Food and Agriculture Organization
of the United Nations

Annex 3

Economic and Financial Analysis (EFA)

For the GCF-FAO Project “Ecosystems-based Adaptation for resilient Watersheds and Communities in Malawi (EbAM)”

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Currency Equivalents[1]

Currency Unit	=	Malawi Kwacha (MWK)
US$ 1.00	=	MWK 1,036

Abbreviations and Acronyms

AEZ	Agroecological Zone
CA	Conservation Agriculture
EbA	Ecosystems-based Adaptation
EFA	Economic and Financial Analysis
EIRR	Economic Internal Rate of Return
EPIC	FAO Economic and Policy Analysis of Climate Change (EPIC) Programme
FIRR	Financial Internal Rate of Return
FOB	Free on Board
GHG	Green House Gas
GM	Gross Margins
HH	Household
IRR	Internal Rate of Return
M$	Million US$
MWK	Malawi Kwacha
NPV	Net Present Value
NTFP	Non Timber Forest Product
SDR	Social Discount Rate
VAT	Value Added Tax
VSLAs	Village Savings and Loans Associations
WOP	Without Project (Baseline)
WP	With Project
4Ps	public-private producers partnerships (4Ps)

[1] Source: Reserve Bank of Malawi, Official Exchange Rates, www.rbm.mw/Statistics/MajorRates . Average 1-10 August 2022

INTRODUCTION

1. **Overview**. This working paper summarizes the main assumptions, hypotheses, and findings of the economic and financial analysis (resulting in Annex 3 of the Funding Proposal[2]) related to the Project 'Ecosystems-based Adaptation for resilient Watersheds and Communities in Malawi' (EbAM) to be funded by the Green Climate Fund (GCF) and other co-financing partners.
2. The project objective is to increase climate-change resilience of rural communities at watershed level in Malawi. The economic and financial analysis (EFA) aims at assessing the financial and economic viability of the proposed investments. It consists of comparing the resources required for the project implementation (represented by the overall costs) with the expected impacts, calculated as benefits of the main promoted activities. It assesses the profitability of the planned investments for project participants through financial models (financial analysis), but also estimates the economic benefits of key investments for the entire project from society's perspective (economic analysis). The economic analysis also estimates the Greenhouse Gas (GHG) emissions impact of the project.
3. **Sources of economic benefits.** EbAM will promote the Ecosystems-based adaptation (EbA) approach combined with Integrated Landscape Management (ILM) to repair degraded ecosystems, and to allow agriculture and other livelihoods to become resilient to climate change. Expected project benefits vary by land use in the project areas of intervention, since the project follows an ILM approach. The area of intervention includes farmland – an estimated 27,030 hectares out of 83,240 hectares – and non-farmland, which in itself includes (among others) rangeland and forestland. Farmland will benefit from all project components: Component 1 will increase the quality of ecosystem services (soil quality, water retention etc…) through the Village Level Actions Plans (VLAPs) while Component 2 will provide support to production through the Farmer Field Schools, the 4Ps and support for access to finance. Non-farm land will mostly benefit from Component 1 and benefits will include quantified benefits such as additional non-timber forest products (NTFPs) collected and the reduction of GHG emissions (the latter are only included as economics benefits) and benefits that are not quantified in the EFA, mostly other ecosystem based benefits[3] but also additional forage production on pastureland for example. Component 3 will support all these activities.

[2] Annex 3 Economic and financial analyses in spreadsheet format.
[3] These are estimated in one sensitivity analysis of the economic analysis, but not included in the main results as the data is insufficiently robust.

Table 1. Project Benefits for Different Interventions and Project Areas

Type of land	Number of hectares	Number of beneficiary HH	Benefits Quantified in the EFA	Other benefits
Total watershed area targeted	**88,800**			
benefitting from Comp 1 * **	**83,240**	**61,549**		
Production benefits on farmland, all benefitting from component 1 and component 2.3	**27,030**	**61,549**		
Also benefitting from the FFS (and 4Ps for a subsection)	16,200	27,000	full prod benefits and GHG reduction	other ecosystem benefits, see sensitivity analysis
Only benefitting from Comp 1 and 2.3	10,830	34,549	50% of production benefits and GHG reduction	other ecosystem benefits, see sensitvity analysis
Soil and water conservation	**14,352**			
of which farmland	7,176	part of above	see prod benefits, already counted (Line 10 above)	other ecosystem benefits, see sensitvity analysis
of which other (Component 1 only)	7,176		GHG reduction	other ecosystem benefits, see sensitvity analysis
Agroforestry, pastureland regeneration and FMNR	**7,308**			
of which farmland	3,654	part of above	see prod benefits, already counted (Line 10 above)	other ecosystem benefits, see sensitvity analysis
of which other (Component 1 only)	3,654		GHG reduction	additional forage production, other ecosystem benefits, see sensitvity analysis
Community forests and woodlot restoration (Component 1 only)	**22,416**	communal	NTFP collection and GHG reduction	other ecosystem benefits, see sensitvity analysis
Forest management (Component 1 only)	**22,640**	communal	GHG reduction	other ecosystem benefits, see sensitvity analysis
River and stream bank restoration (Component 1 only)	**321**	communal	GHG reduction	other ecosystem benefits, see sensitvity analysis

* Net of barelands, urban areas and water bodies
** rounded to 10 hectares

Source: Author

4. In addition, through Component 2, the project will also support post-production activities by supporting access to finance and in particular Village Savings and Loans Associations (VSLAs), with the target of establishing 270 micro-small-medium enterprises (MSMEs). The project will finance "soft" investments.

5. This working paper is structured as follows. The section on Data and Targets focuses on the overall methodology of the analysis and project targets. The section model describes the approach for the development of activity models, which are the building blocks of both the financial analysis and the economic analysis. The sections Financial Analysis and Economic Analysis respectively focus on describing the methodology and results of the financial analysis and the methodology and results of the economic analysis. The bibliography at the end of the annex lists the published resources used for the analysis, while the annexed Excel spreadsheets (Annex 3) provide the detailed computations.

I. DATA AND TARGETS

6. **Data.** The sources of data and information used in the present analysis combine specialized papers and references, official data, and field visits. Main data sources include:

- The latest available national National Census of Agriculture and Livestock (NACAL) data 2006/07 (NSO 2010).
- Data from the Fifth Integrated Household Survey (IHS5) 2019-2020.
- Data from the crop budgets and gross margins from district agriculture offices in project target areas.
- Data retrieved during fieldwork through ad-hoc interviews to farmers.
- Recent price data sourced the FAO Country Office, cross-checked with field interviews (at farm-gate) and available price bulletins[4]. The prices are real prices, and all years consider the 2022/2023 current prices as kept constant for the project duration. Farm gate prices vary and fluctuate widely while all prices fluctuate based on different contextual factors, so the sensitivity analysis tests the robustness of results to decreases in benefits and an increase in costs.

7. Data on yields and production practices come from several sources, including:

(i) A household survey conducted by the FAO Economic and Policy Analysis of Climate Change (EPIC) Programme with the aim to assess the benefits and costs of a set of climate-resilient agriculture techniques in Malawi[5];

(ii) A household survey conducted in January-February 2018 within the InnovAfrica project[6], aimed at collecting information about the agronomic and economic impact of EbA-based agriculture practices tested in experimental fields and demonstration sites[7];

(iii) The Climate Adaptation in Rural Development Assessment (CARD) Tool, developed by IFAD[8], based on the RCP 8.5 scenario.

8. The analysis used the official exchange rate between US$ and Malawi Kwacha (MWK) available on the website of the Reserve Bank of Malawi. The rate used is 1,036 MWK/$ (November 2022).

II. MODELS AND FINANCIAL ANALYSIS

9. Different models were prepared to represent the project activities proposed by the project. For each model, a ***without project (WOP) situation*** is compared to a ***with project (WP) situation.*** In the WOP situation, we consider the situation of beneficiaries prior to the project intervention[9] while in the WP situation we consider the beneficiaries' investments and activities enabled by project support. A model is profitable if the beneficiaries can derive more income following the project investments. Table **2** describes the models used for the financial and economic analyses. These models are described in more detail in this section.

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[4] For example: see Malawi Agricultural Statistical Bulletin (Ministry of Agriculture) and the Horticulture Commodity Prices (Ministry of Agriculture), http://www.nsomalawi.mw/; or IFPRI price bulletins, e.g. https://massp.ifpri.info/resources/price-bulletin/; or FEWS NET, e.g. Price Bulletin October 2022 https://fews.net/southern-africa/malawi/price-bulletin/october-2022

[5] A sample of 524 questionnaires have been collected with reference to the 2012-13 cropping season.

[6] The 'Sustainable Agriculture and Enhanced Food and Nutritional Security in Africa' (InnovAfrica) Project was financed by the EU, H2020 program (Grant nr. 727201). See http://www.innovafrica.eu/ for further details.

[7] In Malawi, 653 households were surveyed.

[8] The tool provides access to historical data and projections of climate change effects on agricultural yields of 17 major crops in most countries in Africa. It relies on the RCP8.5 scenario from the Intergovernmental Panel on Climate Change (IPCC).

[9] In practice, the models here consider a static WOP situation.

Table 2. Production and Enterprise Models

Model	Unit of production	Years of analysis	WOP	WP
Farmland benefitting from both Comp. 1 & 2				
Mid-altitude plateau (Mid Elevation Upland) & Highlands	hectare	20	Monocropping/conventional practices	EbA and new crop mix
Lakeshore plains and upper Shire valley & Lower Shire valley	hectare	20	Monocropping/conventional practices	EbA and new crop mix
Farmland benefitting from Comp. 1 only				
Lakeshore plains and upper Shire valley & Lower Shire valley	hectare	20	Monocropping/conventional practices	EbA and new crop mix
Mid-altitude plateau (Mid Elevation Upland) & Highlands	hectare	20	Monocropping/conventional practices	EbA and new crop mix
MSMEs				
honey production	enterprise	10	Not applicable, new activity	New activity

10. In addition, the Economic Analysis, also takes into consideration the reduction in Greenhouse emissions (GHG) enabled by the project on the different types of project areas, which will not result in additional income for project beneficiaries but represents a benefit for society. The Economic Analysis further includes the additional revenues from non-timber forest products expected from forest restoration and management. A full financial model was not prepared for forest restoration and management due to insufficient data.

a. Methodology and Analytical Assumptions for the Production Models

11. **Method.** For production models, the analysis follows two steps. First, crop models simulate the implementation of conventional and climate-resilient farming practices for a variety of annual and perennial crops grown in the project areas. The conventional practices are already widely used in the project areas, while the climate-resilient practices represent the type of EbA approaches that the project would promote (see Table 3). The project will also support beneficiaries in changing their crop mix (i.e. not just in changing the production practices for one crop but also switching from mono-cropping to crop rotation or intercropping, increased on farm diversification etc.), switching towards more resilient practices and crop mixes/rotations. Hence, in a second step, representative farm models stimulate crop mixes at the farm level to compare costs and revenues with and without project for a farm (see Table 4, lower down in this section).

Table 3. List of Crop Models

Crops	Production Techniques
Mid-altitude plateau & highlands	
Conventional production practices	
Maize	Monocropping, conventional
Soybeans	Monocropping, conventional
Pure Beans	Monocropping, conventional
Mixed Beans	Monocropping, conventional
Groundnuts	Monocropping, conventional
Cassava-Wet	Monocropping, conventional
Production practices promoted by the project	
Maize	EbA/Reduced tillage-planting basins
Maize	EbA/Reduced tillage-ripping & agroforestry
Soybeans	EbA/Reduced tillage, ripping
Groundnuts	EbA/Reduced tillage-ripping & soil conservation
Maize & pure beans	EbA/Intercropping cereals with legumes
Tomato	EbA-based management
Onion	EbA-based management
Irish Potato	EbA/Permaculture
Banana	EbA-based management
Lakeshore plains and upper Shire valley	
Conventional production practices	
Maize	Monocropping, conventional
Sorghum	Monocropping, conventional
Soya beans	Monocropping, conventional
Groundnuts	Monocropping, conventional
Pigeon peas	Monocropping, conventional
Cowpeas	Monocropping, conventional
Pure beans	Monocropping, conventional
Production practices promoted by the project	
Maize	EbA/Reduced tillage & crop rotation
Maize & cowpeas	EbA/Reduced tillage & intercropping
Soybeans	EbA/Reduced tillage, ripping
Groundnuts	EbA/Reduced tillage-ripping & soil conservation
Tomato	EbA-based management
Onion	EbA-based management
Irish Potato	EbA/Permaculture
Avocado	EbA-based management

Source: Author

12. The crop models listed in Table 3 simulate annual budgets reporting all the quantities of inputs and outputs, their unit costs and prices, and considering revenues, investment, and variable costs. Input and output farm-gate prices are used in the computations. Revenues correspond to the total value of production[10]. Variable costs refer to the activities conducted every year during the production process and include all input costs including labour.

13. **Crop model specifications.** Crop activity models refer to one hectare of cropland. Total revenue is computed considering all farm production which is valued using the market price at farm-gate. There is no distinction between output sold and output consumed, as the value of consumed output is in any case equal to the opportunity cost of consuming, so the sales price.

[10] Post-harvest losses are not considered here, as it is assumed that the impact of post-harvest losses will be similar under the two scenarios. Indeed, since the benefits in the WP scenario are estimated as incremental with respect to the WOP one, there are no incremental benefits associated with post-harvest management.

14. **Conventional Practices.** The conventional practices models refer to conventional farming techniques generally adopted by farmers in project interventions areas for rainfed crops, mainly mono-cropping practices. According to the latest Census report (NSO 2010) mono cropping is common, and crop rotation is only practiced on about one out of five parcels. Water management is very rare. Producers carry out almost all farm activities manually, and mechanized farming methods are almost nonexistent. Producers apply pesticides on a very small proportion of plots and inorganic fertilizer applied twice on about one third of maize plots. Farmers mostly retain seeds and planting materials from their own harvest, but these are often of poor quality. Thus, yields are much below the potential.

15. **Production practices promoted by the project.** The project will support farmers in adopting various EbA practices to improve soil fertility and boost yields. Some crop models represent examples of production systems using EbA approaches typical of the two AEZ considered, including both cropland and home gardens. The models are a representative set of the options, since it is not possible to describe all the available alternatives in more complex production systems. The Feasibility Study describes some of these practices in more detail. Crop rotation is considered in the representative farm models (see below) by including the rotating crops in the farming systems and in the land allocation plan of the farm.

16. Due to improved production practices, the yields in the promoted production systems are higher than the yields in conventional systems. However, the models use a conservative approach in estimating yield increase, as the yield level used in the climate-resilient production model are generally below the potential, and a gradual yield increase is considered. The yields in agroecological production systems increase is gradual and accounts for the potential initial decrease in yield resulting from changing practices (e.g. no longer applying chemical) and subsequent gradual improvement in soil fertility. The models also consider that other parameters may change because of yield changes (e.g., labour employed during harvesting). For the perennial crops, the analysis also assesses the yields and margins' progression from the start of the plantation.

17. **Labour costs.** Labour costs are estimated using the average wages for general workers (unskilled farm workers) derived from the dataset. They range about 1-1.5 $/person day depending on the labour type. The models consider both family and wage labour, depending on the activity and considering that most smallholders rely mostly on family labour. External labor costs are included in the computation of operating costs. Family labor cost are also valued using the same wage as for external labor, to make sure that additional benefits also cover additional labor requirements. The return to family labour indicates how much a labourer earns for each day of work attributed to the crop enterprise, irrespective of who provided the labour.

18. Results of the crop models allow the estimation of financial performance indicators at crop level that are instrumental for assessing the impact of project interventions implemented by targeted smallholders including: (i) gross margins (cash flow); (ii) net margins; (iii) returns to family labour. Gross margins (GM) correspond to the difference between total revenue (corresponding to the total value of production) and total variable costs including hired external labour but excluding family labour costs. Net margins correspond to the difference between GMs and the cost of family labour, estimated using the hired labour wage as a proxy. The returns to family labour per day are computed as the ratio between the gross margins and the days of family labour involved in the production activity.

19. **Representative farm models**. The analysis then seeks to assess the impact of project activities on the income of smallholder farm household by developing representative farms/ enterprise models, with similar but slightly varying crop mixes with and without project (see Table 4). Horticulture is cultivated off-season, so the horticulture surfaces are in addition to the one hectare modelled. Project impact estimates corresponds to the incremental net incomes between the WOP and the WP scenarios. The cropping patterns by AEZ/farming system, which represent the baseline of the current analysis, are presented in Table 4. The farm models correspond to one hectare, so it means that a typical farm would correspond to 1.7 households.

Table 4. Representative Farm Household Land Structure by AEZ

Scenario	Plot size (ha)	Crop	Solution
Farm type 1: Mid-altitude plateau & highlands - Home garden & cropland			
WOP			
Cropland area	0.50	Maize	Monocropping, conventional
Cropland area	0.10	Soybeans	Monocropping, conventional
Cropland area	0.10	Pure Beans	Monocropping, conventional
Cropland area	0.10	Mixed Beans	Monocropping, conventional
Cropland area	0.10	Groundnuts	Monocropping, conventional
Home garden	0.10	Cassava-Wet	Monocropping, conventional
Total	1.00		
WP			
Cropland area	0.30	Maize	EbA/Reduced tillage-planting basins
Cropland area	0.15	Maize	EbA/Reduced tillage-ripping & agroforestry
Cropland area	0.10	Soybeans	EbA/Reduced tillage, ripping
Cropland area	0.10	Groundnuts	EbA/Reduced tillage-ripping & soil conserva
Cropland area	0.15	Maize & pure bean	EbA/Intercropping cereals with legumes
Cropland area	0.10	Banana	EbA-based management
Home garden	0.10	Cassava-Wet	Monocropping, conventional
Home garden	0.02	Tomato	EbA-based management
Home garden	0.05	Onion	EbA-based management
Home garden	0.13	Potato	EbA/Permaculture
Total	1.00		
Farm type 2: Lakeshore plains and Shire valley - Home garden & cropland			
WOP			
Cropland area	0.50	Maize	Monocropping, conventional
Cropland area	0.08	Sorghum	Monocropping, conventional
Cropland area	0.08	Soya beans	Monocropping, conventional
Cropland area	0.10	Groundnuts	Monocropping, conventional
Cropland area	0.08	Pigeon peas	Monocropping, conventional
Cropland area	0.08	Cowpeas	Monocropping, conventional
Cropland area	0.08	Pure beans	Monocropping, conventional
Home garden		-	-
Total	1.00		
WP			
Cropland area	0.30	Maize	EbA/Reduced tillage & crop rotation
Cropland area	0.20	Maize & cowpeas	EbA/Reduced tillage & intercropping
Cropland area	0.25	Soybeans	EbA/Reduced tillage, ripping
Cropland area	0.10	Groundnuts	EbA/Reduced tillage-ripping & soil conserva
Cropland area	0.15	Avocado	EbA-based management
Home garden	0.02	Tomato	EbA-based management
Home garden	0.05	Onion	EbA-based management
Home garden	0.13	Potato	EbA/Permaculture
Total	1.00		

Source: Author

b. Enterprise Models

20. Enterprise models. In addition to the representative farm models, the following MSME models are included in the analysis. A honey production model stimulates a new micro enterprise investing in beekeeping and honey production and marketing. This enterprise would be a new investment created via a Village Savings and Loan Association (VSLA) or financial institution loan, so there is no without project situation. For the SMEs, activities will be on the basis of demand and are likely to vary significantly. A lot of the finance parameters might vary based on the specific financing institution and loan instrument. Here, for the SME model, the financing

instrument modelled would be from a financial institution. Interest rates from banks would typically range from 20% to 25% annually, with loan durations of up to two years, so the model uses an interest rate of 23%.

c. Objectives and Methodology

21. The financial analysis considers the investment from the perspective of a beneficiary household. All costs are included in the activity models and valued at market costs or opportunity cost (for labour), whether the project or beneficiaries are paying, and all benefits are valued at market cost or opportunity cost.

22. In the financial analysis, each model compares the costs and benefits of the beneficiaries' activity ***with project*** and ***without project***. This analysis aims to ensure that project beneficiaries have a financial incentive to participate in project activities (through increased revenues) and will be able to sustain the proposed investments.

23. **Financial discount rate.** Results are discounted using a discount rate of 14.2% for the financial analysis, based on the real interest rate paid by commercial or similar banks in the country.

d. Results

24. The results show that the proposed project interventions would result in positive returns for project beneficiaries, with Net Present Values (NPVs) above zero, see Table **5**. A second table, Table 6, shows the financial results with a higher discount rate of 20% as a sensitivity analysis. The Internal Rate of Return (IRR) for the honey model is high because the investment in year 1 only amounts to producers' own capital contribution, since the rest is financed by a loan that is repaid in year 3.

Table 5. Financial Results[11]

Model	Unit of production	Years of analysis	HH model	NPV, USD, @ 14.2%	NPV, MWK, @ 14.2%	NPV per HH, USD, @ 14.2%	IRR
Farmland benefitting from both Comp. 1 & 2							
Mid-altitude plateau (Mid Elevation Upland) & Highlands	hectare	20	1.7	3,047	3,157,247	1,828	NA
Lakeshore plains and upper Shire valley & Lower Shire valley	hectare	20	1.7	4,175	4,326,535	2,505	NA
Farmland benefitting from Comp. 1 only							
Lakeshore plains and upper Shire valley & Lower Shire valley	hectare	20	3.2	1,523	1,578,624	478	NA
Mid-altitude plateau (Mid Elevation Upland) & Highlands	hectare	20	3.2	2,088	2,163,267	654	NA
MSMEs							
honey production	enterprise	10	20.0	2,683	2,779,982	134	62%

Table 6. Financial Results with a Higher Discount Rate

Model	Unit of production	NPV, USD, @ 20%	NPV, MWK, @ 20%	NPV per HH, USD, @ 20%
Farmland benefitting from both Comp. 1 & 2				
Mid-altitude plateau (Mid Elevation Upland) & Highlands	hectare	2,129	2,205,864	1,277
Lakeshore plains and upper Shire valley & Lower Shire valley	hectare	2,892	2,996,315	1,735
Farmland benefitting from Comp. 1 only				
Lakeshore plains and upper Shire valley & Lower Shire valley	hectare	1,064	1,102,932	334
Mid-altitude plateau (Mid Elevation Upland) & Highlands	hectare	1,446	1,498,158	453
MSMEs				
honey production	enterprise	1,833	1,899,241	92

III. ECONOMIC ANALYSIS

a. Objectives and Methodology

25. The economic analysis objectives are to:

(i) determine the economic viability and overall cost effectiveness of the project, estimated from the perspective of the society; and

[11] The table does not present the Internal Rates of Return (IRRs) for the production models, since the model represent a shift in different production practices mostly on annual crops, hence different recurrent costs rather than an upfront investment cost. In the absence of an investment cost, the return on investment is not a meaningful indicator.

(ii) perform a sensitivity analysis to measure the robustness of the proposed investments to other scenarios, which might represent different methodological choices (e.g. a different discount rate) or the materialisation of specific project risks (e.g. price increases).

26. The main quantifiable economic benefits from the project are the incremental benefits in the different models. Such benefits are aggregated over the total number of hectares. The economic analysis considers benefits over a 20-year period, so it goes beyond the 6-year implementation period of the proposed project.

27. Economic benefits are estimated using economic price, which do not include transfers within the economy like taxes or subsidies. Economic prices are based on import/export parity prices at farm gate for some key inputs and outputs. For cereals and staple crops, the analysis uses a conversion factor of one, based on yearly trends that show that the local prices for maize and soy tend to be below the import parity price but above the export parity price[12]. For fertilizer, while fertilizers are subsidised, the price used in the financial is net of subsidies, because producers might not be able to access the subsidised fertilizers[13]. Hence, the economic price does adjust for the subsidy. A shadow exchange rate was computed using the formula below.

Figure 1. Computation of the Shadow Exchange Rate[14]

$$\boxed{SER = OER \cdot \frac{[(M + Tm) + (X - Tx)]}{(M + X)}}$$

Table 7. Conversion Factors

Conversion Factors	
Standard Conversion Factor (SCF)	1.037
Conversion Factor for imported chemicals (including fertilizer)	1.02
Conversion Factor for exported output	1.05
Conversion factor for maize and other staple crops	1.00
Non tradables	1.00
Shadow Wage Rate Factor (SWRF)	0.90

28. **Estimation of the economic benefits.** To compute the flow of direct benefits of the Project, the net incremental benefits of single farm households and SMEs are aggregated over the total number of beneficiaries according to the phasing reported in Table 8. Adoption rates applied to each model reflect the fact that that not all beneficiaries will successfully adopt the proposed practices. In addition, based on evidence[15] that a regenerated forest can provide MWK 100,000 per year of non-timber forest products, and assuming that the opportunity cost of time spent collecting these NTFPs would amount to the 50,000 MWK, incremental benefits of 50,000 MWK per year are added for each hectare of forest regenerated.

Table 8. Phasing of Adopting Households and MSMEs

Phasing of models, adopting only	**Unit**	**adoption rate**	**Y1**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6**	**TOTAL**
Farmland benefitting from both Comp. 1 & 2	hectare	80%	-	1,284.32	8,172.97	3,502.70	-	-	**12,960**
Farmland benefitting from Comp. 1 only	hectare	80%	-	858.59	5,463.78	2,341.62	-	-	**8,664**
Community forest and woodlot restoration (non prod)	hectare	80%	-	1,777.12	11,308.97	790.05	-	-	**13,876**
honey production	enterprise	70%			49.00	46.67	46.67	46.67	**189**

[12] Baulch, 2016

[13] Discussions with the FAO Country Office

[14] SER: shadow exchange rate; OER: official exchange rate; M: imports; Tm: tariffs on imports; X: exports; Tx: tariffs on exports. Averages of the last five years were used

[15] Ministry of Natural Resources, Energy and Mining – Malawi, 2017

Table 9. Phasing by AEZ

Phasing of model		Y1	Y2	Y3	Y4	Y5	Y6	TOTAL
Farmland benefitting from both Comp. 1 & 2		**-**	**1,284**	**8,173**	**3,503**	**-**	**-**	**12,960**
Mid-altitude plateau (Mid Elevation Upland) & Highlands	hectare	-	787	5,005	2,145	-	-	**7,937**
Lakeshore plains and upper Shire valley & Lower Shire valley	hectare	-	498	3,168	1,358	-	-	**5,023**
Farmland benefitting from Comp. 1 only		**-**	**859**	**5,464**	**2,342**	**-**	**-**	**8,664**
Mid-altitude plateau (Mid Elevation Upland) & Highlands	hectare	-	526	3,346	1,434	-	-	**5,306**
Lakeshore plains and upper Shire valley & Lower Shire valley	hectare	-	333	2,118	908	-	-	**3,358**
Other land		**-**	**1,777**	**11,309**	**790**	**-**	**-**	**13,876**
Community forest and woodlot restoration (non prod)	hectare	-	1,777	11,309	790	-	-	13,876
MSMEs								
honey production	enterprise	-	-	49	47	47	47	189

29. **Economic Project Costs.** Total project costs of 50.80 M$ invested over 6 years are derived from the budget. The costs used are those of the March 2024 budget update net of the price contingencies: given that the value of benefits corresponds to 2022 prices the value of the costs should also correspond to 2022 prices. Project costs are then transformed into economic costs using the standard conversion factor (SCF) computed above. Operating costs amounting to 5% of total project costs were included from year 7 to 20, to account for operational costs ensuring the sustainability of project benefits. To avoid double counting of the costs, only the incremental economic costs of the project are considered (i.e., the costs of activities funded by EbAM). Costs already included in the estimation of the net incremental benefits of the individual project activities models (e.g., costs directly borne by farmers engaging in the proposed activities or the project and accounted for in the financial/economic models) are not included.

30. **Mitigation benefits**. The project should also generate mitigation benefits in the form of reduced GHG and Carbon sequestration. The GHG analysis, conducted using the Ex-Ante Carbon Balance Tool (Ex-ACT)[16], estimates that the project will result in a net decrease of GHG emissions of 2.27 million tCO_2e over 20 years. The economic analysis incorporates the expected mitigation benefits in the form of positive externalities of project interventions considering the contribution of the climate co-benefits using two different scenarios of shadow prices[17].

31. **Social discount rate (SDR)** The economic analysis links social discount rates (SDR) to the long-term growth prospects of the country where the project takes place. Indeed, the economic role of the SDR is to guide the allocation of public resources into the most desirable social investments. This analysis uses a discount rate of 10%, in line with the practices of most multilateral development. Nonetheless, because Malawi's long-term Treasury bill yields are higher than 10%, at 13.4%, the sensitivity analysis also considers an alternative discount rate of 15%.

b. Results

32. **Project performance**. The Economic Analysis shows that the project has positive returns and is viable using the discount rate of 10% in all scenarios. If the value of avoided carbon emissions is not quantified, the project Economic Rate of Return (EIRR) is 12.7%, with an NPV of 7.3 million US$. In scenarios where the value of avoided emissions is quantified, the project EIRR are 32.8% (lower end social price of carbon) and 54.6% (higher end social price of carbon) and the NPVs are respectively US$ 68.5 million and 129.7 million.

33. **Sensitivity and risk analysis**. To test the robustness of the above results, a sensitivity analysis measures the robustness of the results to different scenarios including lower benefits (for instance, if output prices of some intercropping crops decrease or adoption rates are lower than envisaged) and higher costs (for instance, if project costs increase). One scenario further attempts to quantify benefits of ecosystem services other than the provisional services (production benefits, already quantified), on the basis of literature[18] suggesting that supporting regulatory and cultural ecosystem services account for 37% of ecosystem benefits in Malawi. The literature was not considered robust enough to add these benefits in the main scenario, but they are indicatively presented in the sensitivity analysis (see the literature source and Excel file for more information). Table 10 presents the results of the sensitivity analysis.

Table 10. Sensitivity Analysis

[16] The detailed Ex-Act analysis and GHG estimation results are reported as a separate Annex.
[17] Based on: World Bank. 2017. Guidance Note on Shadow Price of Carbon in Economic Analysis; updated for inflation.
[18] Kirui, 2015

Sensitivity Analysis			
Scenario	**NPV, million USD**	**NPV, million MWK**	**IRR**
Without carbon benefits	7.3	7,566	12.7%
With carbon benefits, low social price of carbon (= baseline for other scenarios)	68.5	71,030	32.8%
With carbon benefits, high social price of carbon	129.7	134,430	54.6%
With carbon benefits, low social price of carbon, and other ecosystem benefits	133.1	137,897	52.5%
Benefits lower by 10%	57.7	59,788	29.5%
Benefits lower by 20%	46.8	48,545	26.1%
Costs higher by 10%	64.6	66,891	29.8%
Costs higher by 20%	60.6	62,751	27.2%
Discount rate of 15%	36.1	37,393	32.8%

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