HONEY PRODUCTION IN ETHIOPIA: A COST-BENEFIT ANALYSIS OF MODERN VERSUS TRADITIONAL BEEKEEPING TECHNOLOGIES

Mikhail Miklyaev
Eastern Mediterranean University, Mersin 10, Turkey
Cambridge Resources International Inc.
Glenn P. Jenkins,
Queen's University, Kingston, Canada
Cambridge Resources International Inc.
Richard R. Barichello
University of British Columbia, Vancouver, Canada

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Abstract

Ethiopian honey production is characterized by the widespread use of traditional technology resulting in relatively low honey supply and poor quality of honey harvested when compared to the potential honey yields and quality gains associated with modern beehives. Modern beehive yields around 20kg of higher quality honey as compared to 6-8 kg of yields from traditional beehives. This situation results in growing domestic prices of table honey and poor perspectives for reaching export markets. The objective of this study is to assess the financial and economic rationale of the USAID interventions addressed to improve the livelihood of poor honey producers through the provision of modern beehives. This study identifies key risk factors facing producers, and estimates the projects' stakeholders' net economic benefits. A deterministic cost-benefit analysis was used to evaluate three intervention options: provision of 3 modern beehives/ per beekeeper, provision of 3 modern beehives with tools/ per beekeeper, and provision of 3 modern beehives with tools and trainings on modern beekeeping/per beekeeper.

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Keywords: cost-benefit analysis, investment appraisal, stakeholder analysis, small holders' honey production, honey value chain, modern beekeeping, modern beehives, poverty reduction, sustainable development, Ethiopia.

JEL Classification: D13, D31, D61, D62

ACRONYMS

ACDI-VOCA	Nongovernmental Organization, Implementing Organization
ADSCR	Annual Debt Service Coverage Ratio
AGP	Agriculture Growth Program (Program)
AMDe	Agribusiness and Market Development (Program)
CBA	Cost-Benefit Analysis
CF	Conversion Factor
CSA	Central Statistical Agency of Ethiopia
EBA	Ethiopian Beekeepers Association
EHBPEA Association	Ethiopian Honey and Beeswax Producers and Exporters
EOCK	Economic Opportunity Cost of Capital
ETB	Ethiopian Birr (Currency)
FAO	Food and Agriculture Organization
FEP	Foreign Exchange Premium
FtF	Feed the Future (Program)
GDP	Gross Domestic Product
IRR	Internal Rate of Return
Ha	Hectare
kg	Kilogram
MoA	Ethiopian Ministry of Agriculture
MT	Metric Tons
NGO	Nongovernmental Organization
NPV	Net Present Value
SNV	Netherlands Development Agency
US$	United States Dollar

EXECUTIVE SUMMARY

Project Description: The Agricultural Growth Program-Agribusiness And Market Development (AGP-AMDE) for Ethiopia belongs to the comprehensive Feed the Future (FtF) strategy developed by the USAID for the food insecure developing countries. The main goals of the AGP-AMDE include the reduction of poverty and hunger by improving productivity and competitiveness of value chains that would give rural households greater opportunities for increases in employment and income. The USAID/Mission Ethiopia will begin the implementation of the AGP-AMDE project in 2012, in 83 woredas around Ethiopia. Within the duration of this project the USAID plans to specifically target six commodity value chains: maize, wheat, coffee, sesame, chickpeas and honey.

The total budget provided for improvements in the Ethiopia's honey value chain is 248,000.00 ETB and the commodity specific objectives in the AGP-AMDE include increase in quantity of honey supplied to the market that is combined with achieving higher quality of table honey (USAID, AGP-AMDE, 2012). The benefits from such increase in quality and quantity of honey supplied to the market are twofold. First of all Ethiopia will be able to meet domestic supply requirements associated with its strong within the country demand for honey. Secondary, the country will be able to additionally expand its potential opportunities for honey exports.

Strategic Context and Rationale: The USAID Ethiopia has included honey in its AGP- AMDE project in order to address supply problems related to the current status quo in the Ethiopian honey sector. Most of honey produced within the country (95.57% of total honey production) comes from traditional beehives that generally deliver low yields (5-7kg/beehive) and low quality of honey. Modern honey production that includes the use of modern style beehives is still in Ethiopia at a very low level. Out of 4,993,815 beehives present in Ethiopia in year 2011, only 139,682 were modern beehives (CSA, Agricultural Survey, 2012). This widespread use of traditional technology in honey production results in relatively low honey supply and poor quality of honey harvested when compared to the potential honey yields and quality gains associated with modern beehives. Modern beehive yields around 20kg of higher quality honey. This situation results in growing domestic prices of table honey and poor perspectives for reaching export markets. The proposed in this evaluation interventions in honey value chain include: Intervention A: provision of 3 modern beehives/ per beekeeper, Intervention B: provision of 3 modern beehives with tools/ per beekeeper, Intervention C: provision of a "package solution", 3 modern beehives plus tools plus trainings on modern beekeeping/per beekeeper. These interventions were evaluated in two distinctive regions of Ethiopia, Amhara and Tigray.

Financial and Economic Analysis Results: The basic assumption of this analysis is that each beekeeper in targeted household in both analyzed regions will receive 3 modern beehives. In intervention A these are just 3 modern beehives (boxes), in Intervention B these are 3 modern beehives (boxes) plus tools necessary to properly manage the beehives and under Intervention C these are 3 beehives with necessary tools and training on modern beekeeping. The average cost of capital is assumed to be at the level of 12%. In order to obtain financing required to upgrade the current honey production into modern style apiary, the beekeepers would need to provide a down payment at the level of 28% of the total loan. In addition in order to avoid negative cash flows in the first year of the project, additional loan at market based interest rate of 48% would need to be introduced. These two loans will assure successful introduction of proposed interventions. Upon appraisal pursued on each of the proposed interventions following results were obtained:

1. The financial NPV from the viewpoint of the Equity/Beekeeper, "incremental" (in real terms):

For Amhara:	Intervention A: USD 314	Intervention B: USD 571	Intervention C: USD 1082.
For Tigray:	Intervention A: USD 1780	Intervention B: USD 2922	Intervention C: USD 4866.

2. The economic NPV obtained in the analysis:

For Amhara,	Intervention A: USD 422	Intervention B: USD 704	Intervention C: USD 1200.
For Tigray,	Intervention A: USD 2059	Intervention B: USD 3305	Intervention C: USD 5320.

The levels of economic IRR:

For Amhara,	Intervention A: 48%,	Intervention B: 47%	Intervention C: 76%.
For Tigray,	Intervention A: 137%,	Intervention B: USD 153%	Intervention C: 342%

Beneficiary Analysis Results: The main beneficiaries of proposed Interventions A, B and C are government of Ethiopia, beekeepers and those that will engage themselves into provision of inputs necessary to manage modern beehives (labour). The division of economic benefits among stakeholders is presented below:

Amhara

Intervention A: Government: USD 82.42	Beekeepers/Labour:USD 53.41
Intervention B: Government: USD 128.46	Beekeepers/Labour: USD 56.98
Intervention C: Government: USD 204.55	Beekeepers/Labour: USD 53.68

Tigray

Intervention A: Government: USD 238.61	Beekeepers/Labour: USD 83.57
Intervention B: Government: USD 362.75	Beekeepers/Labour: USD 87.85
Intervention C: Government: USD 551.63	Beekeepers/Labour: USD 52.58

Conclusions and Recommendations: The high economic NPV observed in case of both regions as well as high levels of the economic IRR show that the economic benefits to Ethiopia of each of the proposed Interventions A, B and C, in both analyzed regions, Amhara and Tigray are expected to outweigh the costs. At the expected for each region honey price and yields the Equity/Beekeeper's financial NPV will be the highest in case of Intervention C. The highest economic NPV is also in case of Intervention C. Therefore Intervention C is recommended as the best option for improvements in Ethiopia's honey value chain. From the results obtained in this CBA it is clear that USAID's financing provided for AGP-AMDE project will have positive impact on honey sector in Ethiopia.

METHODOLOGY

Introduction and Project Background

Ethiopia is recognized as one of the poorest and most food-insecure countries in the world. It is primarily a net exporter of agricultural products, with 85 percent of its population employed in agriculture. Ethiopian agriculture contributes more than 45 percent to the nation's gross domestic product (GDP) and significantly affects the country's export trade (USAID, AGP-AMDe, 2012).

It has been widely acknowledged that the Ethiopian agricultural sector has the potential to drive the country's economic development, which could translate into a reduction in poverty and could increase the food security of its people.

In recognition of the unexploited potential that exists in the Ethiopian agricultural sector, the United States Agency for International Development (USAID) has decided to include value chains of several commodities in its leading Agricultural Growth Program-Agribusiness and Market Development (AGP-AMDe). The AGP-AMDe project belongs to the comprehensive Feed the Future (FtF) Strategy for Ethiopia, whose main goals include reducing poverty and hunger by improving the productivity and competitiveness of value chains that would give rural households greater opportunities for increasing their employment and income. The main constituents of AGP-AMDe revolve around four components:

1. improving the competitiveness of selected value chains;
2. improving access to finance;
3. improving the enabling environment of selected value chains; and
4. improving innovation and investment.

The AGP-AMDe project specifically targets six value chains—maize, wheat, sesame, coffee, honey, and chickpeas—and aims to reduce poverty and food insecurity in 83 woredas around the country. Commodity-specific objectives in the honey value chain in the AGP-AMDe project include increasing the quantity (supply) and quality of honey to meet strong domestic and export demand for table honey (USAID 2012).

Honey production and beekeeping are environmentally friendly practices and relatively easy to engage in. These nonfarming business activities have the potential to provide a wide range of economic contributions. Two main economic values could be derived from engaging in beekeeping: income generation from marketing honey and its by-products (beeswax, royal jelly, pollen, propolis, bee colonies, and bee venom) and the creation of non-gender-biased employment opportunities.
Additional benefits from beekeeping are associated with the purely biological nature of bees' activities, such as plant pollination and conservation of natural flora. Because of its relatively low labor requirements, when properly handled, beekeeping can coexist almost effortlessly with regular farming activities, such as growing crops, horticulture production, and animal husbandry.

Commodity Background

Ethiopia is one of the top 10 producers of honey in the world, and it is the largest one in Africa (USAID, AGP-AMD, 2012). The total volume of honey production in 2011 was estimated to be 39.89 million kilograms (kg) (CSA 2012a). The country's potential for honey production, the variety of natural honey flavors associated with the country's diverse sources of bee forage, and Ethiopian honey's desirable qualities, such as low moisture content, have been widely recognized. Beekeeping and honey production in Ethiopia form an ancient tradition

that has been incorporated into Ethiopian culture and even the country's religious customs. Ethiopia is also the country with the longest history of marketing honey and beeswax in Africa. Ethiopians use honey in place of sugar to sweeten their foods and to boost their caloric intake. The average household in Ethiopia is composed of six people, and annual honey consumption is estimated to be 10 kg per household. Honey in Ethiopia is generally produced as a cash crop, with yearly sales amounting to 90 to 95 percent of total production. Currently, the majority of honey produced (about 70 percent of the 90 to 95 percent designated for sale) is sold to *tej* houses. The remaining portion is marketed as table honey for general consumption (Tadesse and Phillips 2007).

Production Regions and Volumes

Honey is produced in almost all parts of Ethiopia, with distinctive types of honey coming from different regions. Probably the most famous and characteristic in terms of color and taste comes from Tigray. The honey's pure white color (due to bees foraging on Tebeb plant [*Basium clandiforbium*]) and its low moisture content have garnered fame; some people even believe that this honey has medicinelike proprieties. Even though such claims related to the healing capabilities of Tigray's honey have not been proven scientifically, they are well grounded in local people's minds and widely accepted as fact. Similar in terms of color, white honey is produced in the Highlands of southwest and southeast Ethiopia, but it does not have the same prestige and renown as Tigray's honey.

Yellow honey, also referred to as multi-flora honey, is also commonly produced and available in almost all regions of Ethiopia. It is harvested in many different parts of the country and gets its color from the various crops produced.

The third type of honey is referred to as Lalibela honey and is produced in central Ethiopia. Its main characteristics include light color and fine creaminess that come from bees foraging on acacia trees. This particular honey variety is well known and in high demand in the domestic market.

Somewhat less-appreciated varieties of Ethiopian honey are dark brown in color and bitter in taste, making them less popular for consumption. They are produced in areas with altitudes of 1,200 to 2,400 meters (m) above sea level.

The last type of honey widely produced and marketed is crude red honey. Its main usefulness and popularity among beekeepers comes from its low quality requirements, because tej houses buy it in crude, totally unprocessed form to produce an Ethiopian type of mead (Agonafir 2005).

Ethiopian honey differs not only in color, taste, and quality but also in the quantity produced and the timing of harvesting seasons that vary by region and type of honey. The main harvesting seasons are October through December for Tigray's and Lalibela honey, with an additional harvest period for Tigray's white honey in June and July; November and December for yellow honey; April and May for white honey from the southwest and southeast Highlands; and February, March, May, and June for dark-brown varieties of honey (Global Development Solutions 2009).

Institutional Climate

In recent years, Ethiopian's honey-production potential and its likely contribution to poverty reduction have been recognized and incorporated into the working agenda of the Government of Ethiopia, especially the Ethiopian Ministry of Agriculture (MoA), National Research Centers (Holeta, Andasa), and various nongovernmental organizations (NGOs), such as SNV (Netherlands Development Agency), Oxfam GB, and SOS Sahel. These agencies share the belief that the Ethiopian honey value chain is an important part of the country's development strategy. Several other institutional bodies have also emerged to promote the Ethiopian

honey sector—namely, the Ethiopian Honey and Beeswax Producers and Exporters Association (EHBPEA) and the Ethiopian Beekeeper's Association (EBA). These institutional actors work together to help establish the successful development of the honey value chain in Ethiopia. The EHBPEA and the EBA cooperate with the government to organize commodity-specific workshops, find solutions to industry problems, facilitate honey policy developments, and organize conferences and international honey expositions (e.g., ApiExpo). The main purpose of these activities is to promote Ethiopian honey and to establish promising market linkages between different actors in the honey value chain.

Ethiopian Honey: Market Assessment

Domestic Honey Consumption and Honey Export

The total volume of honey production in Ethiopia in 2007–2011 was 163,257.42 tons, of which 99.2 percent was consumed domestically and 0.8 percent was exported. The total volume of Ethiopian honey exports in 2007–2011 was 1,297,716 kg, with a total value of US$4,066,528. Sudan, Ethiopia's northwest neighbor, was the single biggest importer of Ethiopian honey in terms of volume and monetary value. Although the volume of honey exported increases slightly when the totals for 2007 and 2011 are compared, Ethiopia's honey exports are still very low relative to Ethiopia's total honey production. Tables 1 and 2, below, provide detailed information about honey production, domestic consumption, and export volumes and values in 2007–2011.

Table 1. Honey production and exports versus domestic consumption, 2007–2011

Year	Total production volume (in kg)	Total export volume (in kg)	Total domestic consumption (in kg)
2007–2008	42,180,346	219,889	41,960,457
2008–2009	39,660,647	143,412	39,517,235
2009–2010	41,524,967	414,115	41,110,852
2010–2011	39,891,460	520,301	39,371,159
Total 2007–2011	**163,257,420**	**7**	**161,959,703**

*Source: The Central Statistical Agency of Ethiopia (CSA) for volume of domestic production, and the Ethiopian Ministry of Trade for export volumes.

Table 2. Percentage shares of domestic consumption versus exports (out of total country production), 2007–2011

Ethiopian honey	Total (2007–2011)	2007–2008	2008–2009	2009–2010	2010–2011
Domestic consumption	99.2%	99.5%	99.6%	99.0%	98.7%
Exports	0.8%	0.5%	0.4%	1.0%	1.3%

*Source: The CSA for volume of domestic production, and the Ethiopian Ministry of Trade for export volumes.

Honey Price Patterns in the Domestic Market

Domestic honey prices in Ethiopia differ substantially by region and type of honey. The highest prices for honey are observed in Tigray, where the white honey that is most popular with Ethiopians is produced. In this region,

as of July 2012, farm-gate prices for white honey reached 120 ETB to 130 ETB/kg,[1] with observed differences depending on microregional honey-quality characteristics, such as purity of wax content and intensity of white color. The observed range of yearly (seasonal) variations in farm-gate prices for Tigray's white honey is around 85 ETB to 130 ETB/kg (according to interviews with small-scale farmers and cooperatives in Tigray). An upward trend in prices for Tigray's white honey was confirmed during field interviews with honey collectors/traders in the area. The selling price for white honey in Tigray as of July 2012 was 170 ETB/kg.

The farm-gate price of yellow honey was lower in the period July 2010 through June 2011, reaching a maximum level of 60 ETB/kg and a national average price of around 39.45 ETB/kg (as reported by the CSA). Most current prices for yellow honey in the Tigray area were around 90 ETB/kg.[2] In the same time period, farm-gate prices for yellow honey in the Bahir Dar area of Amhara were 38 ETB to 50 ETB/kg for crude, unprocessed yellow honey and 41 ETB to 60 ETB/kg for purified yellow honey, depending on the area.[3]

Farm-gate prices for red honey, which is mainly used for tej production, are typically lower than prices for white and yellow honey because of the red honey's inferior quality and the low labor input required at the farm level for its production. As of July 2012, in the Tigray area, the prices for red honey reached 30 ETB to 50 ETB/kg for crude, unprocessed honey and 40 ETB to 60 ETB/kg for purified honey, depending on the area. Selling prices for red honey ranged from 40 ETB/kg for totally unprocessed, crude honey sold to tej houses to 60 ETB/kg for purified honey to be used for consumption purposes.[4] Farm-gate prices for unprocessed red honey in the Bahir Dar area were 34 ETB to 45 ETB/kg, while prices for purified red honey in the same area were 37 ETB to 50 ETB/kg. Selling prices for red honey in the Bahir Dar area were 40 ETB to 50 ETB for unprocessed red honey and 55 ETB to 60 ETB for the purified form.[5]

For average prices per region as well as observed price ranges in different regions between July 2010 and June 2011 (as reported by the CSA), please refer to table 3.

Table 3. Honey prices by region, July 2010 to June 2011 (in ETB)

	Average	Price range
Tigray	61.32	40.67–76.44
Amhara	39.45	31.03–56.00
Oromiya	32.10	21.49–62.13
Benishangue-Gumuz	19.10	16.48–21.00
Gambella	21.42	21.42 (only one price was recorded)
SNNPR	27.32	19.07–42.37

*Source: The CSA
**No records for Affar and Somali were available.

Honey Volumes and Price Patterns in the World Market

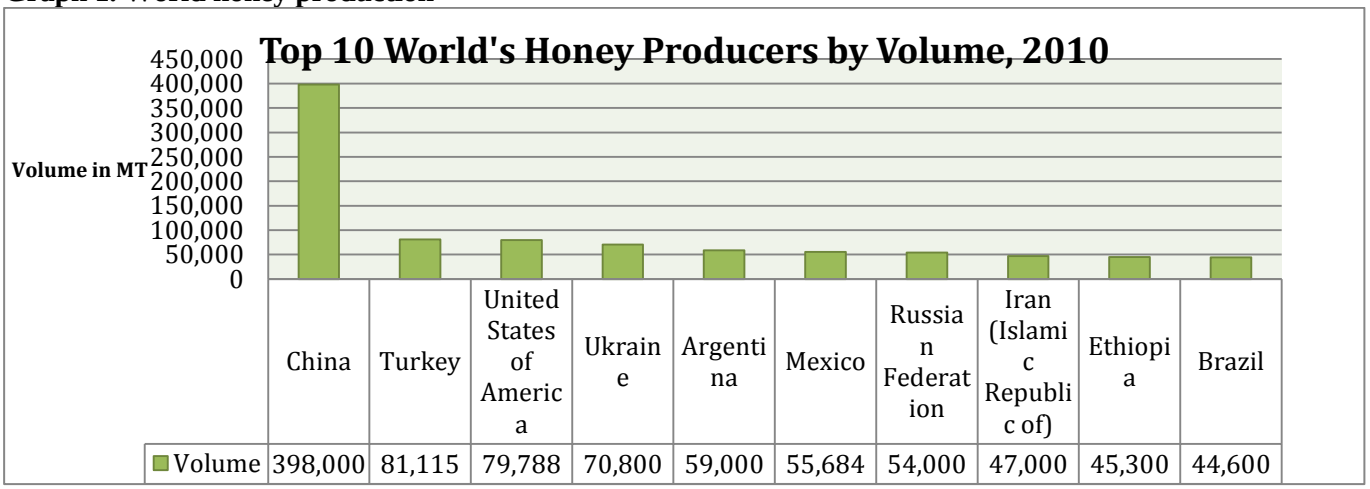
According to FAO Stats, the total volume of worldwide honey production in 2010 was 1,216,556 metric tons (MT), with a total value of US$3.05 billion. The volume of worldwide honey production in 2000–2010 shows a slight increasing trend and a sales value rising from US$2.53 billion in 2000. Average export prices for

[1] As per interviews pursued with honey collectors/traders in Tigray in July 2012.
[2] Price obtained during field interviews with farmers in the Tigray area on July 12, 2012.
[3] Price levels reported by honey collectors/traders and Zembaba Union of Cooperatives in the Bahir Dar area of Amhara.
[4] As per information obtained during interviews with beekeepers and traders in the Mekelle area of Tigray.
[5] As per information obtained from farmers and honey traders in the Bahir Dar area of Amhara.

Ethiopian yellow honey as reported by Beza Mar and Comel during interviews were US$3.25 to US$3.34/kg (FOB Djibouti).

The top 10 honey producers in the world in 2010 (by volume and value) were China, Turkey, United States, Ukraine, Argentina, Mexico, Russian Federation, Iran, Ethiopia, and Brazil. For production volumes of these top 10 world producers, please refer to graph 1, below.

Graph 1. World honey production



*Source: FAO Stats

Many different factors affect world honey prices. The most critical factors are annual weather conditions observed in countries that take the biggest share of exports to the world market, the onset of bee-related diseases, and imposed barriers to trade, such as import bans.

Key Players in the Ethiopian Honey Value Chain and the Degree of Competition

The simplest way to describe the Ethiopian value chain is to analyze the levels at which key players compete for honey in the market in terms of sales or purchases of honey. When using this approach, four main levels can be distinguished:

Level 1: Producers (beekeepers). At this level of the value chain, many beekeepers are engaged in honey production, actively taking advantage of the Ethiopian honey market's high domestic demand and relatively low supply (when compared with demand). Beekeepers actively seek the best possible (highest) prices for honey. Information received during fieldwork in July 2012 in Tigray and Amhara indicates that some beekeepers engage in a type of "honey hedging," postponing immediate sales of a portion of honey harvested to fetch better prices for it in the off-season.

Level 2: Direct buyers of honey. Honey collectors/traders, cooperatives, tej houses, and agribusinesses/processors that buy directly from beekeepers (e.g., Beza Mar buys honey from beekeepers in SNNPR). This level includes a high number of participants in the honey value chain who compete with each other in terms of the purchased quantity, quality, and price of honey. According to field interviews with this group of honey value chain participants in Tigray, Amhara, and Addis Ababa in July 2012, the dominant issue at this level is obtaining an adequate supply of honey, a goal that is affected not only by inadequate honey production but also by the high degree of competition among them. Some of these actors, such as Beza Mar, have tried to establish vertical integration in honey market by establishing their own beekeepers to supply their

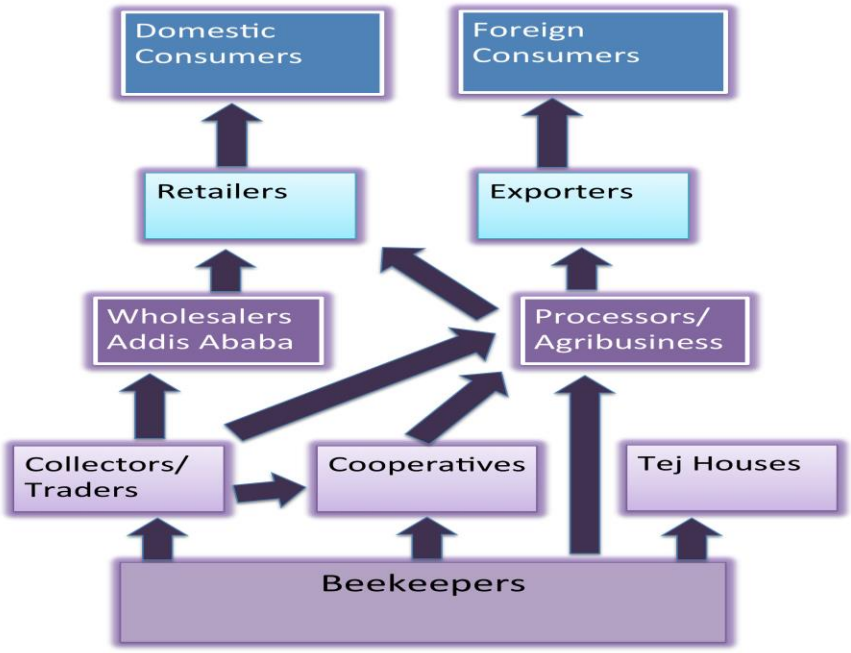
commercial needs. In addition, some value chain participants at this level have tried to establish their own commercial apiaries to ensure a constant honey supply and to minimize the risk associated with increasing honey prices in the domestic market.

Level 3: Agribusiness companies that market honey in domestic and export markets and honey wholesalers in Addis Ababa (Mercato). This level of the honey value chain also includes multiple participants. Wholesalers in Addis Ababa (Mercato) and agribusiness companies that cater to domestic markets compete with agribusinesses that are engaged in sales for export markets in terms of quantity (reliable and timely supply), quality, and price of honey.

Level 4: Domestic retail honey sellers (supermarkets, retail stores) and honey exporters (agribusiness companies/processors). Many participants at this level compete with each other in terms of quantity, quality, and price of honey. Additionally, some agribusinesses/processors that supply honey for export markets are also engaged in sales within the domestic market, so they compete with the wholesalers in Level 3.

Figure 1, below, shows a graphical representation of the Ethiopian honey value chain.

Figure 1. Honey value chain in Ethiopia



Current Deficiencies in the Honey Sector

So far, Ethiopia has not succeeded in exploiting its natural capacity for honey production, nor has it been able to fully benefit from its comparative advantage in the honey sector. Several factors have kept Ethiopian honey production from reaching its full market potential:

1. **Backward technology for honey production, which includes traditional beehives and results in low quantity and poor quality of honey produced.**

   Currently, most of the honey produced in Ethiopia comes from traditional beehives. Statistics show that as of 2011, Ethiopian beekeepers and honey producers possessed about 4,993,815 beehives. Traditional

beehives make up 95.57 percent of the total quantity of beehives in Ethiopia, while the percentage of transitional (Kenya top bar) and modern beehives are 1.63 percent (81,596) and 2.8 percent (139,682), respectively (CSA 2012a). Traditional beehives yield low quantities of honey (around 5 to 7 kg/beehive/year) that is also generally low quality, because it contains brood, wax, and other impurities.

2. **Lack of financial resources (such as access to loans) for beekeepers to obtain modern beehives and other tools necessary to increase honey production.**
   Beekeepers have little access to financial products that would allow them to switch from traditional beehives to improved versions. Moving to transitional and modern beehives requires an initial investment of capital that most beekeepers do not have, so they continue to produce honey using traditional methods.

3. **Supply-related barriers to properly managing modern beehives.**
   The supply of tools necessary to manage modern beehives is not readily available. For instance, some beekeepers possess modern beehives (just boxes), but they lack the tools required for the proper management of these beehives (such as a smoker, queen excluder, or honey extractor).

4. **Lack of proper training regarding efficient management of a modern-style apiary.**

   In general, the beekeepers who do have modern beehives do not have the skills or knowledge needed to properly manage them, and training is not readily available. Therefore, the beekeepers tend to rely on ineffective extractive harvesting methods and inappropriate tools for this type of hive. Additionally, they usually do not provide additional feed (water and sugar syrup or flour) during droughts and have little knowledge about prevailing honey-quality requirements in export markets.

5. **Other associated obstacles.**
   Additional barriers include the disappearance of bee-foraging areas due to crop intensification and the growing use of agrochemicals; extreme weather conditions in some parts of Ethiopia (droughts); poor transportation infrastructure; weak knowledge of proper storage techniques (at the farm and local honey collectors'/traders' levels); problems with packaging, especially at the processors' level (e.g., difficulty obtaining a reliable supply of glass jars); weak access to profitable export markets due to low productivity; limited knowledge of export-market requirements; and lack of or weak connections with processors.

The key barriers to successfully expanding the Ethiopian honey value chain primarily lay at the supply side of this commodity. Ethiopian honey production is insufficient in terms of quantity as well as quality. To meet the growing domestic demand as well as a likely profitable demand in the export markets, these supply-side issues need to be addressed.

COST-BENEFIT ANALYSIS OF INTERVENTIONS

To properly address Ethiopian honey-related problems at the supply level, the following interventions have been evaluated and compared via cost-benefit analysis (CBA):

Intervention A: Introduction of three modern beehives per beekeeper's household.

Intervention B: Introduction of three modern beehives per beekeeper's household, plus the tools needed to properly manage them.

Intervention C: Introduction of a "package solution" that includes

- introduction of three modern beehives per beekeeper's household;
- the tools needed to properly manage the beehives; and
- training on modern beekeeping methods.

PROJECT MODELING

Analytical Framework[6]

The financial cash flow statements constructed for each of the proposed interventions include the following categories: Total Investment/Project, in nominal terms ("without intervention," "with intervention," and "incremental") and in real terms; and Viewpoint of Equity, in nominal and real terms. A sensitivity analysis of the financial outcomes has also been undertaken.

The economic resource flow statements have been derived directly from these financial cash flow statements by multiplying each line in the financial cash flow statement from the total investment point of view by the appropriate economic conversion factor (CF). A sensitivity analysis has been undertaken based on the results of the economic analysis.

The supplementary analysis outlined in the model includes a stakeholders' impact assessment, an analysis of the Family Income Profile, and the Production and Value Chain Distribution system.

The purpose of this modeling exercise is to estimate the net benefits of three for USAID- proposed interventions (in two regions, Amhara and Tigray) in the honey value chain and to estimate the impact of each of these interventions on the honey sector and its main participants. To complete the exercise, the following steps have been undertaken:

1. Total incomes and expenditures of current, traditional beekeeping practices have been estimated (without" intervention scenario).
2. All incomes and expenditures for each proposed intervention (A, B, and C) in each region have been estimated ("with" intervention scenarios).
3. Values from 1 and 2 have been compared to determine whether intervention A, B, or C is the most desirable and cost effective.

"Without" Intervention Scenario

The "without" intervention scenario has been treated as the base-case scenario for each of the three proposed interventions (A, B, and C) in each of the two analyzed regions (Amhara and Tigray). Under the status quo, five traditional beehives have been allocated to each beekeeper's household. The land allocation required for these beehives has been estimated to be 0.002 hectares (Ha). The details related to specific inflows, outflows, and necessary assumptions are presented below.

[6] The analytical framework for cost-benefit analysis used in this report was based on Jenkins, Kuo, and Harberger's (2011) methodology. All the revenues or potential revenue items were treated as cash inflows, and all the expenditures or potential expenditure items were treated as cash outflows.

Inflows

The beekeeper's household income is derived from the sales of the beekeeper's annual honey output whenever it is consumed or sold to the market. The following farm-gate prices have been used to calculate the base-case scenario: 40 ETC/kg for yellow honey from traditional beehives in Amhara, 43 ETB/kg for yellow honey from modern beehives in Amhara, and 130 ETB/kg for white honey from both types of beehives in Tigray. In this scenario, the average yield from a traditional beehive has been established at the level of 6.5 kg/year (regardless of the region or type of honey). Domestic consumption of honey has been confirmed at 10 kg/household/year. Therefore, five traditional beehives produce 32.5 kg of honey per year, of which 10 kg is consumed. The estimated yearly loss due to pests (ants) is 3.25 kg per five beehives, leaving the beekeeper with 19.25 kg of honey to sell.

Expenditures (Input and Operating Costs)

The totals for required expenditures were mainly gathered during field interviews in Amhara and Tigray. The expenditures for each region are summarized in table 4, below; note that some of the expenditures differ by region.

Table 4. Expenditures in the "without" intervention scenario of traditional-hive beekeeping

Expenditures	Cost in ETB (Amhara)	Cost in ETB (Tigray)
Traditional beehives (5)	750.00	1,250.00
Bee colonies (5)	1,500.00	2,750.00
Beehive maintenance (10%)	0.00	0.00
Bee-colony replacement due to ant attack	0.00	0.00
Beehive replacement due to ant attack	0.00	0.00
Labor	146.88	256.25
Rental value of land	1.60	1.60

**Note: These are expenditures for the first year in nominal terms. These values will change, and additional costs will be included for beehive maintenance, bee-colony replacement, and beehive replacement in the later years of the project.*

Assumptions

The honey yield from the traditional beehive will not increase, nor will the prices of inputs (beehives, bee colonies). It is also assumed that the wage rate will not increase, resulting in a 0 percent growth rate.

Intervention A: Introduction of Three Modern Beehives per Beekeeper's Household

The base-case scenario in Intervention A is the same as in the "without" intervention scenario described above.

In the proposed Intervention A, the land requirement for three modern beehives increases to 0.03 Ha (from 0.02 Ha in the base-case scenario). The total cost of buying three modern beehives with three bee colonies is 4,200 ETB in Amhara and 4,950 ETB in Tigray. The beekeeper is expected to make a down payment of 28 percent of the incremental total cost, and then the balance (72 percent) will be financed via loan. An additional loan at the

nominal interest rate of 48 percent will need to be provided to cover operating costs for the first year of the intervention. The base-case scenario's farm-gate prices for honey were used to analyze this intervention (40 ETB/kg and 43 ETB/kg for Amhara and 130 ETB/kg for Tigray).

Due to Intervention A, the following changes in income and expenditures are expected to occur:

Income

It is expected that with Intervention A, the total amount of honey produced per beekeeper's household starting in the second year of the intervention will increase from 32.5 kg (as in the base-case scenario) to 92.5 kg/year. The total annual honey yield from the five traditional beehives will stay at 32.5 kg, but the additional honey production from the three modern beehives will reach a total of 60 kg. The total yearly honey loss due to pests (ants) will stay at the same level as in the without scenario (3.25 kg/year). It is assumed that annual household consumption of honey (10 kg) will not increase with the higher levels of honey production, so the beekeeper's household will end up with 79.25 kg of honey available for sale.

All additional expenditures required for the first year of Intervention A are presented in table 5, below (in bold).

Table 5. Intervention A investment and operating expenditures for expansion with modern beehives, year 1

Expenditures	Cost in ETB (Amhara)	Cost in ETB (Tigray)
Traditional beehives (5)	750.00	1,250.00
Bee colonies (5)	1,500.00	2,750.00
Modern beehives (3)	**3,300.00**	**3,300.00**
Bee colonies for modern beehives (3)	**900.00**	**1,650.00**
Beehive maintenance for traditional beehives (10%)	0.00	0.00
Beehive maintenance for modern beehives (10%)	0.00	0.00
Bee-colony replacement due to ant attack	0.00	0.00
Labor for traditional beehives	146.88	256.25
Rental value of land for traditional beehives	1.60	1.60
Traditional-beehive replacement due to ant attack	0.00	0.00
Labor for modern beehives	**637.75**	**1,287.50**
Rental value of land for modern beehives	**2.40**	**2.40**
Initial 28% down payment for 3 beehives (loan 1 @ 12% interest rate)	**1,176.00**	**1,386.00**
Loan 1 repayment[7]	**1,370.88**	**1,615.68**
Loan 2 repayment	**695.91**	**3,578.71**

**Note: These are expenditures for the first year in nominal terms. These values will change, and additional costs for beehive maintenance, bee-colony replacement, and beehive replacement will occur in the later years of the project.*

Assumptions

[7] The first payments for both loans will be due at the end of the first year, so they are included in the table of expenses.

The honey yield from the traditional beehive will not increase, nor will the prices of inputs (beehives, bee colonies). It is also assumed that the wage rate will not increase, resulting in a 0 percent growth rate. Additionally, it is assumed that beekeepers will pay off their loans at their earliest convenience, whenever they have enough financial resources to first repay the second loan with the 48 percent interest rate.

Intervention B: Introduction of Three Modern Beehives per Beekeeper's Household, Plus the Tools Needed to Properly Manage Them

The base-case scenario in Intervention B is the same as in the "without" intervention scenario described above. In Intervention B, the land requirement for three modern beehives and the farm-gate prices for honey in both regions is the same as in Intervention A. The conditions for both loans are also the same as in Intervention A, except that its value increases to 7,425 ETB for both regions because of the additional cost of tools necessary to manage three modern beehives.

Due to Intervention B, the following changes in income and expenditures are expected to occur:

Income

It is expected that with Intervention B, the total amount of honey produced per beekeeper's household starting in the second year of intervention will increase from 32.5 kg (as in the base-case scenario) to 122.5 kg/year. The total annual honey yield from the five traditional beehives will stay at 32.5 kg, but the additional honey production from the three modern beehives will reach 90 kg. The total yearly honey loss due to pests (ants) will remain at the same level as in the "without" scenario (3.25 kg/year). It is also assumed that the annual household consumption of honey (10 kg) will stay at the "without" scenario level. This will leave the beekeeper's household with 109.25 kg of honey available for sale.

All additional expenditures required for the first year of Intervention B are presented in table 6, below (in bold).

Table 6. Intervention B investment and operating expenditures for expansion with modern beehives and tools, year 1

Expenditures	Cost in ETB (Amhara)	Cost in ETB (Tigray)
Traditional beehives (5)	750.00	1,250.00
Bee colonies (5)	1,500.00	2,750.00
Modern beehives (3)	**3,300.00**	**3,300.00**
Improved bee colonies for modern beehives (3)	**2,100.00**	**2,100.00**
Beehive maintenance for traditional beehives (10%)	0.00	0.00
Beehive maintenance for modern beehives (10%)	0.00	0.00
Bee-colony replacement due to ant attack	0.00	0.00
Labor for traditional beehives	146.88	256.25
Rental value of land for traditional beehives	1.60	1.60
Traditional-beehive replacement due to ant attack	0.00	0.00
Queen excluder	**330.00**	**330.00**
Wax	**675.00**	**675.00**
Smoker	**140.00**	**140.00**
Overall coat	**150.00**	**150.00**
Veil	**90.00**	**90.00**
Glove	**80.00**	**80.00**
Extractor	**320.00**	**320.00**
Wax mold	**150.00**	**150.00**
Plastic container	**90.00**	**90.00**
Labor for modern beehives	**673.75**	**1,287.50**
Rental value of land for modern beehives	**2.40**	**2.40**
Initial 28% down payment for three beehives (loan 1 @12% interest rate)	**2,079.00**	**2,079.00**
Loan 1 repayment	**2,424.00**	**2,423.52**
Loan 2 repayment[8]	**1,191.27**	**4,604.35**

**Note: These are expenditures for the first year in nominal terms. These values will change, and additional costs for beehive maintenance, bee-colony replacement, and beehive replacement will occur in the later years of the project.*

[8] The nominal interest rate on the second loan was established as 48 percent.

Assumptions

The honey yield from the traditional beehive will not increase, nor will the price of inputs (beehives, bee colonies). It is also assumed that the wage rate will not increase, resulting in a 0 percent growth rate. It is also assumed that beekeepers will pay off their loans at their earliest convenience, whenever they have enough financial resources to first repay the second loan with the 48 percent interest rate.

Intervention C: Introduction of a "Package Solution" That Includes:

- **Introduction of Three Modern Beehives per Beekeeper's Household;**
- **The Tools Needed to Properly Manage the Beehives; and**
- **Training on Modern Beekeeping Methods**

The base-case scenario in Intervention C is the same as in the "without" intervention scenario described above.

In Intervention C, the land requirement for three modern beehives, the farm-gate prices for honey, the cost of purchasing tools, and the conditions for both loans in both regions are the same as in Interventions A and B. Additional costs in this scenario are incurred because of the inclusion of training. All these expenditures combine for a total cost of 8,645 ETB per beekeeper (for both regions).

Due to Intervention C, the following changes in income and expenditures are expected to occur:

Income

It is expected that with Intervention C, the total amount of honey produced per beekeeper's household starting in the second year of the intervention will increase from 32.5 kg (as in the base-case scenario) to 47.5 kg per year in the traditional beehives (due to the beekeeper's training on the proper management of apiaries). In addition, the total annual honey yield from the three modern beehives will reach 114 kg. The total yearly honey loss due to pests (ants) will decrease from 3.25 kg/year in the case of the "without" scenario to 2.38 kg/year (due to the beekeeper's increased knowledge of modern apiary management techniques obtained during trainings). As in the previous scenarios, it is also assumed that the annual household consumption of honey (10 kg) will stay at the "without" scenario level. This will leave the beekeeper's household with 149.13 kg of honey available for sale.

All additional expenditures required for the first year of Intervention C are presented in table 7, below (in bold).

Table 7. Intervention C investment and operating expenditures for expansion with modern beehives, tools, and training, year 1

Expenditures	Cost in ETB (Amhara)	Cost in ETB (Tigray)
Traditional beehives (5)	750.00	1,250.00
Bee colonies (5)	1,500.00	2,750.00
Modern beehives (3)	3,300.00	3,300.00
Improved bee colonies for modern beehives (3)	2,100.00	2,100.00
Beehive maintenance for traditional beehives (10%)	0.00	0.00
Beehive maintenance for modern beehives (10%)	0.00	0.00
Bee-colony replacement due to ant attack	0.00	0.00
Labor for traditional beehives	146.88	256.25
Rental value of land for traditional beehives	1.60	1.60
Traditional-beehive replacement due to ant attack	0.00	0.00
Queen excluder	330.00	330.00
Wax	675.00	675.00
Smoker	140.00	140.00
Overall coat	150.00	150.00
Veil	90.00	90.00
Glove	80.00	80.00
Extractor	320.00	320.00
Wax mold	150.00	150.00
Plastic container	90.00	90.00
Sugar for feeding	283.50	283.50
Labor for modern beehives	698.75	1,337.50
Rental value of land for modern beehives	2.40	2.40
Initial 28% down payment for three beehives (loan 1 @12% interest rate)	2,079.00	2,079.00
Loan 1 repayment	2,423.52	2,423.52
Loan 2 repayment	2,956.47	1,260.11
Training		
Trainer's salary	400.00	400.00
Trainer assistant's salary	80.00	80.00
Farmer's accommodation	250.00	250.00
Trainer's accommodation	50.00	50.00
Trainer assistant's accommodations	50.00	50.00
Cost of stationery materials	100.00	100.00
Other demonstration materials	240.00	240.00
Total per diem for each beekeeper	50.00	50.00

**Note: These are expenditures for the first year in nominal terms. These values will change, and additional costs for beehive maintenance, bee-colony replacement, and beehive replacement will occur in the later years of the project.*

Assumptions

The honey yield from the traditional beehive will not increase, nor will the price of inputs (beehives, bee colonies). It is also assumed that the wage rate will not increase, resulting in a 0 percent growth rate. Additionally, it is assumed that beekeepers will pay off their loans at their earliest convenience, whenever they have enough financial resources to first repay the second loan with the 48 percent interest rate.

FINDINGS

Discussion of Financial Analysis[9]

The total budget assigned by the AGP-AMDe project to invest in increasing the Ethiopian honey supply and for the provision of trainings to households for two regions is presented in Table 8 below. The funding for training has been included in the estimates for Intervention C.

Table 8: USAID AMD investment directed toward increased supply of hives, tools and provision of training programs for Amhara and Tigray regions

Budget from July 2012 to June 2013 (thousand ETB)	Amhara	Tigray
Facilitate the supply of hives, colonies and beekeeping equipment to the sites as per the design	248.4	92.00
Organize embedded training programs for smallholders by at least four processors on demo site management, and modern beekeeping in all the four regions	110.16	40.8

The total estimated investment costs per beekeeper for the implementation of the proposed interventions are outlined in table 9, below:

Table 9. Cost of intervention per beekeeper

	Cost in ETB (Amhara)	Cost in ETB (Tigray)
Intervention A: modern beehives	4,200.00	4,950.00
Intervention B: modern beehives plus tools	7,425.00	7,425.00
Intervention C: modern beehives plus tools and training	8,645.00	8,645.00

Taking into consideration the value of the resources that the AGP-AMDe project has allocated, the potential number of beneficiaries of the proposed interventions is presented in table 10, below.

Table 10. Projected number of beneficiaries (per intervention)

	Amhara	Tigray
Intervention A: modern beehives	59	19
Intervention B: modern beehives plus tools	33	12
Intervention C: modern beehives plus tools and training	41	15

[9] For detailed data sources used in the financial analysis, see appendix 2.

The scale – up impact of the interventions for each group of beneficiaries is presented in Table 11:

Table 11. Scale – up benefits for each group of beneficiaries US$ (per intervention)

	Intervention A	Intervention B	Intervention C
		Amhara	
Households	18,579.69	18,854.55	44,362.00
Government	4,862.78	4,239.18	8,386.55
Households/Labor	3,151.19	1,880.34	2200.88
		Tigray	
Households	33,820.00	36,064.00	72,990.00
Government	4,533.59	4,353.00	8,274.45
Households/Labor	1,587.83	1,054.20	788.70

Note: Only Intervention C includes funds allocated for the training programs

To implement the proposed interventions, beekeepers will need two streams of financing, in the form of two separate loans. The first loan will need to be subsidized, resulting in a 12 percent interest rate. These funds will be used to cover expenditures necessary for establishing a modern-style apiary. The second loan will not be subsidized, resulting in a 48 percent interest rate (which is market based). Beekeepers will need these funds to cover the required down payment for the first loan (28 percent of the total loan) for the purchase of beehives (in Intervention A) and beehives plus tools (in Interventions B and C).

Tables 12 and 13, below, present two examples of cash flow statements for Intervention C: Modern Beehives Plus Tools, Plus Training for Amhara.

Table 12. Cash flow statement equity point of view including "bridge financing" and real ETB, "With Intervention" for Intervention C in Amhara

Inflows	2012	2013	2014	2015	2016 and later
Value of in-house honey consumption	400.00	400.00	400.00	400.00	400.00
Revenue from honey sales	1,405.00	6,307.00	6,307.00	6,307.00	6,307.00
Training Cost Subsidy	1220.00				
Subsidized Loan Inflow	5346.00				
Market Loan Inflow	2280.18				
Total inflows	10,651.18	6,707.00	6,707.00	6,707.00	6,707.00
Expenditures					
Training Cost	1,200.00				
Investment costs					
Traditional beehives	750.00				
Bee colonies for traditional beehives	1,500.00				
Modern beehives	3,300.00				
Bee colonies for modern beehives	2,100.00				
Queen excluder	330.00				
Wax	675.00				
Smoker	140.00				
Overall coat	150.00				
Veil	90.00				
Glove	80.00				
Extractor	320.00				
Wax mold	150.00				
Plastic container	90.00				
Service costs					
Sugar for feeding	283.50	283.50	283.50	283.50	283.50
Beehive maintenance	0.00	405.00	405.00	405.00	405.00
Labor cost	698.75	698.75	698.75	698.75	698.75
Rental value of land	2.40	2.40	2.40	2.40	2.40
Cost of beehive replacement due to ant attack	0.00	37.50	37.50	37.50	37.50
Cost of bee-colony replacement due to ant attack	0.00	75.00	75.00	75.00	75.00
Subsidized loan debt service	0.00	2,019.60	1,534.50	1,155.00	0.00
Market loan debt service	0.00	2,463.73	429.81	0.00	0.00
Total outflows	11,879.65	5,985.48	3,466.44	2,657.15	1,502.15
Net cash flows (ETB)	–1,228.48	721.53	3,240.54	4,049.85	5,204.85
Net cash flows (US$)	–70.20	41.23	185.17	231.42	297.42

When the second loan is provided, the net financial cash flows from the beekeeper's point of view become positive in all years of the project. The incremental base of cash flows has been chosen to:

1. eliminate the investment cost of traditional beehives and colonies, because it does not take place in reality—it is assumed that the beekeeper already has these initial beehives; and
2. allow the beekeeper to use only additional cash flows for the purpose of repaying the loans.

Table 13. Cash flow statement equity point of view including "bridge financing," Incremental for Intervention C in Amhara

Inflows	2012	2013	2014	2015	2016 and later
Value of in-house honey consumption	0.00	0.00	0.00	0.00	0.00
Revenue from honey sales	635.00	5,537.00	5,537.00	5,537.00	5,537.00
Training Cost Subsidy	1220.00				
Subsidized Loan Inflow	5346.00				
Market Loan Inflow	2280.18				
Total inflows	9,481.18	5,537.00	5,537.00	5,537.00	5,537.00
Expenditures					
Training Cost	1,220.00				
Investment costs					
Traditional beehives	0.00				
Bee colonies for traditional beehives	0.00				
Modern beehives	3,300.00				
Bee colonies for modern beehives	2,100.00				
Queen excluder	330.00				
Wax	675.00				
Smoker	140.00				
Overall coat	150.00				
Veil	90.00				
Glove	80.00				
Extractor	320.00				
Wax mold	150.00				
Plastic container	90.00				
Service costs					
Sugar for feeding	283.50	283.50	283.50	283.50	283.50
Beehive maintenance	0.00	330.00	330.00	330.00	330.00
Labor cost	551.88	551.88	551.88	551.88	551.88
Rental value of land	0.80	0.80	0.80	0.80	0.80
Cost of beehive replacement due to ant attack	0.00	–37.50	–37.50	–37.50	–37.50
Cost of bee-colony replacement due to ant attack	0.00	–75.00	–75.00	–75.00	–75.00
Subsidized loan debt service	0.00	2,019.60	1,534.50	1,155.00	0.00
Market loan debt service	0.00	2,463.73	429.81	0.00	0.00
Total outflows	9,481.18	5,537.00	3,017.97	2,208.68	1,053.68
Net cash flows (ETB)	0.00	0.00	2,519.02	3,328.33	4,483.33

Net cash flows (US$)	0.00	0.00	143.94	190.19	256.19

Assuming that beekeepers will repay their loans whenever they obtain sufficient financial resources, both loans should be fully repaid within 2 to 3 years, depending on the type of intervention and the type of loan.

Financial Analysis from the Total Project's Point of View

Financial cash flow statements from the total project's point of view in the case of all proposed interventions show negative cash flows (in nominal and real terms) in the first year of the project. These negative flows are caused by initial investments and increased operating costs at the beekeepers' level, but such negative values are not surprising and reflect the status quo observed in the initial stages of the project. In such cases, additional financing in the form of loans is usually proposed to cover negative net cash flows and to ensure the project's continuation. A similar solution is proposed to correct the negative cash flows that appear in the first year of this project. Beekeepers would need loans that are equal to their negative first-year cash flows, determined by the intervention selected. As mentioned previously, such (unsubsidized) loans would be obtained in the credit market for nominal interest rates. With the financial backing obtained from these loans, beekeepers would be able to successfully continue producing honey; during the second year of the project, it is assumed that honey sales would yield positive financial cash flows.

Financial Cash Flows from the Equity's Point of View

From the beekeeper's point of view (aka the equity's point of view), financial cash flow statements are positive (as in case of the total project's point of view) except for the first year of the project, when investments in modern apiary establishment would be pursued. In this first year, beekeepers would need additional financing to cover their initial investments and negative net cash flow of –1,703.68 ETB (for Intervention A in Amhara), –2,606.68 ETB (for Intervention B in Amhara), and –2,280.18 ETB (for Intervention C in Amhara). In Tigray, these values change to –5,982.05 ETB (for Intervention A), –3,111.05 ETB (for Intervention B), and –851.42 ETB (for Intervention C). The calculated values of financial net present value (NPV) from the beekeeper's point of view (incremental) are presented in table 14, below.

Table 14. Financial NPV (incremental) from beekeeper's (equity's) point of view

Financial NPV (incremental) with "bridge financing" (US$)	Amhara	Tigray
Intervention A: modern beehives	314.00	1,780.00
Intervention B: modern beehives plus tools	571.00	2,922.00
Intervention C: modern beehives plus tools and training	1,082.00	4,866.00

All NPV values are positive, but Intervention C: Modern Beehives Plus Tools and Training shows the highest values of financial NPV for both regions.

Sustainability Analysis

One of the main goals for financial institutions is to minimize the risk of loans defaulting, so they tend to lend money to those who are most likely to be able to repay the loans. The benchmark for making such a decision is the Annual Debt Service Coverage Ratio (ADSCR). As part of the analysis for this project, ADSCRs have been calculated for each of the proposed interventions. The ADSCRs for each intervention are well above one (which is a benchmark value), with Intervention C yielding the highest ADSCR and the shortest period of time necessary to repay the loans. These relatively high ADSCRs indicate that the beekeepers' would be able to repay the loans.

These results are not surprising, because the majority of honey produced by the beekeepers would be designated for selling, which would provide the income necessary to fulfill their financial obligations. Specific ADSCR values for each intervention in both regions are outlined in table 15, below.

Table 15. Annual debt service coverage ratio (per beekeeper)

ADSCR (Amhara)	2013	2014	2015	ADSCR (Tigray)	2013	2014	2015
Intervention A: modern beehives	2.26	2.97	3.95	Intervention A: modern beehives	5.79	7.62	10.13
Intervention B: modern beehives plus tools	1.92	2.52	3.35	Intervention B: modern beehives plus tools	5.79	7.62	10.13
Intervention C: modern beehives plus tools and training	2.66	3.50	4.65	Intervention C: modern beehives plus tools and training	8.46	11.13	14.79

Discussion of Economic Analysis[10]

The proposed Interventions A, B, and C were designed to improve the quality and quantity of the supply of honey, which would in turn facilitate development in the Ethiopian honey sector domestically and in terms of potential exports. The main objective of the economic analysis outlined in this report is to determine the net incremental benefit to the beekeeper and to the economy as a whole with each of the proposed interventions in both regions. Incremental financial and economic benefits vary for each proposed intervention because of two issues:

1. Financial values do not reflect all the distortions that are present in the economy (taxes, duties, etc.). To show the true picture of the Ethiopian economy and the true impact that proposed interventions would have, the economic values have been adjusted by multiplying financial values by appropriate conversion factors. If no distortion is observed, the market price has been used in the economic analysis (as outlined later in this report).
2. Financial values vary by region (due to differences in prices and costs between Amhara and Tigray).

The obtained values for the economic NPV for each intervention in each region are presented in table 16, below.

Table 16. Economic net present value per intervention

Economic NPV (US$)	Amhara	Tigray
Intervention A	422.00	2,059.00
Intervention B	704.00	3,305.00
Intervention C	1,200.00	5,320.00

The economic NPV values for each of the proposed interventions are positive, with the highest NPV values observed for Intervention C. In addition, the following economic internal rates of return (IRR) have been calculated: For Amhara, Intervention A is 48 percent, Intervention B is 47 percent, and Intervention C is 76 percent. For Tigray, Intervention A is 137 percent, Intervention B is 153 percent, and Intervention C is 342 percent. These results indicate that all the proposed interventions will benefit the economy and contribute toward an increase in the GDP, but Intervention C will yield the most desirable outcomes.

[10] For detailed data sources used in the financial analysis, see appendix 2.

STAKEHOLDERS' IMPACT ASSESSMENT

Economic surplus is created by considering capital, land, and labor at the value of their proper opportunity cost. To achieve this goal, USAID will guarantee a subsidized credit, which would be treated as a subsidy that comes from outside the country. It is assumed that USAID would provide this credit to Ethiopia even if it were not going be used for the proposed interventions in the honey sector, which is why the value of such credit should be treated as a transfer to the beekeepers' families. It is an expenditure on the USAID side but a financial benefit to the beekeepers. Due to USAID's introduction of these interventions in the honey sector, the government of Ethiopia will benefit from the increased tax inflow caused by the increased volume of honey production and sales; this tax revenue will come from honey traders and wholesalers who are taxed based on their income. In addition, the government will benefit from collecting tariffs on inputs that are necessary for honey production (inputs for bee hives production (wooden boxes), necessary for bee hives proper management tools (smoker, queen excluder, honey extractor) and inputs necessary for manufacturing of necessary clothing (veil, overall coat, glove), plastic containers for honey, duty on gas for transportation and sugar duty). If the NPV generated from the total investment/project point of view is deducted from the economic NPV, the result is a net gain for the government, most of which comes from foreign exchange premiums (FEP).[11] Local labor involved in making domestically produced inputs required for the project will also benefit. For detailed values allocated by stakeholder, please refer to table 17, below.

Table 17. Economic NPV allocated to stakeholders (in US$)

Amhara	Intervention A	Intervention B	Intervention C
Households (FNPV)[12]	314.00	571.00	1,082.00
Beekeepers/labor	53.41	56.98	53.68
Government	82.42	138.46	204.55
Tigray	**Intervention A**	**Intervention B**	**Intervention C**
Households (FNPV)	1,780.00	2,922.00	4,896.00
Beekeepers/labor	83.57	87.85	52.58
Government	238.61	362.75	551.63

The shares for all stakeholders add up to the total value of the economic NPV generated by each of the proposed interventions.

[11] Note: For this analysis, it was assumed that white honey from Tigray is an exportable commodity, but given such high price levels, it is highly uncompetitive in the world market. Additional research is necessary to justify its high price and value for domestic consumers.

[12] Economic present value includes both FNPV and externalities. The ENPV is equal to sum of FNPV and externalities. The total economic value of households' gains due to intervention is equal to sum of FNPV + externalities arising to the labor. Externalities at labor level presents because financial wages used in the analysis are estimated to be less than true economic cost of the labor. For instance total economic value of the households gains for Intervention A in Amhara is equal to US$505.57,

SENSITIVITY ANALYSIS

Honey's financial and economic NPV are sensitive to changes in honey prices and yields.[13] Therefore, this financial and economic sensitivity analysis has been performed based on all mentioned variables for all proposed interventions in Amhara and Tigray. Detailed results of this sensitivity analysis can be seen in the excel model and in tables A, B, C, and D in appendix 1.

Beekeeper's Income Analysis

The beekeeper's annual income from producing honey is the sum of net cash flows after financing, excluding all costs of family labor, rental costs of land, and costs associated with the maintenance of the beehives. For a graphical representation of the beekeeper's yearly income level associated with each scenario and region, see graphs 1 and 2 in appendix 1.

As the graphs show, all three proposed interventions (the "with" intervention scenarios) show higher income for the beekeeper when compared with the base-case scenario (the "without" intervention scenario). The highest level of yearly income is observed in the case of Intervention C. In the "without" intervention scenario, the beekeeper's income level stays constant (due to no initial investments). In the "with" intervention scenarios, initial investments occur in 2012, and additional loan repayments follow from 2013 into 2015 (depending on the intervention and region). These expenditures reduce the beekeeper's income during the first 2 to 3 years of the project.

In poverty-prone countries like Ethiopia, the increase in yearly income enables higher food security and increased purchasing power. This type of income increase goes in hand with the main objectives of international assistance organizations in developing countries: poverty reduction and increased food security.

[13] Note: Additional sensitivity analysis for the rate of bees absconding from traditional beehives can be found in the model. It was assumed that absconding rates for modern beehives will be zero. However, Intervention C will also result in a reduced absconding rate for traditional beehives.

Scenario Analysis

Based on the results obtained from the sensitivity analysis discussed previously, expected, optimistic, and worst-case scenarios have been constructed. Honey prices and yields have been taken into consideration, as these variables could affect the outcome of each of the proposed interventions. For more details regarding these scenarios, see table 18, below.

Table 18. Expected, optimistic, and pessimistic scenario analyses

Amhara				Tigray			
Intervention A				**Intervention A**			
	Expected	Optimistic	Pessimistic		Expected	Optimistic	Pessimistic
Honey price (ETB)	43	50	38	Honey price (ETB)	130	140	80
Honey yield (kg)	20	25	15	Honey yield (kg)	20	25	15
Financial NPV (US$)	314	664	127	Financial NPV (US$)	1,780	2,652	530
Intervention B				**Intervention B**			
	Expected	Optimistic	Pessimistic		Expected	Optimistic	Pessimistic
Honey price (ETB)	40	50	38	Honey price (ETB)	130	140	80
Honey yield (kg)	30	40	25	Honey yield (kg)	30	40	25
Financial NPV (US$)	571	1,292	370	Financial NPV (US$)	2,922	4,569	1,082
Intervention C				**Intervention C**			
	Expected	Optimistic	Pessimistic		Expected	Optimistic	Pessimistic
Honey price (ETB)	40	50	38	Honey price (ETB)	130	140	80
Honey yield (kg)	38	60	35	Honey yield (kg)	38	60	35
Financial NPV (US$)	1,157	2,427	783	Financial NPV (US$)	4,866	8,217	2,793

Although it is not possible to assign the probability of obtaining the results for each of the decision-making criteria without performing a risk analysis, this scenario analysis has established the upper and lower bounds for the possible range of outcomes and compared them to the base-case scenario.

RECOMMENDATIONS

Based on the analysis of the three proposed interventions in the Ethiopian honey value chain in Amhara and in Tigray, Intervention C (the "package solution") is the most appealing choice and therefore the choice recommended by USAID, because it will provide the highest NPV in terms of financial and economic feasibility. The other two proposed interventions will also yield positive NPVs, but these NPVs will be lower than that of Intervention C.

For Intervention C to be successfully implemented, beekeepers will need access to financing resources to obtain modern-style beehives and tools, preferably packaged together to prevent significant delays. Training sessions on modern beekeeping will need to be organized before the beekeepers attempt modern-style honey production, and follow-up workshops will most likely need to be organized to ensure continued proper management of modern apiaries. Assuming that these conditions are fulfilled and that no unanticipated factors in the domestic and/or world economy occur, the implementation risk for Intervention C will be rather low.

If it is properly implemented, Intervention C will improve honey productivity levels and increase its quality, thus resulting in a larger, improved supply of honey in Ethiopia. The beekeepers will benefit from increased incomes, honey traders will benefit from increased sales, and the government will benefit from increased tax inflows. In addition it is advisable to reconsider the level of the initial down payment required to obtain the loan. The burden of the down payment (*28%)* that is required from each beekeeper in order to become a part of the AMDe intervention in the honey value chain is significant. Downsizing the required amount of money necessary for down payment can facilitate the implementation of the **Intervention C** and ensure that beekeepers are able to join the project and benefit from its likely successful outcomes.

Given the likely successful outcomes of Intervention C (positive effects on the honey sector and the Ethiopian economy), the question of continuing to build on these improvements arises. To develop a successful and reliable system for honey production and marketing in Ethiopia, other aspects of honey production will need to be researched, and more investments will be necessary. Bee foraging is one area that might be worth researching, especially in Eastern Tigray, where white honey is produced. In that area, bees forage in a specific type of herbaceous plants that are considered to be medicinal by local people. One of these herbs, Tebeb (in local language; scientifically known as *Basium clandiforbium*), is believed by many local people to lower blood sugar.

If the medicinal quality of Tebeb were confirmed and also found in Tigray's white honey, the discovery could potentially open export markets for Ethiopian honey, as happened with the widely consumed Manuka honey from New Zealand and Australia. If the claims were scientifically proven, such recognition for Tigray's white honey would likely facilitate the expansion of its export market and would most likely guarantee a price premium related to its healing proprieties. These potential results would make investments in Tebeb bee-forage development rational and worthwhile. The outcome would be a positive spillover not only for the Ethiopian economy but also for the country's natural resource conservation.

The interest rate of 15 % provided by MFIs under the loan – guarantee fund (as in the case of GRAD project) is subsidized, since inflation rate in Ethiopia is around 20 percent. It was assumed that farmers may need to get additional loan to provide equity contribution of 28 percent as in case of GRAD honey interventions. Such loans can be obtained only under market interest rates of 48 to 50 percent per annum. High interest rates on the second loan significantly reduces returns to the households, so it is recommended for USAID negotiate conditions under which farmers will have access to the amount sufficient for the investment without equity contribution.

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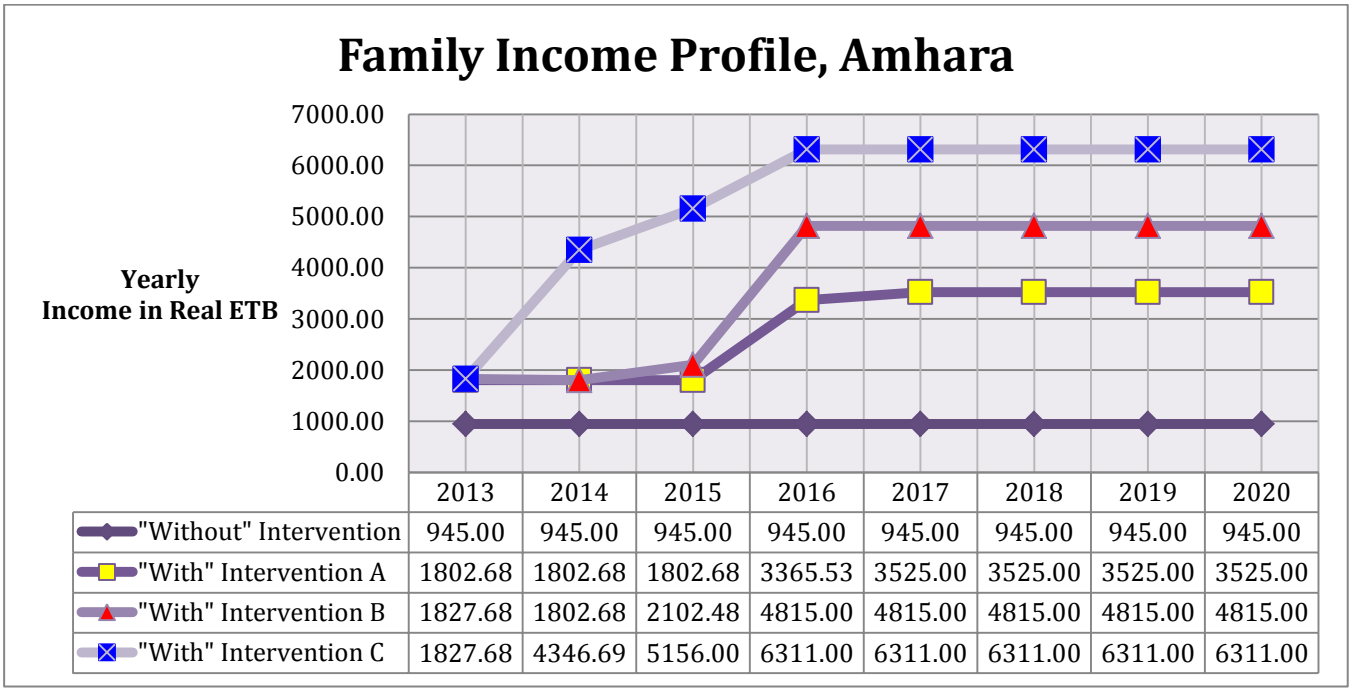
Appendix 1

Graph 1.



	2013	2014	2015	2016	2017	2018	2019	2020
"Without" Intervention	945.00	945.00	945.00	945.00	945.00	945.00	945.00	945.00
"With" Intervention A	1802.68	1802.68	1802.68	3365.53	3525.00	3525.00	3525.00	3525.00
"With" Intervention B	1827.68	1802.68	2102.48	4815.00	4815.00	4815.00	4815.00	4815.00
"With" Intervention C	1827.68	4346.69	5156.00	6311.00	6311.00	6311.00	6311.00	6311.00

Graph 2.

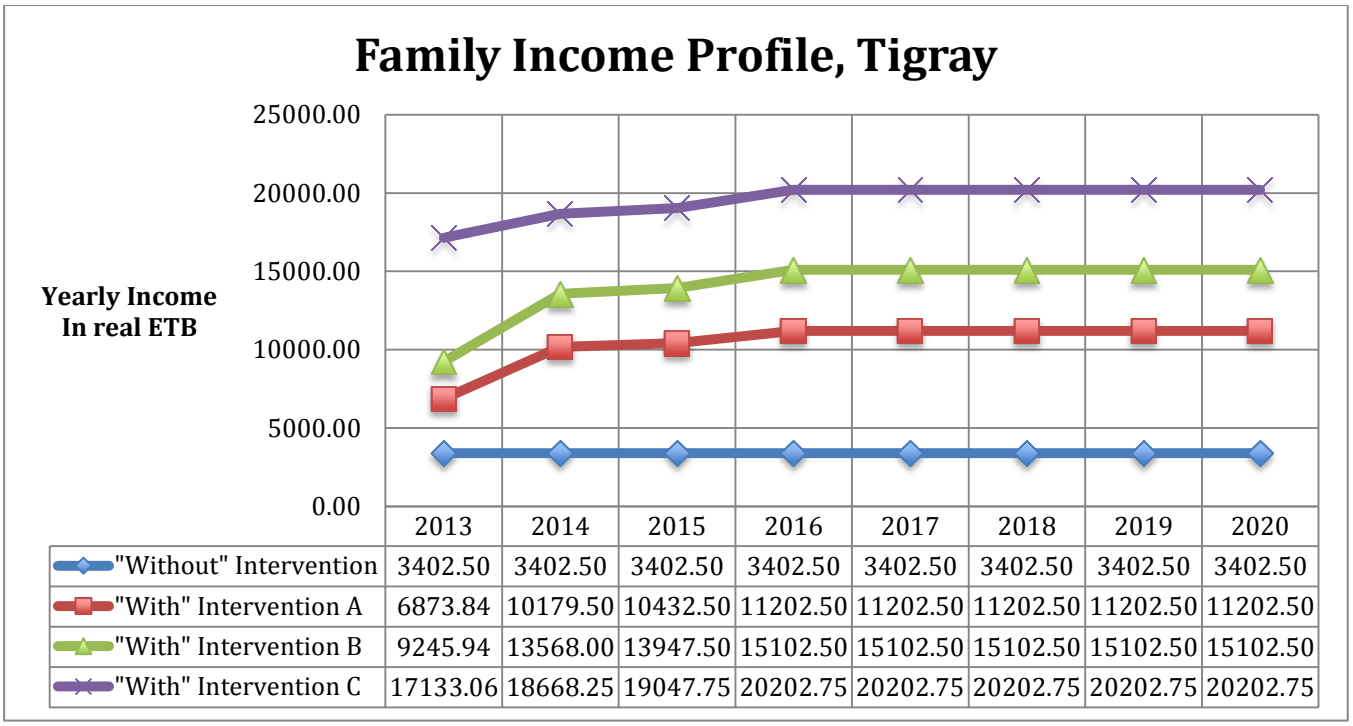


Table A. Financial sensitivity analysis, Amhara (joint yield and price)

Intervention A					
Amhara NPV equity US$313.91	**Honey yield (kg)**				
	15	**18**	**20**	**22**	**25**
38.00	127.26	178.32	224.14	292.37	394.71
40.00	140.70	194.45	260.05	331.87	439.59
43.00	160.85	236.71	313.91	391.12	506.92
45.00	174.29	269.02	349.82	430.62	551.81
50.00	215.16	349.82	439.59	529.37	664.02
Intervention B					
Amhara NPV equity US$571.35	**Honey yield (kg)**				
	25	**28**	**30**	**35**	**40**
38.00	369.82	433.30	475.62	611.95	804.79
40.00	397.66	464.49	480.00	683.00	885.99
43.00	439.43	484.06	571.35	789.57	1,007.79
45.00	467.27	540.90	632.25	860.62	1,088.99
50.00	530.75	683.00	784.50	1,038.24	1,291.99
Intervention C					
Amhara					

Intervention A					
NPV equity US$1,082.33	Honey yield (kg)				
	35	38	45	50	60
38.00	783.16	895.35	1,157.12	1,344.10	1,718.06
40.00	852.05	970.14	1,245.69	1,442.51	1,836.15
43.00	955.38	1,082.33	1,378.54	1,590.12	2,013.29
45.00	1,024.27	1,157.12	1,467.11	1,688.53	2,131.38
50.00	1,196.49	1,344.10	1,688.53	1,934.56	2,426.61

Table B. Financial sensitivity analysis, Tigray (joint yield and price)[14]

Intervention A					
Tigray NPV equity US$1,779.85	Honey yield (kg)				
	15	18	20	22	25
80.00	530.47	726.20	811.24	966.22	1,198.68
90.00	652.80	830.61	1,004.96	1,179.31	1,440.84
110.00	859.67	1,179.31	1,392.41	1,605.50	1,925.14
130.00	1,150.25	1,528.01	1,779.85	2,031.69	2,409.45
140.00	1,295.55	1,702.36	1,973.57	2,244.78	2,651.60
Intervention B					
Tigray NPV equity US$2,922.13	Honey yield (kg)				
	25	28	30	35	40
80.00	1,081.77	1,314.24	1,469.21	1,856.66	2,244.10
90.00	1,323.92	1,585.45	1,759.80	2,195.67	2,631.55
110.00	1,808.23	2,127.87	2,340.96	2,873.70	3,406.43

130.00	292.53	2,670.29	2,922.13	3,551.72	4,181.32
140.00	2,534.68	2,941.50	3,212.71	3,890.74	4,568.76
Intervention C					
Tigray NPV equity US$4,865.81	**Honey yield (kg)**				
	35	**38**	**45**	**50**	**60**
80.00	2,792.98	3,025.45	3,567.87	3,955.32	4,730.20
90.00	3,132.00	3,393.52	4,003.75	4,439.62	5,311.37
110.00	3,810.02	4,129.67	4,875.49	5,408.84	6,473.70
130.00	4,488.05	4,865.81	5,747.24	6,376.84	7,636.03
140.00	4,827.06	5,233.88	6,183.12	6,861.14	8,217.20

Table C. Economic sensitivity analysis, Amhara (joint yield and price)

Intervention A					
Amhara NPV equity US$421.76	**Honey yield (kg)**				
	15	**18**	**20**	**22**	**25**
38.00	114.59	235.34	315.84	396.34	517.08
40.00	146.37	273.47	358.21	442.94	570.04
43.00	194.03	330.67	421.76	512.85	649.48
45.00	225.81	368.80	464.12	559.45	702.44
50.00	305.25	464.12	570.04	675.96	834.84
Intervention B					
Amhara NPV equity US$706.07	**Honey yield in Kg**				
	25	**28**	**30**	**35**	**40**
38.00	345.95	466.70	547.19	748.44	949.69
40.00	398.91	526.01	610.75	822.58	1,034.42

43.00	478.35	614.98	706.07	933.80	1,161.52
45.00	531.31	674.30	769.62	1,007.94	1,246.26
50.00	663.71	822.58	928.50	1,193.30	1,458.10
Intervention C					
Amhara NPV equity US$1,271.36	**Honey yield (kg)**				
	35	**38**	**45**	**50**	**60**
38.00	949.36	1,070.11	1,351.85	1,553.10	1,955.59
40.00	1,023.51	1,150.61	1,447.18	1,659.02	2,082.69
43.00	1,134.72	1,271.36	1,590.17	1,817.90	2,273.35
45.00	1,208.86	1,351.85	1,685.50	1,923.81	2,400.45
50.00	1,394.22	1,533.10	1,923.81	2,188.61	2,718.20

Table D. Economic sensitivity analysis, Tigray (joint yield and price)

Intervention A					
Tigray NPV equity US$2,057.97	**Honey yield (kg)**				
	15	**18**	**20**	**22**	**25**
80.00	576.11	830.31	999.78	1,169.25	1,423.45
90.00	734.98	1,020.96	1,211.62	1,402.27	1,688.25
110.00	1,052.74	1,402.27	1,635.29	1,868.31	2,217.84
130.00	1,370.49	1,783.58	2,058.97	2,334.35	2,747.44
140.00	1,529.37	1,974.23	2,270.80	2,567.38	3,012.23
Intervention B					
Tigray NPV equity US$3,307.63	**Honey yield (kg)**				
	25	**28**	**30**	**35**	**40**

80.00	1,295.18	1,549.38	1,718.85	2,142.53	2,566.20
90.00	1,559.97	1,845.95	2,036.61	2,513.24	2,989.87
110.00	2,089.57	2,439.10	2,672.12	3,254.67	3,837.22
130.00	2,619.16	3,032.24	3,307.63	3,996.10	4,684.57
140.00	1,883.96	3,318.81	3,625.39	4,366.82	5,108.25
Intervention C					
Tigray NPV equity US$5,390.75	**Honey yield (kg)**				
	35	**38**	**45**	**50**	**60**
80.00	3,124.10	3,378.30	3,971.45	4,395.12	5,242.47
90.00	3,494.81	3,780.79	4,448.08	4,924.71	5,877.98
110.00	4,236.24	4,585.77	5,401.35	5,983.90	7,149.00
130.00	4,977.67	5,390.75	6,354.61	7,043.09	8,420.03
140.00	5,348.39	5,793.25	6,831.25	7,572.68	9,055.54

Appendix 2

DETAILS ON THE FINANCIAL ANALYSIS

Data Sources Used for Modeling Purpose (Table of Parameters)

The baseline for the financial analysis included all private cash flows that were identified during the field interviews with various actors in the Ethiopian honey value chain, including small-scale farmers/beekeepers, honey collectors/traders, cooperatives, research institutes (Holeta and Andasa), a beekeeping association (EBA), owners of agribusinesses (Beza Mar, Comel, Dima, Rahi, Tsedey), and various NGOs (SNV, Care Ethiopia, CRS Ethiopia and Oxfam GB) involved in developing the honey value chain in Ethiopia.[15] Whenever possible, real-life data were used for modeling purposes. In cases where real-life data were not available, local consultants provided the insight necessary to calculate proper estimations. Obtained data were additionally compared with available sector-specific publications.

1.1. Land Utilization/Area Under Beehives

[15] Note: All field interviews were conducted between July 2 and July 13, 2012, in Addis Ababa, Tigray, and Amhara.

The estimations for the amount of land necessary for beekeeping activities (traditional beehives as well as modern ones) were based on physical inspections of beekeeping sites and were established for five traditional beehives as 0.002 Ha and for three modern beehives as 0.003 Ha.

1.2. Family Information: Household Size and Average Family Honey Consumption

The information regarding the average family size (six people per household) was obtained during field interviews and additionally confirmed by CSA official estimations. The information regarding the typical yearly honey consumption per household (10 kg/household/year) was obtained from beekeepers during field interviews.

1.3. Annual Productivity and Prices

The information regarding the productivity of traditional beehives (6.5 kg) was calculated as an average of actual productivities obtained from beekeepers during field interviews. These figures were additionally verified with local consultants as well as available publications for this sector. The most common range of productivity yields from traditional beehives were 5 kg to 7 kg/beehive.

A similar approach was undertaken to calculate honey productivity from modern beehives, which was established for Intervention A as 20 kg/beehive. The range of obtained productivity yields with modern beehives varied from 15 kg/beehive at the farm level to 60 kg/beehive in the Holeta Research Center. These figures varied depending on the area and the number of harvesting seasons (one to three times/year). The rationale for the initial productivity yield of 20 kg/modern beehive was additionally confirmed with local consultants and available publications on this topic.

Yields from modern beehives were additionally adjusted to higher levels for Interventions B and C (due to likely productivity increases caused by use of tools in Intervention B and tools plus training in Intervention C). These yields were set at the level of 30 kg/beehive for Intervention B and 38 kg/beehive for Intervention C.

The number of traditional beehives per family (five) was established based on interviews with beekeepers (five was the most prevailing number of traditional beehives they possessed). The number of modern beehives per household (three) was based on information obtained from SNV regarding the minimum number of modern beehives needed to establish a successful modern-style apiary.

Prices of honey at the farm-gate level were obtained from farmers and additionally confirmed by honey collectors/traders and cooperatives in visited regions. The farm-gate price of yellow honey from traditional beehives in Amhara was established as 40 ETB/kg, while the price of purified yellow honey from modern beehives was established as 43 ETB/kg. Prices for Tigray's white honey were established in a similar manner, except the price for white honey from traditional beehives and modern beehives was the same, 130 ETB/kg. Because of its specific qualities, especially its very low moisture content, Tigray's white honey can be easily harvested from traditional beehives without significant differences in quality when compared with modern beehives, so no difference in price was assumed.

1.4. Growth Rates

The growth rates for honey prices and labor were assumed to stay constant (growth level of 0 percent).

1.5. Cost of Inputs for Traditional Beehives

Information about the cost of inputs for traditional beehives was obtained from farmers during field interviews and established at 150 ETB in Amhara and 250 ETB in Tigray. The price of bee colonies for traditional beehives and Interventions A and B was established at 300 ETB/colony in Amhara and 550 ETB/colony in Tigray.

1.6., 1.7. Unit Input Requirement and Cost of Inputs for Modern Beehives

Input requirements and costs for modern beehives used for Interventions B and C (for both regions) were obtained from the estimations most currently prepared by the SNV:

- cost of modern beehive (box), 1100 ETB/beehive (quantity proposed: three boxes)
- improved bee colony, 700 ETB/colony (quantity proposed: three colonies)[16]
- queen excluder, 110 ETB (quantity proposed: three)
- wax, 90 ETB/kg (quantity proposed: 4.5 kg)
- smoker, 140 ETB (quantity proposed: one)
- overall coat, 150 ETB (quantity proposed: one)
- gloves, 80 ETB (quantity proposed: one set)
- extractor, 8,000 ETB (quantity proposed: 0.04 [a fraction of total to be shared among beekeepers])
- wax mold, 5,000 ETB (quantity proposed: 0.04 [a fraction of total to be shared among beekeepers])
- bee-forage seeding, 50 ETB (quantity proposed: one)
- plastic honey container, 30 ETB (quantity proposed: three containers)[17]

1.8. Service Costs/Labor Requirements

Information regarding the labor requirements for managing traditional and modern beehives was obtained from farmers and the Andasa Research Center. Labor requirements for traditional beehives were estimated to be 26 hours in non-harvesting periods and an additional 15 hours during harvesting periods. Labor requirements for modern beehives were estimated to be 182 hours during non-harvesting seasons[18] and an additional 24 hours during harvesting periods.

In Amhara, the cost of family labor for both beehive types in harvesting seasons was calculated as 35 ETB/day and in non-harvesting seasons as 25 ETB/day. In Tigray, the cost of labor was estimated as 50 ETB/day for both seasons. These wage levels were obtained from farmers during field interviews.

The working-day duration was established as 8 hours per day. This figure and the rental rate of land were also based on information gathered from farmers during field interviews; the rental rate was

[16] Note: For Intervention B in both regions, the price of a bee colony was established as 300 ETB for Amhara and 550 ETB for Tigray. It was assumed that beekeepers will not obtain improved bee colonies during this intervention. It was assumed that in Intervention C, after receiving training and topic knowledge, beekeepers will invest in improved bee colonies.

[17] Note: For Intervention A, the only input requirement will be a modern beehive (wooden box), but for Interventions B and C, tools necessary for the proper maintenance of modern beehives will also be required.

[18] Note: In the case of Intervention C, the quantity of hours will increase to 190 hours because of the additional activities associated with providing extra feed for bees.

established as 800 ETB/Ha. The maintenance costs of both types of beehives were assumed to be 10 percent. These figures were used for analysis in both regions.

1.9. Additional Bee Feed Requirements and Costs

Information on the quantity of bee feed necessary to maintain a healthy modern-style bee colony came from the Andasa Research Center and was established as 2.25 kg of sugar to produce sugar syrup. To produce syrup, sugar is mixed with water in a proportion of 0.75 kg of sugar per 1 L of water. According to the Andasa Research Center, such feed is necessary during the dry season (1 month) as well as during the rainy season (6 months). The price of sugar (18 ETB/kg) was taken from the retail market.

DETAILS ON THE ECONOMIC ANALYSIS

To come up with appropriate estimations for economic analysis, the necessary values estimated in the financial cash flows were adjusted to their shadow prices. Properly calculated conversion factors were used for these adjustments.

Table 1. Conversion factors used in economic analysis

Honey	**1.09**
Transportation	**0.84**
Labor	**1**
Traditional beehive	**1**
Modern beehive	**0.85**
Bee colony	**1**
Queen excluder	**0.85**
Wax (ETB/kg)	**1**
Smoker	**0.85**
Overall coat	**0.73**
Veil	**0.73**
Glove	**0.8**
Extractor	**0.82**
Wax Mold	**1**
Plastic honey container	**0.74**
Beehive maintenance	**1**
Rental value of land	**1**
Cost of traditional beehive and bee-colony replacement	**1**
Sugar	**0.79**

*Source: Own calculations.

Taxes and Duties

Data on Ethiopia's taxes and duties were retrieved from the official Ethiopian government publication *The Federal Democratic Republic of Ethiopia Ethiopian Revenues and Customs Authority, Customs Tariff, Volumes I and II, January 2008, Addis Ababa*.

Social Opportunity Cost of Labor

In Ethiopia, there is considerable rural labor mobility—people from rural areas frequently take jobs in nearby towns. Different areas offer many opportunities for employment (e.g., many roads are constructed and there are many possibilities for obtaining jobs in these areas). At village level, the typical wages for farm labor (unskilled, rural) are 25 ETB/day during non-harvesting periods and 35 ETB/day during harvesting periods. There were no observed distortions in the labor market, therefore CF Labour=1 and rural labor prices were used in the economic analysis.

Opportunity Cost of Land

There are two approaches to estimating the opportunity cost of land in a cash flow statement. The first approach is to include as an investment cost at the beginning of the project the market value of land and then to include it in the residual value of the project as an inflow at the end of the evaluation period. The

residual value is the same real value as the initial investment cost (Jenkins, Kuo, and Harberger 2011). The second approach is to estimate the rental value of land in real terms and include it with any other recurring expense upon adjusting for inflation (Jenkins, Kuo, and Harberger 2011). In this project, the second approach was followed. During field interviews, farmers provided rental prices for land of 800 ETB/Ha, which translated into a rental value of land under beehives of 1.60 ETB for traditional beehives and 2.40 ETB for modern beehives.

Economic Opportunity Cost of Capital (EOCK) and Foreign Exchange Premium (FEP)

The values for EOCK (12 percent) and FEP (6.5 percent) were based on recent estimations published by Chun-Yan Kuo in *Estimates of the Foreign Exchange Premium and the Premium for Non-tradable Outlays for Countries in Africa* (2011).