Cost-Benefit Analysis of Honey Production in Ethiopia: A Modern Versus Traditional Beekeeping Technologies

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ABSTRACT

Ethiopia is attributed to the widespread use of traditional methods for honey production, faulty equipment and training. This situation results in low productivity and quality of table honey, and only a little is prepared for the export. Due to low productivity and low agricultural income, this project seeks to improve farmers' livelihoods. This analysis describes the primary risk factors posed by beekeepers, and it calculates the net economic gains to the different project stakeholders.

A deterministic cost-benefit model was used to determine three choices for intervention: the provision of three new beehives / per beekeeper, the provision of three new beehives with equipment / per beekeeper, and the provision of three modern beehives with modern beehives / per beekeeper equipment and training to improve the honey production capacity of the honey value chain in Ethiopia.

Keywords: traditional beehives, modern beehives, honey production, honey value chain, sustainable development, Ethiopia.

JEL Classification: D13, D31, D61, D62

LIST OF ABBREVIATIONS

ADSCR	Annual Debt Service Coverage Ratio
AGP	Agriculture Growth Program (Program)
AMDe	Agribusiness and Market Development (Program)
CBA	Cost-Benefit Analysis
CF	Conversion Factor
CSCFs	Commodity Specific Conversion Factors
EOCK	Economic Opportunity Cost of Capital
EIRR	Economic Internal Rate of Return
ENPV	Economic Net Present Value
ETB	Ethiopian Birr (Currency)
FEP	Foreign Exchange Premium
FIRR	Financial Internal Rate of Return
FNPV	Financial Net Present Value
FtF	Feed the Future (Program)
GDP	Gross Domestic Product
Ha	Hectare
IIA	Integrated Investment Approach
IRR	Internal Rate of Return
Kg	Kilogram
M^2	Square Meters
NCFADs	Net Cash Flow after Debt Service
NPV	Net Present Value
SPINTO	Shadow Price of Non-Tradable Outlays
USAID	United States Agency for International Development
USD	United States Dollar
VAT	Value Added Tax

1 INTRODUCTION

1.1 Background

Ethiopia is located in the eastern part of Africa, and it is bordered by Eritrea, Djibouti, Somalia, Kenya, South Sudan and Sudan. As in the case of many African countries with diverse ethnicity. Ethiopia is identified as one of the "world" most unfortunate and most food-deficient nations. It is predominantly a net exporter of farm products such as maize, wheat, coffee, sesame, chickpeas and honey. More than 85 percent of its population are engaged in agriculture.

Beekeeping is an environmentally sustainable activity that can be associated with farming activities such as crop processing, animal husbandry, horticultural crops and the protection of natural resources through plant pollination and restoration of ecosystems. Ethiopians honey production meets the urban and rural population's beverage requirements, it is an important component needed for nutritional and medical purposes (Aberbe, Puskur, & Karippai, 2008). The total honey production in Ethiopia is estimated up to 47,706 metric tonnes. Only a small amount of this is marketed.

1.2 Importance and Objectives

Agriculture development and the enhancement of its productive capacity are essential requirements for sustained economic growth. Attempts by numerous researchers and technology stakeholders have shown that both honey quality and quantity in Ethiopia could be improved in terms of developing the beekeeping system, processing and marketing to meet both local and international demand.

Ethiopia is attributed to the widespread use of traditional methods of honey production, faulty equipment and training. These have led to relatively low availability of honey prepared for export and low quality of harvested honey compared with potential honey yields and quality improvements associated with the use of modern beehives. Among the significant constraints behind low agricultural production are diseases, pests, predators, droughts deforestation, and chemical pesticides, which are found to be critical factors that underestimate the beekeeping subsector contribution to the economy (Berhe, Asale, & Yewhalaw, 2016).

Due to low productivity and low agricultural income, this project seeks to improve farmers' livelihoods. It has, therefore, become an issue of paramount importance to expand honey production capacity and the export capacity of the Ethiopian honey sector. This analyzes the possibility of expanding the use of modern beekeeping equipment in Ethiopia.

1.3 Study Methodology

There are varying techniques used in honey production in Ethiopia, and it has been found that the large proportion of the honeybee population is hived in traditional beehives. A smaller population is hived in transitional and modern beehives. A significant number of honeybee colonies, estimated at over 10 million, exist due to the suitable natural environment of the country.

Evaluation of the financial and social feasibility of projects is critical so that scarce financing is spent only on economically beneficial projects. This study was conducted in a way so that it would combine political, environmental, stakeholder, and risk analysis. The cost-benefit analysis aims to ensure that scarce resources are used efficiently to optimize their benefit (Jenkins, Kuo, & Harberger, 2019).

The integrated investment approach (IIA) is used to determine project costs and benefits to archive this. The project was evaluated in such a way as to combine the financial, economic, stakeholder and risk analysis. It was done using a financial model for analyzing and drawing conclusions, and data were obtained based on an IIA approach. The net present value test was used to assess if the project is feasible financially and economically, which was also extracted from the project review. Also, a sensitivity analysis was performed to assess the essential variables by measuring and reporting the effect of their discrepancies on project performance suggestions for ways of managing the risk.

2 LITERATURE REVIEW

2.1 Ethiopian Honey Sector

The agricultural sector in Ethiopia has been widely recognized as having the potential to drive economic development in the country, in order to reduced poverty and improve the food security of their citizens. Ethiopia is one of the top ten honey producers in the world, and it is the largest producer in Africa USAID, (2012).

Beekeeping practices are one of the oldest agricultural practices in Ethiopia, and it is a significant essential element of the country's agricultural economy that contributes directly and indirectly to the country's economy. It plays a significant role in producing income for rural households.

As Africans top honey producer, honey trading plays a vital role in the country's domestic economy, and through foreign-exchange earnings, it serves to boost the national economy. A large number of rural farmers engage in honey farming, which includes honey collection and retailing (Fikru, Gebersilassie, & Kassa, 2015).

Besides poor marketing conditions, the main reason for the relatively small share of honey production that is exported is that about 80 percent of the total Ethiopian honey production goes into the local Taj-preparation, a honey wine. This beverage is consumed in large quantities as a national drink. Despite the challenges and constraints, Ethiopia has the largest bee population in Africa, with over 10 million bee colonies, of which 5-7.5 million are hived while the remaining exists in the wild (Dekebo, Bisrat, & Jung, 2019).

Agriculture contributes almost half the Gross Domestic Product (GDP) of Ethiopia and creates jobs for 85 percent of the population. It also accounts for approximately 90 percent of export sales and meets up to 70 percent of the raw material requirements of the country's industry. All regions in Ethiopia produce honey, but their production capacity varies according to the suitability of the beekeeping regions, i.e. the density of bee forests across the country. Its woodlands and forests contain a variety of plant types producing nectar and pollen for bee foraging.

2.2 Production Systems in Ethiopia

Local farmers in Ethiopia today effectively use three processing systems to produce honey. Each class of each production system defined by the techniques utilized and the possible effects of each system (Teferi, 2018). This system includes traditional, semi-modern (transitional), and modern beehives.

2.2.1 Traditional System

Traditional beekeeping in Ethiopia is the oldest and most popular methods practiced by the people for thousands of years. A large quantity of the honey produced in the country comes from traditional beehives resulting in low yield and low quality. Ethiopia, bee farmers, mostly use the traditional beehive, which is not easy to conduct

internal examination and feeding, and does not provide the option of combining (adding more boxes) to differentiate between the brood chamber and the honey chamber. Which tends to kill the bee colonies during the honey practice.

Bahta (2018), in his study, discovered that with many millions of fixed comb hives, traditional farming is practiced, especially in remote areas of the country. Traditional beekeeping requires little or no use of new techniques and improved technology. Cylindrical beehive is the most common form of traditional beehive used in Ethiopia by local farmers.

Figure 1: Traditional Beehive 1

Figure 2: Traditional Beehive 2

2.2.2 Semi Modern (Transitional) System

The transitional beehive is a combination of traditional and Modern beehive technologies (Teferi, 2018). In implementing beekeeping technology, this is designed in such a way that beekeepers can use more sophisticated techniques and increase the production ability of honey bees. It is made locally around protected areas for skills creation for beekeepers. Transitional beekeeping has its drawbacks such as top bar beehives are more costly than traditional beehives, and combs hanging from the top bars are more effective at breaking off than combs built inside the frames (Mitikie, 2017).

Figure 3: Semi Modern (Transitional) Beehive

2.2.3 Modern Beehives

Research shows that modern beehive were introduced in Ethiopia 30 years ago and was adopted for honey production only by a few farmers. Furthermore, to increase the consistency and quantity of honey production, this improved beehive has also decreased the swarming rate of bees and the survival rate of honey bee colonies (Aberbe, Puskur, & Karippai, 2008).

Sebho and Baraki (2018), in their study, also adds that Modern beehives enable colony maintenance and the use of higher-level technologies, with larger colonies that can achieve better honey yields. With modern beehives in use, frames are built to separate honeycombs, as bees connect honeycombs to adjacent frames, making it easier for beekeepers to manage the bees making honey harvesting easier.

Figure 4: Modern Beehive

Figure 5: Beekeepers working on Modern Beehives

2.3 Constraints of Honey Production

It is no doubt the honey sector in Ethiopia is faced with some constraints. The critical restrictions concerning the subsection of honey production sub-sector in Ethiopia are lack of beekeeping expertise, lack of human resources skills, scarcity of beekeeping tools, pests and predators, the threat of pesticides, weak infrastructure growth, inadequate bee forage and lack of comprehensive science (Sebho & Baraki, 2018).

Farmers had low beekeeping gear, and when they are harvesting, they did not care about their colonies. The honey bee population is in a state of continuing decline due to deforestation and poisoning by agro-chemicals. As a result, getting honey bee

colonies to start and expand beekeeping becomes a severe challenge. The population of honey bees is not free of predators, which can take numerous forms, from the collapse of a hive by wax moth infestation to the physical destruction by a hungry black bear of a colony (Gebremeskel, Tamir, & Begna, 2015).

Honey farmers are losing a large number of colonies and honey bees. A large number of these beekeepers indicated that specific local native activities are carried out to reduce the damage of predators and disease harm. These activities include daily visits and apiary watching, which has helped to be a solution to most of the local farmers. Surveyed beekeepers around Ethiopia identified that significant predators such as honey badgers, wax moths, worms, birds, lizards and snakes are some of the predators that attack their beehives.

Also, the study shows that the location of certain varieties of plants that mostly supply bees with nectar and pollen is critical. Identifying the presence of these abundant forage crops and their flowering timelines is also an issue for farmers, primarily due to deforestation. Variations in weather patterns, climate and other cultural and agricultural practices, flowering plants and their flowering period vary from one place to another and so affect the quality of honey production in some regions.

Through growing globalization, colonies of bees are shipped across vast distances and also across continents, thereby spreading alien species and their diseases. These diseases are killing the bees that are critical for the pollination of crops. Despite these obstacles, the global demand for honey keeps rising, and the honey sector keeps expanding.

2.4 International Honey Market

Nowadays, honey production and the global honey market are expected to rise by 3.2 billion, led by 4.8 percent incremental expansion annually (Research, 2019). The changing trends of more farmers using new methods and technologies around the world fuels this development, which makes it essential for honey-producing countries to stay abreast of the evolving position to hit more than 7 billion dollars expansion by 2025.

In 2018, the global market for honey was estimated at USD 8.4 billion. Ethiopia

supplies over 23.6% of African production and over 2.1% of world output. The honey market has gained growing attention from the government, legal experts, the media, beekeeping societies and research laboratories around the world today as a result of the great qualities it contains.

With the high level of health insecurities faced by people around the world, health-conscious customers find honey to be a significant source of multiple health benefits and this "liquid gold," as it is labeled, contains antioxidants that help to prevent damage to brain cells. The significant factor is expected to be changing customer tastes for a balanced, nutritious, and natural sugar substitute as well as an artificial sweetener (Future, 2018). Skincare products, as well as healthy beverages around the world, contains honey. Manufacturers are increasing the use of honey as a raw material for their products, causing the global price and demand of honey to rise generally. The honey market is expected to improve as it grows in popularity over the coming years.

2.5 Plans to Develop the Honey Sector in Ethiopia

Despite its long history, beekeeping is still an undeveloped agricultural industry in Ethiopia. Begna, Gela, Negera, and Bezabeh (2016), in their study, examined that Ethiopia's know-how and skill in honey processing and beeswax extraction is still traditional. Until recently, USAID Ethiopia has integrated honey in its AGP-MADE projects to tackle supply concerns regarding the emerging honey market current system in the different regions in Ethiopia (Miklyaev, Jenkins, & Barichello, 2013).

Considering the opportunity in Ethiopia's agricultural sector, the United States Agency for International Development (USAID) has agreed to include honey in its leading agribusiness and market growth (AGP-AMDE) list of crops. The total budget assigned for the development of the Ethiopian honey value chain is 248,000.00 ETB. The key goals include mitigating poverty and hunger by improving the efficiency and profitability of supply chains that will give rural households more significant incentives to improve their jobs and profits.

3 OVERVIEW OF THE WITHOUT AND THE WITH THE PROJECT SCENARIOS

3.1 Honey Production "Without" The Project

Most of the honey produced by local farmers in all the regions of Ethiopia is extracted from traditional beehives, meaning that modern technology and techniques are not used in any way or capacity. Until now, Ethiopia has not been able to export its abundant production potential for honey, nor has it been able to take full advantage of its strategic edge in the honey market. Ethiopia currently produces only 47,706 tons of honey, which is below its capacity to produce (Yeserah, Jenberie, & Begna, 2019). It is due to the weak state of the Ethiopian honey market and the continuous use of the traditional method for honey production around the different honey-producing regions.

In Ethiopia today, traditional beehives yield small volumes of honey, around 7-9 kg per beehive annually. Honey produced using such beehives is usually low in terms of quality, which contains wax, pollen and other impurities. Local honey bee farmers do not have the expertise and tools available to handle the honey bees better. Tools used by modern honey farmers such as smokers, gloves and honey extractors are not available to increase the productive potential of honey producers resulting in low yield and quality. Many related barriers in Ethiopia, such as adverse weather conditions (drought), inadequate financial accessibility, poor knowledge of proper storage and processing methods, and inadequate knowledge of business specifications for exports constrain the low level of productivity of the Ethiopian honey sector.

Figure 6: Map Showing the Location of Ethiopia in Africa

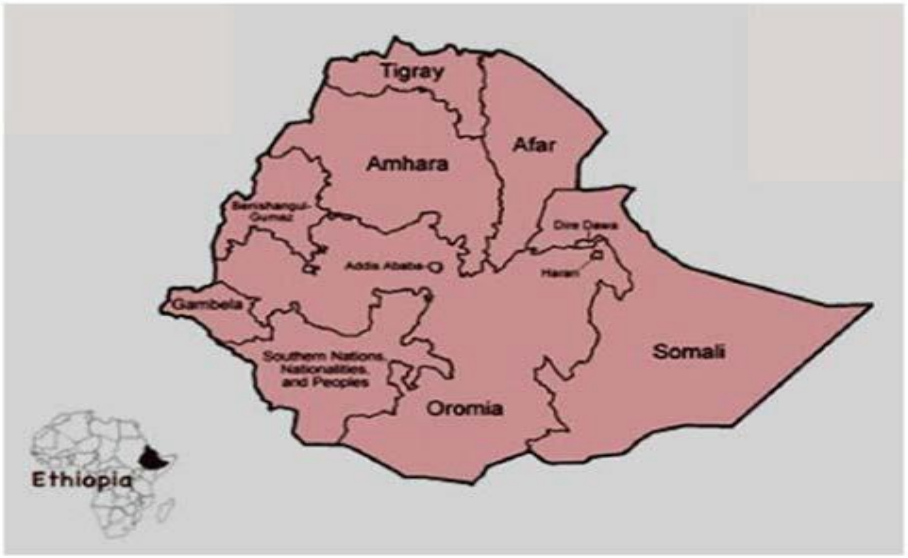

Figure 7: Map Showing the Honey-Producing Regions in Ethiopia.

3.2 Project Scope

Through integrating honey into its AGP-AMDe initiative, USAID directly aims to boost the quantity and efficiency of the honey sector in all Ethiopian regions. The result aims to satisfy the domestic supply requirements as well as to increase the honey export prospects of the country. In this project, the USAID plans to:

i. Boost financial exposure of local farmers, which includes hunger and poverty reduction.
ii. Strengthen honey market productivity and competitiveness.
iii. Provide the appropriate instruments and skills of modern beekeeping practices and,
iv. Develop a suitable climate for forage and honey beekeeping.

This project is scheduled for a 10-year time frame.

3.3 Honey Production with the Project

Potential yields and productivity improvements from modern beehives in Ethiopia surpass 20kg per beehive annually. With new strategies, Ethiopia should be able to meet the domestic supply of quality honey as well as improve its honey export capacities. The strategies in the honey value chain suggested by this project for the expansion of the Ethiopian honey sector includes:

i. The provision of 3 modern beehives per beekeeper

ii. The provision of 3 modern beehives plus tools per beekeeper and,
iii. The provision of 3 modern beehives, tools and training per beekeeper.

These approaches were analyzed and evaluated using cost-benefit analysis (CBA) to help address the low production-level of the honey value chain. Also, these strategies have been analyzed in the different regions of Ethiopia that produce honey, and the results indicate that these activities will promote the Ethiopian honey sector and establish promising market linkages throughout the honey value chain and other economic sectors in the economy.

4 METHODOLOGY

The Integrated Investment Appraisal (IIA) methodology is used to measure the benefits and impact(s) of USAID's agricultural investment program through its Agricultural Growth Program-Agribusiness and Market Development (AGP-AMDE). IIA is a tool used to determine both the economic and socio-economic effects of a project and the uncertainties that might affect a project. The IIA approach incorporates the financial, economic, stakeholders and risk components of a project to allow estimation of project impacts from different perspectives, which is a way to apply the cost benefit approach.

The cost benefit analysis is a system designed by identifying the benefits of carrying out a project and the related costs of the project by subtracting the costs from the benefits. It can yield analytical findings that can be used to draw logical conclusions on the effectiveness and long-term feasibility of a project decision. The rationale for proceeding with the project is given if the benefits are higher than the costs of investment, taking into account the opportunity cost of the resources used and the time value of money.

The project analysis was carried out on an incremental basis, that is, what are the financial and economic outcomes of the traditional methods of honey production (without the project) and what they would be with the project. For the identification and calculation of possible benefits and costs resulting from undertaking the project, distinctions between "with" and "without" project scenarios are explicitly and regularly identified in the analysis.

The project base year is 2019, and the analysis covers a 10-year period, which is from the year 2019 - 2028, contrasting 'with-project' and 'without-project' outcomes on an incremental basis. The project's nominal cash flows are first extracted from the model, which is then adjusted by the price index is used to extract actual cash flows in real (constant price level) terms. A 12 percent discount rate used for the financial analysis as well as the economic analysis. Based on annual financial and economic cash flow analysis statements, the externalities incurred to AGP-AMDE were established.

5 FINANCIAL ANALYSIS

Financial analysis is vital to determine the feasibility of a project. It determines all project expenditures and revenue over the lifespan of the project, intending to achieve a reasonable amount of return, which will be appealing to private investors. When the project does not produce adequate returns in line with the goals of private investors, the financial analysis is also used to calculate the level of the net cash flow required to make the project attractive to these investors. With each of these stakeholders, two different income statements were constructed to calculate the economic effect of the project on private investors and financial institutions offering debt financing.

For any project, constructing cash flows is one of the necessary aspects of financial analysis. The project's capacity to meet its debt obligations was calculated using the cash inflows and outflows from the investor's and project owner's and leader's perspectives. These cash flows are the "without" and "with" the project scenarios, which are used to derive the incremental cash flow. The incremental cash flow is derived by subtracting the cash outflows from inflows of the "with" scenario and comparing it to the "without" scenario.

5.1 With the Project Case

With the project, the AGP-MADE program aims to improve the honey sector in Ethiopia by suggesting three interventions to achieve this purpose. Unlike animal husbandry and crop farming, which requires a large land size for production. The honey production requires more or less a small portion of land of about 20m² - 30m² for beekeeping depending on the size and number of beehives. With the proposed interventions, only 30 m² of land is required by each beekeeper to implement these

strategies effectively.[1]

The three different strategies that are provided to beekeepers are as follows;

i. The provision of three modern beehives per beekeeper
ii. The provision of three modern beehives plus tools per beekeeper and,
iii. The provision of three modern beehives, tools and training per beekeeper.

The AGP-MADE also aims to see which of these strategies will yield the highest returns to the local farmers. The primary goal of financial analysis is to see how financially attractive the honey project can be if any of the planned interventions are implemented. Accordingly, the financial analysis indicates which of the interventions is better off if implemented. The honey project financial analysis was calculated in both nominal and real terms.

5.2 Life Span of Project Assets

Each beekeeper needs to acquire some set of equipment to produce honey, which could be either traditional or modern beekeeping equipment. For the honey project, it is assumed that each beekeeper has in his possession, traditional beekeeping equipment from the traditional method of beekeeping and modern beekeeping equipment as a result of the project depending on which strategy in use. These project assets include traditional beehives, modern beehives, bee colonies, and tools. The life span of these assets is summarized and presented in table 1.

Table 1: Project Assets and Their Life Span

ASSETS	**LIFE SPAN**
Modern Beehives	30 Years
Traditional Beehives	10 Years
Bee Colonies	10 Years
Tools	20 Years

5.3 Project Assumptions

With the honey project, provides each beekeeper with a loan charged at a12% interest rate. The loan requires a down payment of 28% from each beekeeper, and the remaining 72% is charged at a 12% interest rate. The domestic inflation rate at the time

[1] The estimated amount of land needed for beekeeping activities (Traditional and Modern Beehives) was based on physical inspections of beekeeping sites showing that the ratio of 20m2 of land space to five Traditional Beehives and 30m2 of land space to three Modern Beehives.

of our project is assumed to be 12% and the foreign inflation rate is assumed to be 2%. The exchange rate used in the honey project is assumed to be 31.1 ETB per unit of the United States dollar (the foreign currency used in the project).

5.4 Project Financing

Debt and equity are required to fund 72% and 28% of the overall capital expense, respectively. The debt financing is provided by the AGP-AMDE program to increase current honey production in the modern apiary of honey production. A 12% interest rate loan is assumed to be provided. This loan will ensure that the proposed interventions are successfully implemented. Beekeepers have to provide a deposit of 28 percent of the total cost of capital in advance, and the balance (72 percent) will be financed through a loan.

Suppose the beekeepers can pay off their debts until they gain sufficient financial resources, all debt should be paid off in full within two to three years, depending on which intervention is chosen and the size of the debt. Beekeepers are therefore expected to repay their loans at their earliest opportunity once they have enough financial capital to do so.

To mitigate the possibility of defaulting on borrowed funds, only creditors that are most likely to settle their loans are worthy to assess borrowed funds. For such a decision, the benchmark is the debt service coverage ratio (ADSCR). Accordingly, the ADSCR shows how long it takes for a project to pay off its debt obligation. As part of the study for this project, ADSCRs were estimated for each of the suggested measures. The ADSCR was determined for each of the interventions with intervention C (three

modern beehives + tools + training per beekeeper) supplying the maximum ADSCR and the shortest period required to pay off the loan. Such relatively high ADSCRs suggest that beekeepers will be able to pay off their loan[2]. The loan should be repaid within 2 to 3 years, assuming beekeepers can repay their loan when they have the financial resources, depending on the type of intervention chosen.

5.5 Project Service Cost

To fully understand the variability and sustainability of improving the honey sector in Ethiopia, financial analysis was conducted. "Without" the honey project, it is

[2] ADSCR is calculated as follows; ADSCR= $\frac{\text{Annual net cash flow available for debt service}}{\text{Total debt repayment (principal + interest)}}$

anticipated that farmers will realize some cost to keep the honey production going as a result of using the traditional method of beekeeping. Labor and rental cost of land is realized on an annual base, and it is assumed that 10 percent of the initial cost of investment is spent on maintenance costs. The cost of replacement of traditional beehive due to ant attack, bee colony replacement cost due to ant attack, and beehive maintenance are all incurred after the first year on an annual base. The maintenance of these beehives is done during the year.

"With" the project, it is presumed that the service costs borne by the farmers are maintenance costs, labor costs and rental costs of the land[3]. This cost will be realized annually, starting from the base year (2019). The farmers do not incur costs related to replacing traditional beehive and replacement costs for bee colonies due to the use of modern equipment and techniques. Maintenance of these modern beehives is done during the year.

5.6 Project Timing

The project is expected to last for eleven years. It is expected to start in year one and end in year 11. Beekeeping starts in year one, and harvesting starts in year 2. The project is assumed to start operating and generating cash flow to honey farmers in year two up until year 10. The last year (year 11) is the year in which the project's assets are liquidated.

5.7 Cash Flow Statements

The financial analysis of the project provides cash flow statements from both the project owner's point of view and the total investment point of view. These cash flow statements are calculated using the details and assumptions contained in the preceding chapters. The results of these cash flow statements are used to assess the viability and sustainability of the honey project. An evaluation of the financial returns from the owner's perspective and the total investment perspective can be seen in sections 5.9 and 5.10, respectively.

5.8 Projects Owners Perspective

The cash flow statement, from an investor's point of view, contains both debt financing and debt servicing to calculate the return on equity net of debt financing. To calculate FNPV and FIRR, the cash inflows and outflows were all converted to real values.

[3] It is assumed that the annual increase of wage rate stay constant (growth level of 0 percent).

Using these calculations, FNPV and FIRR were derived, which shows the expected revenue inflow to investors. It is important to note that both forms of financing, which is debt and equity financing, is included in the calculations of the project cash flows, project owner's perspective. The aim of this is to ensure that the project can generate the needed cash flow available for debt service after all project expenses are paid off.

5.9 Total Investment Perspective

On the other hand, the cash flow statement from the total investment point of view excludes debt service and interest payments in its calculations to assess if the net cash flow from the project is enough to meet its debt obligations. Negative cash flows are realized in the base year for all scenarios. With the financial support from the loan, beekeepers will continue to produce honey successfully. It is expected that sales of honey would yield positive financial cash flows during the project's second year. These negative cash flows are the nominal product of the expenses incurred in the first year of the project, and operational cost is also incurred by beekeepers.

It is vital to ensure the net cash flow available for debt service (NCFADS) from which the debt coverage metrics can be measured. Cash receipts and expenditures are all calculated in nominal values, which is then used to derive the net cash flows of the project from the total investment point of view. The examination of this project shows that the net financial cash flows generated are positive, which means that the project's cash flow is enough for the ADSCR of the project and enough to service all debt obligations from the total investment perspective.

5.10 Financial Results Analysis

Table 2 contains the results of the analysis for the without project situation from the farmer's equity point of view. Table 3 reports on the results of the analysis for each of the alternative interventions. The detailed analysis table for the without project case and for the three alternative project scenarios are presented in tables 4,5,6,7, respectively.The subsequent sections describe the various assumptions and parameters used to derive project income and cash flow statements.

Table 2: Results of Financial Analysis Project Owner's Perspective Real, Without Intervention

Without The Project	FNPV (USD)	FIRR(ETB)	FIRR
	12,669	407	177%

Table 3: Financial Analysis Results from Owner's Perspective With Intervention Incremental (With – Without the Project)

Results (NPV)	Intervention A: Three Modern Beehive	Intervention B: Three Modern Beehive + Tools	Intervention C: Three Modern Beehive + Tools + Training
NPV (ETB)	8,009	11,971	19,392
NPV (USD)	258	385	624
IRR	55%	62%	107%

The incremental benefits of the honey project presented in table 3 for the three interventions show the summary of the financial benefits of the honey from the project owners' perspective for all three interventions. The results presented for intervention A (three modern beehives per beekeeper) is 8,009 ETB, intervention B (three modern beehive + tools per beekeeper) is 11,971 ETB, and intervention C (three modern beehive + tools + training per beekeeper) is 19,392 ETB. These incremental net present value benefits are what the farmers gain after all expenses incurred as a result of the project is paid off, including loan (principal + interest payment) over the life of the project. This present value benefits for the three interventions that show that the provision of three modern beehives + tools + training per beekeepers gives the highest incremental benefit of 19,392 ETB to farmers more than alternative interventions presented.

With 12% inflation rate and a fixed interest rate of 12% on loan, it means that the real rate of interest charged by the project sponsors on loan provided is equal to zero. This is a subsidy component in the loan made by the project sponsors.

From the FIRR viewpoint, the FIRR must be higher than the discount rate used in the project evaluation for the project to be considered financially profitable. Using a 12% real discount rate for all three interventions, the FIRR shows that all three interventions are profitable to the farmers. Still, the provision of three modern beehives + tools + training per beekeeper has the highest FIRR compared to alternative interventions presented.

Table 4: Real Cash Flow Statement Equity Point of View (Without Intervention)

			1	2	3	4	5	6	7	8	9	10	11
Reciepts													
Value for in house consumption from traditional beehives		ETB	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00
Value for in house consumption from modern beehives		ETB	-	-	-	-	-	-	-	-	-	-	-
Revenue from traditional beehives		ETB	2,840.00	2,840.00	2,840.00	2,840.00	2,840.00	2,840.00	2,840.00	2,840.00	2,840.00	2,840.00	2,840.00
Revenue from modern beehives		ETB	-	-	-	-	-	-	-	-	-	-	-
Liquidation Values													
Residual Value -Traditional Beehive (Real)		ETB	-	-	-	-	-	-	-	-	-	-	-
Total inflows		ETB	3,240.00	3,240.00	3,240.00	3,240.00	3,240.00	3,240.00	3,240.00	3,240.00	3,240.00	3,240.00	3,240.00
Expenditures													
Investment cost													
Traditional beehive		ETB	1,500.00	-	-	-	-	-	-	-	-	-	-
Beehive colony for traditional beehive		ETB	3,000.00	-	-	-	-	-	-	-	-	-	-
Service cost													
Beehive maintenance		ETB	-	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00
Labor Cost		ETB	146.88	146.88	146.88	146.88	146.88	146.88	146.88	146.88	146.88	146.88	146.88
Rental Value of Land		ETB	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60
Cost of beehive replacement due to ant attack		ETB	-	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00
Cost of bees colony replacement due to ant attack		ETB	-	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00
Total outflows		ETB	4,648.48	748.48	748.48	748.48	748.48	748.48	748.48	748.48	748.48	748.48	748.48
Net Cashflow		ETB	(1,408.48)	2,491.53	2,491.53	2,491.53	2,491.53	2,491.53	2,491.53	2,491.53	2,491.53	2,491.53	2,491.53
Net Cashflow USD		ETB	(45.29)	80.11	80.11	80.11	80.11	80.11	80.11	80.11	80.11	80.11	80.11
Real Financial Discount Rate	12%	%											
Net Present Value - FNPV (ETB)	**12,669**	ETB											
Net Present Value - FNPV (USD)	**407**	USD											
Internal Rate of Return-IRR	177%	%											

Table 5: Incremental Real Cash Flow Statement Equity Point of View with Intervention (Scenario 1)

			1	2	3	4	5	6	7	8	9	10	11
Value for in house consumption from traditional beehives		ETB	-	-	-	-	-	-	-	-	-	-	-
Value for in house consumption from modern beehives		ETB	-	-	-	-	-	-	-	-	-	-	-
Revenue from traditional beehives		ETB	-	-	-	-	-	-	-	-	-	-	-
Revenue from modern beehives		ETB	-	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00
Liquidation Values													
Residual Value -Traditional Beehive (Real)		ETB	-	-	-	-	-	-	-	-	-	-	-
Residual Value - Input Requirement (Real)		ETB	-	-	-	-	-	-	-	-	-	-	2,700
Residual Value - Modern Beehive (Real)		ETB	-	-	-	-	-	-	-	-	-	-	733
Residual Value - Bee Colony (Real)		ETB	-	-	-	-	-	-	-	-	-	-	-
Loans													
Subsidized loan inflow		ETB	3,888	-	-	-	-	-	-	-	-	-	-
Total inflow		ETB	3,888.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	6,433.33
Expenditures													
Investment cost													
Traditional Beehive		ETB	-	-	-	-	-	-	-	-	-	-	-
Beehive Colony for traditional beehive		ETB	-	-	-	-	-	-	-	-	-	-	-
Modern Beehive		ETB	3,300.00	-	-	-	-	-	-	-	-	-	-
Bee Colony for modern beehives		ETB	2,100.00	-	-	-	-	-	-	-	-	-	-
Queen Excluder		ETB	-	-	-	-	-	-	-	-	-	-	-
Wax		ETB	-	-	-	-	-	-	-	-	-	-	-
Smoker		ETB	-	-	-	-	-	-	-	-	-	-	-
Overall Coat		ETB	-	-	-	-	-	-	-	-	-	-	-
Veil		ETB	-	-	-	-	-	-	-	-	-	-	-
Glove		ETB	-	-	-	-	-	-	-	-	-	-	-
Extractor		ETB	-	-	-	-	-	-	-	-	-	-	-
Wax Mould		ETB	-	-	-	-	-	-	-	-	-	-	-
Bee forage seeding		ETB	-	-	-	-	-	-	-	-	-	-	-
Plastic Honey Container		ETB	-	-	-	-	-	-	-	-	-	-	-
Service cost													
Beehive maintenance		ETB	-	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00
Labor Cost		ETB	526.88	526.88	526.88	526.88	526.88	526.88	526.88	526.88	526.88	526.88	526.88
Rental Value of Land		ETB	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Cost of beehive replacement due to ant attack		ETB	-	-	-	-	-	-	-	-	-	-	-
Cost of bees colony replacement due to ant attack		ETB	-	-	-	-	-	-	-	-	-	-	-
Subsidized loan service		ETB	-	1,573.71	1,281.12	1,033.16	-	-	-	-	-	-	-
Total outflows		ETB	5,927.68	2,431.39	2,138.80	1,890.84	857.68	857.68	857.68	857.68	857.68	857.68	857.68
Net Cashflow		ETB	(2,039.68)	568.61	861.20	1,109.16	2,142.33	2,142.33	2,142.33	2,142.33	2,142.33	2,142.33	5,575.66
Net Cashflow USD		USD	(65.58)	18.28	27.69	35.66	68.89	68.89	68.89	68.89	68.89	68.89	179.28

Real Financial Discount Rate	12%	%
Net Present Value - FNPV (ETB)	8,009	ETB
Net Present Value - FNPV (USD)	258	USD
Internal Rate of Return-IRR	55%	

Table 6: Incremental Real Cash Flow Statement Equity Point of View with Intervention (Scenario 2)

			1	2	3	4	5	6	7	8	9	10	11
Value for in house consumption from traditional beehives		ETB	-	-	-	-	-	-	-	-	-	-	-
Value for in house consumption from modern beehives		ETB	-	-	-	-	-	-	-	-	-	-	-
Revenue from traditional beehives		ETB	-	-	-	-	-	-	-	-	-	-	-
Revenue from modern beehives		ETB	-	3,960.00	3,960.00	3,960.00	3,960.00	3,960.00	3,960.00	3,960.00	3,960.00	3,960.00	3,960.00
Liquidation Values													
Residual Value -Traditional Beehive (Real)		ETB	-	-	-	-	-	-	-	-	-	-	-
Residual Value - Input Requirement (Real)		ETB	-	-	-	-	-	-	-	-	-	-	3,738
Residual Value - Modern Beehive (Real)		ETB	-	-	-	-	-	-	-	-	-	-	733
Residual Value - Bee Colony (Real)		ETB	-	-	-	-	-	-	-	-	-	-	-
Loans													
Subsidized loan inflow		ETB	5,382	-	-	-	-	-	-	-	-	-	-
Total inflow		ETB	**5,382.00**	**3,960.00**	**3,960.00**	**3,960.00**	**3,960.00**	**3,960.00**	**3,960.00**	**3,960.00**	**3,960.00**	**3,960.00**	**8,430.83**
Expenditures													
Investment cost													
Traditional Beehive		ETB	-	-	-	-	-	-	-	-	-	-	-
Beehive Colony for traditional beehive		ETB	-	-	-	-	-	-	-	-	-	-	-
Modern Beehive		ETB	3,300.00	-	-	-	-	-	-	-	-	-	-
Bee Colony for modern beehives		ETB	2,100.00	-	-	-	-	-	-	-	-	-	-
Queen Excluder		ETB	330.00	-	-	-	-	-	-	-	-	-	-
Wax		ETB	675.00	-	-	-	-	-	-	-	-	-	-
Smoker		ETB	140.00	-	-	-	-	-	-	-	-	-	-
Overall Coat		ETB	150.00	-	-	-	-	-	-	-	-	-	-
Veil		ETB	90.00	-	-	-	-	-	-	-	-	-	-
Glove		ETB	80.00	-	-	-	-	-	-	-	-	-	-
Extractor		ETB	320.00	-	-	-	-	-	-	-	-	-	-
Wax Mould		ETB	150.00	-	-	-	-	-	-	-	-	-	-
Bee forage seeding		ETB	50.00	-	-	-	-	-	-	-	-	-	-
Plastic Honey Container		ETB	90.00	-	-	-	-	-	-	-	-	-	-
Service cost													
Beehive maintenance		ETB	-	**330.00**	**330.00**	**330.00**	**330.00**	**330.00**	**330.00**	**330.00**	**330.00**	**330.00**	**330.00**
Labor Cost		ETB	**526.88**	**526.88**	**526.88**	**526.88**	**526.88**	**526.88**	**526.88**	**526.88**	**526.88**	**526.88**	**526.88**
Rental Value of Land		ETB	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**
Cost of beehive replacement due to ant attack		ETB	-	-	-	-	-	-	-	-	-	-	-
Cost of bees colony replacement due to ant attack		ETB	-	-	-	-	-	-	-	-	-	-	-
Subsidized loan service		ETB	-	2,178.43	1,773.41	1,430.17	-	-	-	-	-	-	-
Total outflows		ETB	**8,002.68**	**3,036.10**	**2,631.08**	**2,287.84**	**857.68**	**857.68**	**857.68**	**857.68**	**857.68**	**857.68**	**857.68**
Net Cashflow		ETB	**(2,620.68)**	**923.90**	**1,328.92**	**1,672.16**	**3,102.33**	**3,102.33**	**3,102.33**	**3,102.33**	**3,102.33**	**3,102.33**	**7,573.16**
Net Cashflow USD		USD	**(84.27)**	**29.71**	**42.73**	**53.77**	**99.75**	**99.75**	**99.75**	**99.75**	**99.75**	**99.75**	**243.51**

Real Financial Discount Rate	12%	%
Net Present Value - FNPV (ETB)	**11,971**	ETB
Net Present Value - FNPV (USD)	**385**	USD
Internal Rate of Return-IRR	**62%**	

Table 7: Incremental Real Cash Flow Statement Equity Point of View with Intervention (Scenario 3)

			1	2	3	4	5	6	7	8	9	10	11
Value for in house consumption from traditional beehives		ETB	-	-	-	-	-	-	-	-	-	-	-
Value for in house consumption from modern beehives		ETB	-	-	-	-	-	-	-	-	-	-	-
Revenue from traditional beehives		ETB	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00	180.00
Revenue from modern beehives		ETB	-	5,016.00	5,016.00	5,016.00	5,016.00	5,016.00	5,016.00	5,016.00	5,016.00	5,016.00	5,016.00
Liquidation Values													
Residual Value -Traditional Beehive (Real)		ETB	-	-	-	-	-	-	-	-	-	-	-
Residual Value - Input Requirement (Real)		ETB	-	-	-	-	-	-	-	-	-	-	3,738
Residual Value - Modern Beehive (Real)		ETB	-	-	-	-	-	-	-	-	-	-	733
Residual Value - Bee Colony (Real)		ETB	-	-	-	-	-	-	-	-	-	-	-
Loans													
Subsidized loan inflow		ETB	5,382	-	-	-	-	-	-	-	-	-	-
Total inflow		ETB	**5,562.00**	**5,196.00**	**5,196.00**	**5,196.00**	**5,196.00**	**5,196.00**	**5,196.00**	**5,196.00**	**5,196.00**	**5,196.00**	**9,666.83**
Expenditures													
Investment cost													
Traditional Beehive		ETB	-	-	-	-	-	-	-	-	-	-	-
Beehive Colony for traditional beehive		ETB	-	-	-	-	-	-	-	-	-	-	-
Modern Beehive		ETB	3,300.00	-	-	-	-	-	-	-	-	-	-
Bee Colony for modern beehives		ETB	2,100.00	-	-	-	-	-	-	-	-	-	-
Queen Excluder		ETB	330.00	-	-	-	-	-	-	-	-	-	-
Wax		ETB	675.00	-	-	-	-	-	-	-	-	-	-
Smoker		ETB	140.00	-	-	-	-	-	-	-	-	-	-
Overall Coat		ETB	150.00	-	-	-	-	-	-	-	-	-	-
Veil		ETB	90.00	-	-	-	-	-	-	-	-	-	-
Glove		ETB	80.00	-	-	-	-	-	-	-	-	-	-
Extractor		ETB	320.00	-	-	-	-	-	-	-	-	-	-
Wax Mould		ETB	150.00	-	-	-	-	-	-	-	-	-	-
Bee forage seeding		ETB	50.00	-	-	-	-	-	-	-	-	-	-
Plastic Honey Container		ETB	90.00	-	-	-	-	-	-	-	-	-	-
Service cost													
Beehive maintenance		ETB	-	**330.00**	**330.00**	**330.00**	**330.00**	**330.00**	**330.00**	**330.00**	**330.00**	**330.00**	**330.00**
Labor Cost		ETB	**551.88**	**551.88**	**551.88**	**551.88**	**551.88**	**551.88**	**551.88**	**551.88**	**551.88**	**551.88**	**551.88**
Rental Value of Land		ETB	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**	**0.80**
Cost of beehive replacement due to ant attack		ETB	-	**(75.00)**	**(75.00)**	**(75.00)**	**(75.00)**	**(75.00)**	**(75.00)**	**(75.00)**	**(75.00)**	**(75.00)**	**(75.00)**
Cost of bees colony replacement due to ant attack		ETB	-	-	-	-	-	-	-	-	-	-	-
Subsidized loan service		ETB	-	2,178.43	1,773.41	1,430.17	-	-	-	-	-	-	-
Total outflows		ETB	**8,027.68**	**2,986.10**	**2,581.08**	**2,237.84**	**807.68**	**807.68**	**807.68**	**807.68**	**807.68**	**807.68**	**807.68**
Net Cashflow		ETB	**(2,465.68)**	**2,209.90**	**2,614.92**	**2,958.16**	**4,388.33**	**4,388.33**	**4,388.33**	**4,388.33**	**4,388.33**	**4,388.33**	**8,859.16**
Net Cashflow USD		USD	**(79.28)**	**71.06**	**84.08**	**95.12**	**141.10**	**141.10**	**141.10**	**141.10**	**141.10**	**141.10**	**284.86**

Real Financial Discount Rate	12%	%
Net Present Value - FNPV (ETB)	**19,392**	ETB
Net Present Value - FNPV (USD)	**624**	USD
Internal Rate of Return-IRR	**107%**	

5.11 Macro-Economic Parameters

The project is subject to a variety of external factors that can affect the project both positively and negatively. Macroeconomic variables are examples of such factors. Inflation (Domestic and foreign) and exchange are the two major macroeconomic factors most likely to have a direct impact on the project outcomes. At the time of this analysis, the national inflation rate was assumed to be 12 percent, while the foreign inflation rate was 2.5 percent. The real exchange rate is assumed to be at 31.1 ETB per unit of USD.

5.12 Rate of Return

The project's required rate of return is estimated to be 12%.

5.13 Financial Sensitivity Analysis

Sensitivity analysis is conducted due to the level of uncertainty that may arise in the future in project variables. These uncertainties could have particular implications and could have a significant effect on projects outcome. This analysis shows the project's success or failure if one parameter is altered. When adjustments are made on one variable at a time, it keeps other variables constant by separating the effect of that variable that has been adjusted. A financial variable such as honey price set by the international market can be subject to a high degree of volatility. The awareness of these project variables cannot be overemphasized to help deal with these uncertainties.

5.14 Investment Decision

For any project to be implemented, it should be financially feasible and attractive, especially to the project owners. From the project owner's point of view and the total investment point of view shows that the results of the financial analysis cash flow statement discussed in the different sections of the honey project are profitable and feasible for honey farmers in Ethiopia and the AGP-AMDE program.

All the interventions prove to be profitable and feasible. Still, intervention C, which is the provision of three modern beehives + tools + training per beekeeper, provides the maximum FNPV and FIRR compared to intervention A (the provision of three modern beehives per beekeeper) and intervention B (the provision of three modern beehives + tools).

The financial analysis of the honey project shows that the provision of three modern beehives + tools + training (Intervention C) is a profitable strategy, and it should be

implemented for the improvement of the honey sector in Ethiopia.

Providing the highest FNPV of 19,392 ETB, the honey farmer's benefits more than alternative interventions proposed. The provision of three modern beehives + tools + training per beekeeper also provides the highest ADSCR. Such high ADSCRs suggest that beekeepers will be able to repay their loans after all other expenses have been paid. The ADSCRs for all interventions are presented in tables 8, 9, and 10, respectively, for all three interventions.

Table 8: Annual Debt Service Coverage Ratio, Total Investment Point of View With Intervention (Intervention 1)

		1	2	3	4	5	6	7	8	9	10	11
Net cash flow Available for Debt Service (Nominal)	ETB	(7,336.15)	5,189.91	5,812.70	6,510.23	7,291.45	8,166.43	9,146.40	10,243.97	11,473.24	12,850.03	25,055.45
Nominal DEBT repayment obligation for subsidized loan	ETB	-	1,763	1,607	1,452	-	-	-	-	-	-	-
Annual DEBT service coverage ratio (ADSCR)	ETB	-	2.94	3.62	4.49	-	-	-	-	-	-	-

Table 9: Annual Debt Service Coverage Ratio, Total Investment Point of View With Intervention (Intervention 2)

		1	2	3	4	5	6	7	8	9	10	11
Net cash flow Available for Debt Service (Nominal)	ETB	(9,411.15)	6,265.11	7,016.93	7,858.96	8,802.03	9,858.28	11,041.27	12,366.22	13,850.17	15,512.19	31,259.38
Nominal DEBT repayment obligation for subsidized loan	ETB	-	2,440	2,225	2,009	-	-	-	-	-	-	-
Annual DEBT service coverage ratio (ADSCR)	ETB	-	2.57	3.15	3.91	-	-	-	-	-	-	-

Table 10: Annual Debt Service Coverage Ratio, Total Investment Point of View With Intervention (Intervention 3)

		1	2	3	4	5	6	7	8	9	10	11
Net cash flow Available for Debt Service (Nominal)	ETB	(9,256.15)	7,873.43	8,818.24	9,876.43	11,061.61	12,389.00	13,875.68	15,540.76	17,405.65	19,494.33	35,719.38
Nominal DEBT repayment obligation for subsidized loan	ETB	-	2,440	2,225	2,009	-	-	-	-	-	-	-
Annual DEBT service coverage ratio (ADSCR)	ETB	-	3.23	3.96	4.92	-	-	-	-	-	-	-

6 ECONOMIC ANALYSIS

Unlike the financial analysis which only evaluates the net benefit to only one entity, for example, beekeepers, the economic analysis measures the overall social gain to the economy. The proposed interventions were intended to increase the quality and quantity of supply, this would, in turn, encourage domestic production in the Ethiopian honey value chain and possible exports. The fundamental purpose of the economic analysis presented in this study is to assess the net marginal gain to beekeepers and the economy.

A project may be financially weak, and yet it might produce a favourable net economic

benefit. For such a scenario, the economic analysis would offer facts to persuade decision-makers, to give additional financial benefits and provide incentives to stakeholders. Also, a project with negative economic returns can still be financially enticing, particularly in the presence of budgetary subsidies, government grants and investor financing. In the absence of economic analysis, projects may be carried out regardless of the negative impact they will have on the economy as a whole.

By integrating honey into its AGP-AMDE initiative, USAID directly aims to boost the quantity and efficiency of the honey sector in Ethiopia. The result aims to satisfy the domestic supply requirements as well as to increase the honey export prospects of the country. In this project, the USAID plans to:

i. Boost financial exposure of local farmers, which includes hunger and poverty reduction.
ii. Strengthen honey market productivity and competitiveness.
iii. Provide the appropriate instruments and skills of modern beekeeping practices and,
iv. Develop a suitable climate for forage and honey beekeeping.

With new strategies, Ethiopia should be able to meet the domestic supply of quality honey as well as improve its honey export capacities. For the AGP-AMDE to achieve this, three different strategies were proposed. The different strategies include;

i. The provision of three modern beehives per beekeeper.
ii. The provision of three modern beehives plus tools per beekeeper and,
iii. The provision of three modern beehives, tools training per beekeeper.

The aim of the AGP-AMDE program is for the honey project to generate benefits to the honey farmers if the project is implemented.

Other benefits enjoyed as a result of the honey project comes from the increase in the sale of quality honey to both local and the international market. An increase in honey sale benefits not only local farmers but also the Ethiopian economy as a whole this is due to the inflow of foreign exchange to the economy.

6.1 Economic Assumptions

An estimation of the distortions in tradable commodities in Ethiopia shows that the value of the foreign exchange premium (FEP) is 6.64%, and the shadow price of non-tradable outlay (SPINTO) is valued at -0.24% (Jenkins, Kuo, & Salci, 2013). The Ethiopian Economic Opportunity Cost of Capital (EOCK) is estimated to be 12 percent, and the standard VAT in Ethiopia is 15 percent. The rate of customs duties used for primary, transitional and finished goods is 5 percent, 10 percent and 20 percent, respectively. These are the input assumptions and the economic analysis parameters used in the economic analysis of the honey project.

6.2 Tradable and Non-Tradable Goods and Services

Goods or services are considered tradable if the increase in demand or supply from the project does not change the amount demanded or supplied by other domestic consumers (producers). Tradable goods and services can be either importable or exportable goods or services. For importable goods that are demanded by the project are usually distorted in the market and are subject to non-traded service costs, which need to be adjusted in the economic evaluation. These costs include the cost of handling from the port to the project site. Demanding more importable goods by the project will be measured based on the increase in demand for foreign exchange by the project.

Likewise, exportable goods include goods and services that their financial value is determined by the world market. Exportable goods and services that are demanded by the project from the export market can also be used as an input by the project. If the project demands an exportable good as an input, then its financial value will need to be adjusted in the foreign exchange premium, and the economic evaluation for distortions such as value-added tax and excise tax should also be adjusted. Demanding more exportable goods by the project will be measured based on the economic value of foreign exchange forgone. All importable and exportable goods should be considered as tradable goods. The tradable items used by the honey project include; honey extractor, plastic honey containers, overall coat, and gloves, which are all importable project inputs.

Non-traded goods are goods that are not internationally traded. When the price of a good is not determined by the world market, but only in the domestic market for the

item, then it should be considered a non-tradable good. Also, if no import or export of the commodity is taking place, then it is conceded a non-tradable good. Non-traded goods can be considered as goods that are produced and consumed in the domestic market. The economic values of these goods used by the project as inputs or outputs depends on the demand and supply for these items.

6.3 Commodity Specific-Conversion Factor (CF)

The economic conversion factor is the ratio of the economic value to its financial price. Conversion factors are essential in performing economic analysis and contribute to the switch from financial analysis to economic analysis. The switch from financial analysis to economic analysis demands that financial values be converted into economic values. Due to the presence of various taxes, tariffs, subsidies and foreign exchange premiums, the financial prices of some goods are distorted. It means that the first step in conducting economic analysis is to turn financial values into economic values, therefore. The CSCFs of each project cash flow factor is calculated and used to produce resource flow statements for projects[4].

Table 11: The Conversion Factors (CF) Calculated and Used the Economic Analysis of the Honey Project

ITEMS	CONVERSION FACTORS
Honey	1.11
Traditional Beehive	1.00
Modern Beehive	0.76
Bee Colony	1.00
Queen Excluder	0.85
Wax	1.07
Smoker	1.05
Overall Coat	0.81
Vail	0.85
Glove	0.89
Extractor	0.88
Wax Molder	1.00
Plastic Honey Container	0.81
Beehive Maintenance	1.00
The rental value of land	1.00
Replacement cost for Traditional Beehive and Bee Colony	0.85
Liquidation Value – Other Inputs	0.88
Unskilled Labor	0.85

[4] A conversion factor is defined as the ratio of a commodity's economic price to its financial price. The CF can be calculated and expressed as: $CF_i = EP_i / FP_i = (1+ FEP)/[(1 + t_i)(1 + d_i)]$

The estimation of the conversion factors are detailed in appendix 2. Economic values are derived by multiplying financial values with the calculated conversion factors. It is demonstrated as follows;

*Financial value (project input or output) * CSCF=Economic value (project input or output).*

Customs duty and value-added tax (VAT) are part of the financial price of the tradable items used in the project, but the financial price does not include the foreign exchange premium (FEP). The FEP is taken into account when all distortions are removed.

In the case of non-tradable items, their economic value requires a non-tradable outlay premium (SPNTO). A conversion factor of less than one is often obtained for non-tradable inputs, which means that their financial prices are higher than their economic values. In the case of labor, income tax, discrepancies between project wages, and other wages are labor-related distortions. Labor is also one of the inputs used in the economic analysis of the honey project.

6.4 Economic Resource Flow Statement

The conversion factors displayed in table 11 were used in the calculation of the economic cash flow statement of the honey project. Economic cash flow estimates for project scenarios 'without' and 'with' are derived by converting expenditure and receipts from financial cash flows to their relative economic costs and benefits. It is done by multiplying annual financial expenditure and receipts by their respective conversion factors.

The incremental resource flow statement describes the total costs and benefits of the project from the viewpoint of society as a whole. It is used to quantify the metrics used to assess the economic feasibility and sustainability of the project. The incremental resource flow statement is extracted by subtracting the resource flow statement of the "without" from the "with." Project resource flow statement. The economic resource flow statement in real values is presented in table 13, and table 14 shows the statement of economic externalities in real values. All results displayed in this analysis is based on intervention C, which is the provision of three modern beehives + tools + training per beekeeper.

Table 12: Economic Resource Flow Statement, Real ETB (Incremental With- Without Intervention)

Line Items												
Value for in house consumption from traditional beehives	1.11	ETB	-	-	-	-	-	-	-	-	-	-	-
Value for in house consumption from modern beehives	1.11	ETB	-	-	-	-	-	-	-	-	-	-	-
Revenue from traditional beehives	1.11	ETB	199.06	199.06	199.06	199.06	199.06	199.06	199.06	199.06	199.06	199.06	199.06
Revenue from modern beehives	1.11	ETB	-	5,547.05	5,547.05	5,547.05	5,547.05	5,547.05	5,547.05	5,547.05	5,547.05	5,547.05	5,547.05
Liquidation Values													
Residual Value -Traditional Beehive (Real)	1.00	ETB	-	-	-	-	-	-	-	-	-	-	-
Residual Value - Input Requirement (Real)	0.88	ETB	-	-	-	-	-	-	-	-	-	-	3,293.26
Residual Value - Modern Beehive (Real)	0.76	ETB	-	-	-	-	-	-	-	-	-	-	559.01
Residual Value - Bee Colony (Real)	1.00	ETB	-	-	-	-	-	-	-	-	-	-	-
Loans													
Subsidized loan inflow	-	ETB	-	-	-	-	-	-	-	-	-	-	-
Total Inflows		ETB	**199.06**	**5,746.11**	**5,746.11**	**5,746.11**	**5,746.11**	**5,746.11**	**5,746.11**	**5,746.11**	**5,746.11**	**5,746.11**	**9,598.38**
Investment Costs													
Traditional Beehive	1.00	ETB	-	-	-	-	-	-	-	-	-	-	-
Beehive Colony for traditional beehive	1.00	ETB	-	-	-	-	-	-	-	-	-	-	-
Modern Beehive	0.76	ETB	2,515.53	-	-	-	-	-	-	-	-	-	-
Bee Colony for modern beehives	1.00	ETB	2,100.00	-	-	-	-	-	-	-	-	-	-
Queen Excluder	0.85	ETB	280.50	-	-	-	-	-	-	-	-	-	-
Wax	1.07	ETB	720.19	-	-	-	-	-	-	-	-	-	-
Smoker	1.05	ETB	146.65	-	-	-	-	-	-	-	-	-	-
Overall Coat	0.81	ETB	121.78	-	-	-	-	-	-	-	-	-	-
Veil	0.85	ETB	76.50	-	-	-	-	-	-	-	-	-	-
Glove	0.89	ETB	70.82	-	-	-	-	-	-	-	-	-	-
Extractor	0.88	ETB	283.15	-	-	-	-	-	-	-	-	-	-
Wax Mould	1.00	ETB	150.00	-	-	-	-	-	-	-	-	-	-
Bee forage seeding	0.85	ETB	42.50	-	-	-	-	-	-	-	-	-	-
Plastic Honey Container	0.81	ETB	73.20	-	-	-	-	-	-	-	-	-	-
Services Costs													
Beehive maintenance	1.00	ETB	-	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00
Labor Cost	0.85	ETB	469.09	469.09	469.09	469.09	469.09	469.09	469.09	469.09	469.09	469.09	469.09
Rental Value of Land	1.00	ETB	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Cost of bees colony replacement due to ant attack	0.85	ETB	-	(63.75)	(63.75)	(63.75)	(63.75)	(63.75)	(63.75)	(63.75)	(63.75)	(63.75)	(63.75)
Cost of beehive replacement due to ant attack	0.85	ETB	-	-	-	-	-	-	-	-	-	-	-
Subsidized loan service	-	ETB	-	-	-	-	-	-	-	-	-	-	-
Total Outflows		ETB	**7,050.72**	**736.14**	**736.14**	**736.14**	**736.14**	**736.14**	**736.14**	**736.14**	**736.14**	**736.14**	**736.14**
Net Resource Flow		ETB	**(6,851.66)**	**5,009.96**	**5,009.96**	**5,009.96**	**5,009.96**	**5,009.96**	**5,009.96**	**5,009.96**	**5,009.96**	**5,009.96**	**8,862.23**
Net Resource Flow, real USD		USD	**(220.31)**	**161.09**	**161.09**	**161.09**	**161.09**	**161.09**	**161.09**	**161.09**	**161.09**	**161.09**	**284.96**

Real Economic Discount Rate	12%	%
Net Present Value - ENPV (ETB)	**22,696**	ETB
Net Present Value - ENPV (USD)	**730**	USD
Internal Rate of Return-EIRR (ETB)	**73%**	%

Table 13: Statement of Economic Externalities, Real ETB (Incremental With-Without Intervention)

Line Items			1	2	3	4	5	6	7	8	9	10	11
Value for in house consumption from traditional beehives		ETB	-	-	-	-	-	-	-	-	-	-	-
Value for in house consumption from modern beehives		ETB	-	-	-	-	-	-	-	-	-	-	-
Revenue from traditional beehives		ETB	19.06	19.06	19.06	19.06	19.06	19.06	19.06	19.06	19.06	19.06	19.06
Revenue from modern beehives		ETB	-	531.05	531.05	531.05	531.05	531.05	531.05	531.05	531.05	531.05	531.05
Liquidation Values													
Residual Value -Traditional Beehive (Real)		ETB	-	-	-	-	-	-	-	-	-	-	-
Residual Value - Input Requirement (Real)		ETB	-	-	-	-	-	-	-	-	-	-	(444.24)
Residual Value - Modern Beehive (Real)		ETB	-	-	-	-	-	-	-	-	-	-	(174.33)
Residual Value - Bee Colony (Real)		ETB	-	-	-	-	-	-	-	-	-	-	-
Loans													
Subsidized loan inflow		ETB	(5,382.00)	-	-	-	-	-	-	-	-	-	-
Total Inflows		ETB	(5,362.94)	550.11	550.11	550.11	550.11	550.11	550.11	550.11	550.11	550.11	(68.46)
Investment Costs:													
Traditional Beehive		ETB	-	-	-	-	-	-	-	-	-	-	-
Beehive Colony for traditional beehive		ETB	-	-	-	-	-	-	-	-	-	-	-
Modern Beehive		ETB	(784.47)	-	-	-	-	-	-	-	-	-	-
Bee Colony for modern beehives		ETB	-	-	-	-	-	-	-	-	-	-	-
Queen Excluder		ETB	(49.50)	-	-	-	-	-	-	-	-	-	-
Wax		ETB	45.19	-	-	-	-	-	-	-	-	-	-
Smoker		ETB	6.65	-	-	-	-	-	-	-	-	-	-
Overall Coat		ETB	(28.22)	-	-	-	-	-	-	-	-	-	-
Veil		ETB	(13.50)	-	-	-	-	-	-	-	-	-	-
Glove		ETB	(9.18)	-	-	-	-	-	-	-	-	-	-
Extractor		ETB	(36.85)	-	-	-	-	-	-	-	-	-	-
Wax Mould		ETB	-	-	-	-	-	-	-	-	-	-	-
Bee forage seeding		ETB	(7.50)	-	-	-	-	-	-	-	-	-	-
Plastic Honey Container		ETB	(16.80)	-	-	-	-	-	-	-	-	-	-
Services Costs:													
Beehive maintenance		ETB	-	-	-	-	-	-	-	-	-	-	-
Labor Cost		ETB	(82.78)	(82.78)	(82.78)	(82.78)	(82.78)	(82.78)	(82.78)	(82.78)	(82.78)	(82.78)	(82.78)
Rental Value of Land		ETB	-	-	-	-	-	-	-	-	-	-	-
Cost of bees colony replacement due to ant attack		ETB	-	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25
Cost of beehive replacement due to ant attack		ETB	-	-	-	-	-	-	-	-	-	-	-
Subsidized Loan DEBT Service		ETB	-	(2,178.43)	(1,773.41)	(1,430.17)	-	-	-	-	-	-	-
Total Outflows		ETB	(867.25)	(2,249.96)	(1,844.94)	(1,501.70)	(71.53)	(71.53)	(71.53)	(71.53)	(71.53)	(71.53)	(71.53)
Net Resource Flow		ETB	(4,495.69)	2,800.07	2,395.04	2,051.80	621.64	621.64	621.64	621.64	621.64	621.64	3.07
Net Resource Flow, real USD		ETB	(141.03)	90.03	77.01	65.97	19.99	19.99	19.99	19.99	19.99	19.99	0.10
Real Economic Discount Rate	12%	%											
Net Present Value of Net Cash flows - ENPV (ETB)	**3,194**	ETB											
Net Present Value of Net Cash flows - ENPV (USD)	**106**	USD											

6.5 Economic Benefit of the Project

The economic net present value (ENPV) measures the change in economic wealth created by the project. Only a project with an attractive NPV and is economically beneficial to society should be approved for implementation. Positive economic NPV indicates that the projects expected benefits outweigh the negative cost to society. The present value of cost is deducted from the present value of the net profit, which is used in calculating the ENPV of the honey project. The overall budget allocated by USAID for the development of the honey sector in Ethiopia is 248,000 ETB. Consequently, if the project is implemented, it would contribute significantly to the overall economic development of society.

For any of the measures suggested, the economic NPV values are optimistic, with the highest NPV values reported in intervention 3 (Three modern beehive + tools + training per beekeeper). These results suggest that all the suggested interventions would support the economy, which will result in significant volumes of honey exports, an increase in farmer's income and an increase in the Ethiopian GDP.

With the project, honey yields have significantly improved, causing the net benefit to increase for all interventions in local and foreign currency. Honey farmers benefit both in skills and income from the different proposed interventions. Table 15 presents the summary of the real, incremental resource flow statement from the economy point of view.

Table 14: Summary of the Real Incremental Resource Flow Statement, Economic Point of View

Interventions	**ENPV (ETB)**	**ENPV (USD)**
Intervention A: Three Modern beehives per beekeeper	10,228	329
Intervention B: Three modern beehives + Tools per beekeeper	14,555	468
Intervention C: Three modern beehives + Tools + Training per beekeeper	22,696	730

The real incremental resource flow statement, economic point of view shows that society is better off with the honey project. All the interventions prove to be economically profitable, with all the intervention proving to be profitable, the provision of three modern beehives + tools + training per beehive proves to be the most profitable strategy and has the highest benefit of 22,696 ETB to the economy. If the inflation rate is 12% and the fixed interest rate on loan is also 12%, it means that the real rate of interest charged by the project sponsors on loan is equal to zero. This is considered as a subsidy component of the loan made by the project sponsors. With a positive Economic NPV for all proposed interventions, the honey project shows that society is better off.

7. STAKEHOLDERS ANALYSIS

Stakeholder analysis is an essential part of the Integrated Investment Approach, which is used to assess whether the beneficiaries of the project are gainers or losers. Stakeholder analysis does not only identify the gainers and losers of a project but also measures how much these gainers and losers are impacted. Such impacts are referred to as externalities, which is the difference between what a project's winners earn and what project's loser's loss. These externalities are in the form of tariffs, taxes, sales, subsidies, and excise tax.

People who are affected positively or negatively by a project are called project stakeholders. A positive NPV increases the wealth of stakeholders, and from a countries perspective, it increases the net wealth of a country. It assumes that the project cash flow calculates the net income to the business as a whole and that the capital flow statement calculates the project's net profit to the project's shareholders.

Stakeholders in the honey project include;

1. Beekeepers
2. Honey traders and wholesalers
3. The Ethiopian government, and
4. USAID

7.2 Project Externalities

The honey project was designed to improve the honey sector in Ethiopia by providing three different strategies that will help to achieve this purpose. The strategies suggested

include the following;

i. Three modern beehives per beekeeper.
ii. Three modern beehives + tools per beekeeper.
iii. Three modern beehives + tools + training per beekeeper.

The USAID investment in the honey sector amounts to 248,000.00 ETB, with a 12 percent interest rate on investment. Introducing the honey project, the Ethiopian government would gain from the improved revenue inflows related to the increase in the honey production and sales volume in which honey dealers and wholesalers will pay tax on the gains they earn to the Ethiopian government. The honey project expenditure is a cost to the USAID but a financial gain to the beekeepers.

By implementing the honey project and implementing the various interventions to increase the amount of honey produced, tax revenue would increase, benefiting the Ethiopian government. Taxed inputs such as wooden boxes, management tools and overall coat also improve the government's net benefits. Most of these benefits come from the foreign exchange premium. Wholesalers and honey traders benefit from the increase in the honey sale; also, project farmers benefit from increased employment and income as a result of cash inflows from the project. Table 15 presents a summary of the real incremental statement of economic externalities.

Table 15: Summary of Real Incremental Statement of Economic Externalities

Interventions	ENPV (ETB)	ENPV (USD)
Intervention A: Three Modern beehives per beekeeper	2,219	71
Intervention B: Three modern beehives + Tools per beekeeper	2,474	83
Intervention C: Three modern beehives + Tools + Training per beekeeper	3,194	106

The table of externalities shows the net benefit of the project to the economy as a whole as a result of the externalities created by the project. These externalities may be taxes, subsidies, and changes in producers and consumer surplus. The externalities created

as a result of undertaking intervention A (three modern beehives per beekeeper) is 2,219 ETB, and the externalities created by intervention B (three modern beehives + tools) is 2,474 ETB. The externalities created by intervention C (three modern beehives + tools + raining) is 3,194 ETB. The result presented shows that the provision of three modern beehives + tools + training increase the net wealth of the society as a result of the externalities it creates.

The reconciliation of the honey project is presented in Table 16, which shows the net benefit of the honey project to the economy. Based on the fact that the economic value of an item is equal to its financial value + the externalities generated by the item. This means that using the same discount rate, the economic NPV of a project should be = financial net present value + net present value of externalities.5 The financial net present value of the honey project + the externalities generated by the project should be equal to the economic net present value to be considered as an economically profitable project using the same discount rate.

[5] NPV Economic= NPV financial + PV(∑Externalities)

Table 16: Reconciliation Between Financial, Economic and Stakeholders Statements in Present Values, Real (EBT) To the Economy

Total Inflows	**FINANCIAL NPV**	**EXTERNALITIES NPV**	**FINANCIAL NPV + EXTERNALITIES NPV**	**ECOMOMIC NPV**	**CHECK**
Value for in house consumption from traditional beehives	-	-	-	-	-
Value for in house consumption from modern beehives	-	-	-	-	-
Revenue from traditional beehives	1,197.04	126.73	1,323.77	1,323.77	-
Revenue from modern beehives	28,341.52	3,000.55	31,342.07	31,342.07	-
Liquidation Values					
Residual Value -Traditional Beehive (Real)	-	-	-	-	-
Residual Value - Input Requirement (Real)	1,203.37	(143.03)	1,060.34	1,060.34	-
Residual Value - Modern Beehive (Real)	236.11	(56.13)	180.0	179.98	-
Residual Value - Bee Colony (Real)	-	-	-	-	-
Loans					
Subsidized loan inflow	5,382.00	(5,382.00)	-	-	-
Total	**36,360**	**(2,454)**	**33,906**	**33,906**	**-**
Total Outflows					
Investment Costs:					
Traditional Beehive	-	-	-	-	-
Beehive Colony for traditional beehive	-	-	-	-	-
Modern Beehive	3,300.00	(784.47)	2,515.53	2,515.53	-
Bee Colony for modern beehives	2,100.00	-	2,100.00	2,100.00	-
Queen Excluder	330.00	(49.50)	280.50	280.50	-
Wax	675.00	45.19	720.19	720.19	-
Smoker	140.00	6.65	146.65	146.65	-
Overall Coat	150.00	(28.22)	121.78	121.78	-
Veil	90.00	(13.50)	76.50	76.50	-
Glove	80.00	(9.18)	70.82	70.82	-
Extractor	320.00	(36.85)	283.15	283.15	-
Wax Mould	150.00	-	150.00	150.00	-
Bee forage seeding	50.00	(7.50)	42.50	42.50	-
Plastic Honey Container	90.00	(16.80)	73.20	73.20	-
Services Costs:					
Beehive maintenance	1,864.57	-	1,864.57	1,864.57	-
Labor Cost	3,670.09	(550.51)	3,119.58	3,119.58	-
Rental Value of Land	5.32	-	5.32	5.32	-
Cost of bees colony replacement due to ant attack	(423.77)	63.57	(360.20)	(360.20)	-
Cost of beehive replacement due to ant attack	-	-	-	-	-
Subsidized Loan DEBT Service	4,376.74	(4,376.74)	-	-	-
Total Outflows	**16,968**	**(5,758)**	**11,210**	**11,210**	**-**
Net Cash Flows	**19,392**	**3,304**	**22,696**	**22,696**	**-**
Net Cash Flows, real USD	**624**	**106**	**730**	**730**	**-**

7.3 Distributive Analysis

Who are the beneficiaries of a project, and by how much do they benefit? Who are the sponsors of a project, and what is the size of their investment? These are questions often asked by a distributive analysis of a project. The net externalities flow reflects the sum of both the negative and positive effects of the project on all stakeholders. This analysis combines both financial, economic and distributive analysis to assess the impact of the project on poverty reduction. The distributive analysis of project externalities is illustrated in Table 17 for scenario3. It shows the specific winners and losers of the project and who all honey project stakeholders are and how much they benefit or lose, and by what amount. The (32) ETB represents the economic opportunity cost of the resources transferred to the project by the project sponsors through the low interest loan to the project.

Table 17: Distributive Analysis Real (ETB)

Line Items	EXTERNALITIES @ EOCK	GOVERNMENT	LABOUR	FINANCING CONTRIBUTION
Value for in house consumption from traditional beehives	-	-		
Value for in house consumption from modern beehives	-	-		
Revenue from traditional beehives	-	-		
Revenue from modern beehives	2,369	2,369		
Liquidation Values				
Residual Value -Traditional Beehive (Real)	-	-		
Residual Value - Input Requirement (Real)	(143)	(143)		
Residual Value - Modern Beehive (Real)	(56)	(56)		
Residual Value - Bee Colony (Real)	-	-		
Loans				
Subsidized loan inflow	(5,382)			(5,382)
Total Inflows	**(3,212)**	**2,170**	-	**(5,382)**
Investment Costs:				
Traditional Beehive	-	-		
Beehive Colony for traditional beehive	-	-		
Modern Beehive	(784)	(784)		
Bee Colony for modern beehives	-	-		
Queen Excluder	(50)	(50)		
Wax	45	45		
Smoker	7	7		
Overall Coat	(28)	(28)		
Veil	(14)	(14)		
Glove	(9)	(9)		
Extractor	(37)	(37)		
Wax Mould	-	-		
Bee forage seeding	(8)	(8)		
Plastic Honey Container	(17)	(17)		
Services Costs:				
Beehive maintenance	-	-		
Labor Cost	(526)		(526)	
Rental Value of Land	-	-		
Cost of bees colony replacement due to ant attack	-	-		
Cost of beehive replacement due to ant attack	-	-		
Subsidized Loan DEBT Service	(4,377)			(4,377)
Total Outflows	**(5,796)**	**(894)**	**(526)**	**(4,377)**
Net Cash Flows	**2,584**	**3,064**	**526**	**(1,005)**
Net Cash Flows, real USD	**83**	**99**	**17**	**(32)**

In summary, the ENPV refers to the sum of the FNPV and Externalities. The overall economic value of the intervention-related profits of the households is equal to the number of FNPV + labor Externalities.

The highest gainers of the honey project are the beekeepers, with a net gain of 19,392 ETB. This gain comes as a result of the increase in honey production and sale of quality honey to wholesalers and honey traders, which sold in the domestic market and also exported to the international market.

The government of Ethiopia are also gainers of the honey project, with a net gain of 3,759 ETB. This benefit accrues from the inflow of tax from the inputs used by the project. Also, tax paid by wholesalers and honey traders contributes to the net benefit that is enjoyed by the Ethiopian government.

Day laborers are receiving a net positive benefit of 551 ETB more than their alternative earnings from other jobs. Externalities at the labor level occur since the estimated financial wages used in the analysis are lower than actual real labor costs. For example, the overall economic value of retained family labor wages gained is
673.75 ETB. The summary of the net benefit of the project to significant stakeholders can be seen below in table 18.

Table 18: Summary of the Net Benefit to Major Project Stakeholders

STAKEHOLDERS	**BENEFITS**
Beekeepers	19,392
Government	3,759
Labor	551

8. SENSITIVITY ANALYSIS

Sensitivity analysis seeks to calculate the sensitivity of project parameters that are of great significance in the model. Concerning the common assumption that potential costs and benefits are known to a high degree of certainty, one value estimates were calculated for the cost or benefits of the honey project's financial and economic analysis. Nevertheless, primary project variables used in the estimation of costs and benefits are prone to a high degree of risk.

Since project benefits are spread over time, some of the critical variables are subject to change. That is why for the sensitivity test to be fair enough, the intensity of the potential fluctuations of the measured parameter must be calculated first. For this analysis to obtain practical and useful results, it is crucial to consider potential uncertainties and variations in the values of the input and output variables. Sensitivity analysis measures the effect of a change in one or two project parameters on project results at the same time. The link between the calculated parameters should be translated into project model formulas to perform the sensitivity analysis properly.

The effectiveness of any kind of risk and uncertainty analysis depends on the accuracy of the variables described and the analytical capabilities of the spreadsheet model used (Salci & Jenkins, 2016). The purpose of the sensitivity analysis is to enable decision-makers to identify the source of the project's uncertainty. It helps to evaluate the value and impact of critical variables in the outcome of your project and to identify suitable mitigation measures to minimize risk.

Adequate knowledge of the effects caused by variations in crucial project parameters on the projects leading decision indicators, such as FNPV, FIRR and ADSCR, must, therefore, be analyzed and explained to decision-makers. As obtained from the Sensitivity Analysis, testing is being conducted on the main variables that have the most critical influence on the performance of the project. A sensitivity analysis was conducted to analyze the honey's project financial and economic NPVs, which are vulnerable to changes in deterministic returns of the honey project. This analysis was carried out on four project variables:

i. Honey prices
ii. Honey yield
iii. Bee colonies absconding rate
iv. Domestic inflation rate.

Accordingly, this financial and economic sensitivity analysis was carried out based on all the variables suggested for all the interventions proposed in the honey project.

8.2 Results of Sensitivity Analysis

Sensitivity analysis includes:

i. Identify factors that could affect project outcomes
ii. The range of the most likely assumed values of these variables
iii. Identify the major possible range of values that would reduce the net financial or economic gain of the project to zero.
iv. Calculate the effect of various combinations of worst-case and best-case outcomes on these variables.

Four project input variables have been identified to significantly influence the financial, economic and stakeholder outcomes of the project. The effect of these variables on the project is presented in the Tables below, and these results are presented for intervention three, which is the provision of three modern beehives + tools + training per beekeepers. The change in net present value incremental is coming from the change in the with – without the project case. The change in NPV incremental is coming from change in (with-without) the project case.

Table 16 presents the sensitivity results for honey yield from modern beehives. An increase or decrease in the average honey yield affects the financial, economic and stakeholders of the honey project. A 21% decrease in honey yield will result in a 44% decrease in the FNPV, and a 21% increase will result in a 7% increase in the FNPV. A 31 % decrease in ADSCR 1 and ADSCR 2 will result in a 2% decrease in both ADSCRs, and an increase of 31% will result in a 5% increase in both ADSCRs. Also, a 31% decrease in ENPV and a 31% increase in ENPV will result in a 40% decrease and a 29% increase in economic benefits, respectively. Benefits to labor will not change, no matter the increase or decrease in honey yield. Honey farmers should still work to ensure the financial profitability of the project.

Table 19: Sensitivity Analysis for Honey Yield from Modern Beehive

Honey Yield	FINANCIAL				ECONOMIC		STAKEHOLDER		
	FNPV (ETB)	FNPV (USD)	ADSCR 1	2 ADSCR	ENPV (ETB)	ENPV(USD)	Government	Labor	Financing Contributions
	19,392	624	3.23	3.96	22,696	730	3,759	551	(1,005)
15	2,238	72	1.83	2.25	3,726	120	1,943	551	(1,005)
23	8,205	264	2.32	2.85	10,324	332	2,574	551	(1,005)
30	13,425	432	2.74	3.37	16,098	518	3,127	551	(1,005)
38	**19,392**	**624**	**3.23**	**3.96**	**22,696**	**730**	**3,759**	**551**	**(1,005**
40	20,884	672	3.35	4.11	24,346	783	3,917	551	(1,005)
42	22,375	719	3.47	4.26	25,995	836	4,075	551	(1,005)
45	24,613	791	3.65	4.49	28,470	915	4,311	551	(1,005)

Honey price is one of the project variables that can affect the decision indicators of the

honey project. A decline in honey price by 10% from modern beehive will result in a 15% decrease in FNPV, and a 12% rise will result in a 17% rise in FNPV. ADSCR 1 decreases by 9% when honey price decreases by 10% and increases by 11% when honey price increases by 12%. ADSCR 2 decreases by 9% when the honey price decreases by 10%. The ENPV decreases by 14% when the price drops by 10%, and it increases by 16% when the price increases by 11%. Government benefit also decreases and increases by 8% and 10%, respectively. Labor benefit remains constant, whether the honey price from modern beehive increases or decreases. Table 17 presents the sensitivity results for honey price from modern beehives.

Table 20: Sensitivity Analysis for the Price of Honey from Modern Beehives

Honey Price	FINANCIAL				ECONOMIC		STAKEHOLDER		
	FNPV (ETB)	FNPV (USD)	ADSCR 1	2 ADSCR	ENPV (ETB)	ENPV(USD)	Government	Labor	Financing Contributions
	19,392	624	3.23	3.96	22,696	730	3,759	551	(1,005)
25	7,154	230	2.23	2.74	9,162	295	2,463	551	(1,005)
30	10,374	334	2.49	3.06	12,724	409	2,804	551	(1,005)
35	13,595	437	2.76	3.39	16,285	524	3,145	551	(1,005)
40	16,816	541	3.02	3.71	19,847	638	3,486	551	(1,005)
44	**19,392**	**624**	**3.23**	**3.96**	**22,696**	**730**	**3,759**	**551**	**(1,005)**
50	23,257	748	3.54	4.35	26,970	867	4,168	551	(1,005)
55	26,477	851	3.80	4.67	30,532	982	4,509	551	(1,005)
60	29,698	955	4.06	4.99	34,093	1,096	4,850	551	(1,005)
65	32,919	1,058	4.33	5.31	37,655	1,211	5,191	551	(1,005)

The lower the absconding rate of the bee colonies, the better for all the decision indicators. Lower bee colony absconding rate makes the FNPV attractive. A 25%
reduction in the absconding rate of the bee colony results in a 2% rise in the FNPV, and a 25% increase results in a 2% decrease in the project's FNPV. A 25% decrease results in a 2% decrease in ADSCR 1 and 2. The ENPV increases by 1.5% if the absconding rate decreases by 25% and decreases by 1.5% when the rate increases by 25%. Also, government benefit increases and decreases by 0.3% when the absconding rate decreases and increases by 25%. The benefits of labor remain constant. For all the project scenarios, farmers should ensure that the bee colony absconding rate as low as possible for the project to be beneficial and financially attractive to all stakeholders. Table 18 presents these results.

Table 21: Sensitivity Analysis for Bee Colonies Absconding Rate from Traditional Beehives

Bee Colonies Absconding Rate from traditional beehives	FINANCIAL				ECONOMIC		STAKEHOLDER		
	FNPV (ETB)	FNPV (USD)	ADSCR 1	2 ADSCR	ENPV (ETB)	ENPV(USD)	Government	Labor	Financing Contributions
	19,392	624	3.23	3.96	22,696	730	3,759	551	(1,005)
1%	20,689	665	3.38	4.15	24,043	773	3,809	551	(1,005)
2%	20,365	655	3.34	4.10	23,706	762	3,797	551	(1,005)
3%	20,040	644	3.30	4.06	23,370	751	3,784	551	(1,005)
4%	19,716	634	3.26	4.01	23,033	741	3,771	551	(1,005)

5%	**19,392**	**624**	**3.23**	**3.96**	**22,696**	**730**	**3,759**	**551**	**(1,005)**
6%	19,068	613	3.19	3.92	22,359	719	3,746	551	(1,005)
7%	18,744	603	3.15	3.87	22,022	708	3,733	551	(1,005)
8%	18,420	592	3.12	3.83	21,686	697	3,721	551	(1,005)
9%	18,095	582	3.08	3.78	21,349	686	3,708	551	(1,005)

The sensitivity analysis of the honey project shows that domestic inflation is subject to change and can have an impact on the project decision indicators. This analysis shows that a high inflation rate makes the honey project appealing financially and economically. This is due to the fixed interest rate payment of 12% on loan. A decrease or increase in inflation does not affect the economic net present value of the project, government benefits and benefits to labor. Still, it affects the FNPV and the ADSCRs of the project.

A 14% and 12% decrease and increase in domestic inflation respectively results in a 1% decrease and 1% increase in the honey project's FNPV and a 14% and 12% decrease and increase in domestic inflation results in an increase and decrease of 2% and 1.2% respectively in ADSCR 1 and 2. Table 19 presents the sensitivity results for the domestic inflation rate in Ethiopia.

Table 22: Sensitivity Rate for Domestic Inflation Rate

Domestic Inflation	FINANCIAL				ECONOMIC		STAKEHOLDER		
	FNPV (ETB)	FNPV (USD)	ADSCR 1	2 ADSCR	ENPV (ETB)	ENPV(USD)	Government	Labor	Financing Contributions
	19,392	624	3.23	3.96	22,696	730	3,759	551	(1,005)
2.5%	18,628	599	2.95	3.32	22,696	730	3,759	551	(241)
5.0%	18,850	606	3.03	3.48	22,696	730	3,759	551	(463)
11.0%	19,321	621	3.20	3.89	22,696	730	3,759	551	(934)
12.0%	**19,392**	**624**	**3.23**	**3.96**	**22,696**	**730**	**3,759**	**551**	**(1,005)**
15.0%	19,593	630	3.31	4.18	22,696	730	3,759	551	(1,206)
16.0%	19,657	632	3.34	4.25	22,696	730	3,759	551	(1,270)
20.0%	19,894	640	3.46	4.55	22,696	730	3,759	551	(1,507)
21.0%	19,950	641	3.49	4.63	22,696	730	3,759	551	(1,563)
30.0%	20,393	656	3.75	5.34	22,696	730	3,759	551	(2,006)
33.0%	20,520	660	3.83	5.59	22,696	730	3,759	551	(2,134)

The purpose of the Sensitivity Analysis is to help decision-makers identify the source of uncertainty for the project, to evaluate the importance and effect of the significant variables found on project outcomes, and to help determine the best mitigation measures to minimize project risk exposure.

CONCLUSION

Understanding the honey sector in Ethiopia is of great importance both for the development of the Ethiopian economy and the livelihood of beekeepers and honey traders. Bee-keeping is an income-generating activity for millions of Ethiopian farmers. The widespread use of traditional beekeeping methods indicates that modern hives are not

well promoted due to the low involvement of agents for expansion and financial availability or assessability.

This study focuses on three possible Ethiopian honey sector strategies, which will boost the honey sector to satisfy the local and international demand. USAID has proposed three interventions providing attractive NPVs. Still, the best alternative among the three proposed interventions is intervention three, which is the most appealing solution, as it ranks the highest feasibility in financial and economic NPV. To successfully introduce intervention 3, beekeepers need access to financial capital to buy modern beehives, equipment and acquire necessary training sessions.

The twenty-eight percent of equity down payment of the farmers and the subsidy content of the loan provided by USAID are relatively small as compared to the benefits that farmers will receive from the program, which will provide the possible impact of intervention C (the provision of three modern beehive + tools + training) over the Ethiopian economy and the positive influence on the honey value chain. It will also

ensure that beekeepers join and benefit from the project and its potential positive outcomes.

Other areas of the honey sector, such as producing bee forage crops, needs to be addressed, and more investment will be required for its improvement. Bee forage crops are particular types of herbaceous plants considered medicinal by Ethiopian people. This forage crops includes *Leucas abyssinica*, *Hypoestes forskaolii* and *Becium grandiflorum* among others, and research has shown that more than 20 of these herbaceous plants are to be found in various regions of Ethiopia.

Recognizing the availability of such bee forage spaces and their flowering calendar in the different Ethiopian regions is very important for the quality of the honey produced in the region, such improved practices will give Ethiopian honey an edge in terms of quality when sold in the world market. The results would be an enormous benefit not only for the farmers but also for the Ethiopian economy.

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