,599	659,135	83,378	515,052
3.5	336,407	695,940	83,378	515,052
4.0	469,276	732,744	83,378	515,052
4.5	602,146	769,549	83,378	515,052
5.0	735,015	806,353	83,378	515,052
5.5	867,885	843,158	83,378	515,052
6.0	1,000,755	879,963	83,378	515,052
6.5	1,133,624	916,767	83,378	515,052

Physical Input Cost

A sensitivity analysis was conducted on the cost of the ingredients for RUTF. Although a general increase in cost of 20 percent will significantly lessen the financial profits, it will not jeopardize the financial viability of the project. ADSCRs, however, will drop significantly, especially in year 1, leaving the producer at risk of default. For the first few years of operation, the producer will need to monitor and to control ingredient costs closely or be prepared to inject additional equity to avoid default.

Table 10. Impacts of ingredient costs on financial performance

% change	FNPV	ADSCR year 1	ADSCR year 2	ADSCR year 3	ADSCR year 4
0%	1,014,736	1.21	1.57	1.61	1.69
–15%	1,698,542	1.52	2.01	2.10	2.24
–10%	1,470,607	1.41	1.86	1.94	2.06
–5%	1,242,671	1.31	1.72	1.77	1.88

0%	1,014,736	1.21	1.57	1.61	1.69
5%	783,552	1.05	1.48	1.45	1.51
10%	550,231	0.86	1.42	1.29	1.33
15%	311,861	0.67	1.26	1.23	1.15
20%	68,362	0.47	1.05	1.14	1.05

Two-Way Sensitivity Analysis on RUTF Price and Additional Sales

The last area of analysis concerned the possibility of the producer's being able to produce and to sell RUTF to other agencies and governments in the region that are using RUTF to treat malnutrition. The short-run marginal cost of production will be approximately US\$ 3.17 /kg. At sale prices above this value, there will be significant potential for the domestic producer and the local economy to benefit from the additional production and sales of RUTF through increased utilization of the factory's production capacity. Table 11 combines different levels of sales for the last 5 years of operations with different prices. In other words, for the first 5 years, the price will be maintained at US\$ 5.00/kg. After that period, the producer may sell RUTF at a different price and also expand production. It should be noted that the RUTF market is not a normal market characterized by a larger number of buyers and sellers: It is oligopolistic, with only a small number of producers. The buyers are international-aid organizations and a few governments. If the producer has the possibility of selling abroad, it is very likely that it will charge domestic and foreign customers an amount close to the CIF price of US\$ 5.00/kg.

Table 11. Increase in total sales in years 5–9 and RUTF price on financial NPV

Percentage of additional sales	RUTF price			
	1,014,736	3.50	4.00	5.00
0%		144,069	434,291	724,514
5%		159,419	464,152	768,886
10%		174,769	494,013	813,258
15%		190,119	523,874	857,630
20%		205,469	553,735	902,002
25%		220,818	583,596	946,374
30%		236,168	613,457	990,746

Table 11 shows how the producer's FNPV will change as the producer expands its volume of production and sales between years 5 and 9. With a 10 percent increase in sales and a real price of US\$ 5.00/kg, the FNPV will increase by 12 percent to US\$ 1.13 million.

RECOMMENDATIONS

This project has high financial, economic, and social potential, and USAID should support it through the proposed 5-year product purchase agreement. Due to the risky nature of the future market for RUTF, it is a

sound policy for USAID to purchase RUTF for 5 years at the CIF price of imports. This contract should give the domestic producer the financial stability required to launch this specialized manufacturing process.

REFERENCES

- Bachman, M.O. (2009). Cost Effectiveness of Community-Based Therapeutic Care for Children with Severe Acute Malnutrition in Zambia. *Cost Effectiveness and Resource Allocation*.
- Defourney, I., G. Seroux, I. Abdelkader, and G. Harczi. (2009). *Management of Moderate Acute Malnutrition with RUTF in Niger*. Field article.
- Jenkins, Kuo, and Harberger (2011). Cost Benefit Analysis for Investment Decision, August 2011 Edition.
- Kuo, C.Y. (2011). *Estimates of the Foreign Exchange Premium and the Premium for Non-Tradable Outlays for Countries in Africa*. John Deutsch International, Department of Economics, Queen's University, Canada. The Sphere Project. (2011). *Humanitarian Charter and Minimum Standards in Humanitarian Response*.
- Uganda Bureau of Statistics. (2006). *Demographic and Health Survey (UDHS)*.
- Uganda Bureau of Statistics. (2011). *Demographic and Health Survey (UDHS)*.
- Uganda Bureau of Statistics. (2011). *Statistical Abstract*.
- Uganda Bureau of Statistics. (2012). *Consumer Price Index 2007–2012*.
- Uganda Export Promotion Board. (2010). www.ugandaexportsonline.com.
- Uganda Ministry of Health (MoH). (2012). *IMAM Guidelines: Integrated Management of Acute Malnutrition*.
- Uganda Revenue Authority. (2012). *Domestic Tax Laws*.
- Umes Kapil. (2009). *Ready to Use Therapeutic Food (RUTF) in the Management of Acute Malnutrition in India*. All Institute of Medical Sciences, New Delhi, India.
- University Research Company. (2011). *NuLife Final Report*.
- USAID. (2011). *Food and Nutrition Interventions for Uganda*.
- USAID, prepared by Emerging Markets Group. (2008). *Stabilization-Driven Value Chain Analysis of Rice, Groundnuts, and Maize in Northern Uganda*.