Economic and financial analysis (EFA)

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Glossary

BCR	Benefits cost ratio
CBA	Cost-Benefit Analysis
CO2	Carbon dioxide
GCF	Green Climate Fund
GHG	Greenhouse gas
Ha	Hectare
IRR	Internal rate of return
IT	Investment
Kg	Kilogram
Km	Kilometer
L	Liter
m3	Cubic meter
NPV	Net present value
O&M	Operation and Maintenance
SCC	Social cost of Carbon
SSA	Sub-Saharan Africa
tCO2eq	Tons of CO2 equivalent
USD	United States dollar

1. Overview of the Economic and Financial analysis

The economic and financial analysis (EFA) of ten investments (called ITs) has been carried by pursuing a Cost-Benefit Analysis (CBA) modeling.

Whenever justified, the CBA was pursued in financial and economic terms. [1] The CBA's *financial part* shows whether the investment is financially profitable over an assumed time frame and chosen discount rate of 8.5%. The *economic part* of the CBA shows if proposed interventions are economically sustainable and beneficial for the entire economy and a society. The economic analysis in all cases was pursued over the same timeframe of 20 years, using an economic discount rate of 6% (this value has been retrieved from the World Bank (2019)).

The ten interventions also known as investments that were analyzed are: (IT1) improved drainage networks, (IT2) irrigation schemes, (IT3) de-silting systems, (IT4) landscape restoration, (IT5) water tanks, (IT6) irrigation parameters, (IT7) ridge ditches, (IT8) runoff collection, (IT9) road improved drainage and reinforcement during the rehabilitation, (IT10) road storage infrastructure.

While the economic analysis was performed for all investments, the financial analysis was pursued for six investments only. This is because four investments (IT7, IT8, IT9 and IT10) do not generate financial inflows for intended beneficiaries.

Finally, concerning GHG co-benefits, IT2 considers avoided emissions from motor pumps, while investments IT3, IT4, IT5 and IT6 consider carbon sequestration from improved agricultural practices. The economic valuation of GHG emissions was performed using a shadow price retrieved from the World Bank. The main text of the report presents results that use the low estimate, while section 3.2 also presents the economic results when using the higher shadow price.

The main assumption for the climate models is the RCP 4.5 emissions scenario. Further details are provided in Annex 2.b of the Funding Proposal.

2. EFA Assumptions and results

2.1. Introduction

The following assumptions were used in the modeling process:

- The discount rate of 8.5% has been adopted for the financial analysis, and 6% for the economic analysis.
- The estimation of investment costs for each investment type is as follows:
    - Each investment typology has been aligned to the project budget to reflect the exact amount allocated to that will be spent on different investments. The project implementation will cover 6 years; however, some project activities like construction will take 5 years. The annual spread of the physical targets in the EFA is also in line with the project budget plan. The total budget for the entire project is then included in the overall economic analysis for the 10 investment types to assess the overall economic performance indicators.
    - While including the total project costs in the overall assessment, costs already included in each investment typology have been deducted to avoid double counting of costs.

[1]If proposed intervention was income generating, the financial analysis was pursued and was followed by the economic analysis. For non-income generating interventions, only economic analysis was carried forward as there were no financial inflows or outflows to justify the financial part.

- We assume that the proposed project covers the capital cost of the investments analyzed, for the 6 years of implementation. Additional investment is required for operation and maintenance, and for the years of lifetime of the investment, past the 6-year duration of the project.

The implementation time of the investment is 6 years, but the lifetime of the investment stretches beyond the implementation time of the project.

The results of the economic and financial analyses consider the following crops: Vanilla, Maize, Rice, Onion and Cassava. The crop models have been considered in all ITs from IT1 to IT10 with the exception of IT9 (road resurfacing or encroachment). Maize, rice and cassava are all food security crops at the household level. Yield improvements are anticipated for all crops as a result of increased dissemination and adoption of drought tolerant (early maturing) varieties as well improved agricultural practices.

Methods used in crop models: It is worth noting that the analysis has used crop models to derive benefits expected from the project investment. The method is based on the activity and individual household models which simulate the implementation of farming practices for crops grown in the target area. The activity models simulate the financial budget and estimate the performance indicators namely; net present value (NPV) and economic rate of return (ERR) that are the instruments for assessing the impact of project intervention on economic activities.

Without Project (WOP) and With Project (WP) Scenarios in crop models: The WOP models are representative of the current situation where farmers do not have access to suitable technologies, improved agricultural practices & inputs, and yields are below the potential. The WP scenario simulates the impact of the project investments. In such scenario, beneficiaries will adopt improved agricultural practices, including irrigation, and improved inputs such as fertilizers, basic seeds, and other materials (plough, cultivators, weeders etc.). Therefore, the incremental benefits used to assess the project effectiveness have been computed as a difference between the with-project (WP) and the without project gross margins.

Data Source: The secondary data used in the models i.e., yields were adopted from a credible source (FAO2) a UN agency which provides access to food and agricultural statistics.

Overall, the results show that the investments are economically viable, when considering both the economic and financial performance of the investment. It is also worth noting that the size of the positive externalities generated (and included in the economic assessment) is at times larger than the revenues generated by the project. This highlights the importance of considering the societal outcomes of the investment in addition to the direct economic benefits it generates (i.e., comparing the economic and financial performance of the investment).

Specifically, the total investment available for the project and considered for the overall economic and financial analysis is USD 150.8 million. When considering the overall project investment costs and agricultural/farm operating costs, the project generates a baseline Economic Internal Rate of Return (E-IRR) of 24%, and Economic Net Present Value (E-NPV) of USD 255.5 million. The Financial Internal Rate of Return (F-IRR) for the whole project investment is estimated at 19% with a Financial Net Present Value (F-NPV) of USD 31.07 million.

Table 1: Summary of results – overall economic analysis

[2] https://www.fao.org/faostat/en/#data/QCL

Overall Economic Incremental Benefits (IT1-IT10)		2023	2024	2025	2026	2027	2028+
Costs in US$ '000							
Net Incremental Benefits - IT 1	USD	$ (3,279)	$ (3,082)	$ (1,727)	$ 3,622	$ 4,771	$ 5,747
Net Incremental Benefits - IT 2	USD	$ (4,455)	$ (3,982)	$ (1,800)	$ 6,275	$ 8,153	$ 9,394
Net Incremental Benefits - IT 3	USD	$ (853)	$ (803)	$ (271)	$ 1,116	$ 1,439	$ 1,613
Net Incremental Benefits - IT 4	USD	$ (4,022)	$ (3,868)	$ (2,177)	$ 4,819	$ 6,238	$ 7,094
Net Incremental Benefits - IT 5	USD	$ (114)	$ (958)	$ (1,386)	$ (497)	$ 459	$ 459
Net Incremental Benefits - IT 6	USD	$ (7,482)	$ (7,133)	$ (3,695)	$ 10,396	$ 13,286	$ 14,450
Net Incremental Benefits - IT 7	USD	$ (366)	$ (230)	$ 55	$ 605	$ 825	$ 1,100
Net Incremental Benefits - IT 8	USD	$ (27)	$ (21)	$ (8)	$ 31	$ 43	$ 43
Net Incremental Benefits - IT 9	USD	$ 1,132	$ 2,401	$ 3,686	$ 4,972	$ 6,258	$ 6,429
Net Incremental Benefits - IT 10	USD	$ (267)	$ (194)	$ (86)	$ 139	$ 241	$ 342
Total Incremental Benefits		**$ (19,733)**	**$ (17,871)**	**$ (7,408)**	**$ 31,478**	**$ 41,713**	**$ 46,673**
Project Costs							
GCF	USD	$ 3,961	$ 12,285	$ 12,665	$ 10,744	$ 8,317	$ 5,889
IFAD	USD	$ 16,333	$ 17,131	$ 16,850	$ 16,270	$ 16,814	$ 13,588
Total Project Costs	**USD**	**$ 20,295**	**$ 29,416**	**$ 29,515**	**$ 27,015**	**$ 25,131**	**$ 19,476**
Costs already included in the models to avoid double counting	USD	$ 3,612	$ 8,455	$ 8,635	$ 7,360	$ 5,772	$ 1,591
Net project costs after deducting costs included in midels	USD	$ 16,683	$ 20,961	$ 20,880	$ 19,655	$ 19,359	$ 17,885
Net Incremental Benefits	**USD**	**$ (36,416)**	**$ (38,832)**	**$ (28,288)**	**$ 11,823**	**$ 22,354**	**$ 28,788**

Discount Rate	6%
ENPV	255,526
ERR	24%
EMIRR	11%

Overall, the analysis shows positive economic and financial outcomes from investments in water and road management with the goal to improve climate resilience.

It is worth noting that the only investments for which we did not calculate financial indicators are IT7, IT8, IT9 and IT10 (road-related investments), since they do not generate direct cash inflows. However, these investments generate considerable economic value (i.e., positive externalities). Specifically, these are investments in improved climate resilience for existing roads. They improve access to markets for farmers. On the other hand, since these are not toll roads, there is no direct benefit generated for the investor, hence the focus on the economic rather than on the financial analysis.

2.2. Results by investment type

Table 2: Summary of results – Results per investment type

	Total investment	Revenues generated	Value of externalities	ENPV	FNPV	EIRR	FIRR	E-Benefit to cost ratio	F-Benefit to cost ratio	E-Payback Period (Years)	F-Payback Period (Years)	Debt Service Coverage Ratio
IT1	$ 4,880,000	$ 488,919,105	$ 15,042,600	$ 40,859,197	$ 24,250,903	40%	33%	1.2	1.17	4.95	5.44	8.90
IT2	$ 6,201,000	$ 727,772,089	$ 28,610,033	$ 69,979,425	$ 38,564,851	47%	36%	1.2	1.18	5.55	5.19	8.88
IT3	$ 872,500	$ 137,472,857	$ 4,303,171	$ 11,921,717	$ 6,263,986	44%	33%	1.2	1.15	4.92	5.90	1.21
IT4	$ 4,283,615	$ 630,517,226	$ 1,271,376	$ 50,901,433	$ 25,179,757	40%	29%	1.2	1.14	4.97	5.96	8.52
IT5	$ 3,460,551	$ 27,232,269	$ 106,962	$ 1,157,864	$ 138,251	11%	9%	1.2	1.15	6.93	11.33	9.54
IT6	$ 5,821,596	$ 1,274,774,600	$ 10,844,972	$ 106,522,557	$ 56,344,122	44%	33%	1.2	1.15	4.63	5.36	7.94
IT7	$ 1,377,500	$ 53,587,041	$ 12,361,981	$ 8,577,576	Not Calculated	64%	Not Calculated	1.5	Not Calculated	5.24	Not Calculated	Not Calculated
IT8	$ 80,000	$ 3,768,330	$ 483,918	$ 442,702	Not Calculated	46%	Not Calculated	1.3	Not Calculated	4.95	Not Calculated	Not Calculated
IT9	$ 1,080,000	$ 123,782,634	$ 123,406,720	$ 63,466,963	Not Calculated	-	Not Calculated	50.2	Not Calculated	2.13	Not Calculated	Not Calculated
IT10	$ 1,607,800	$ 23,752,840	$ 7,503,067	$ 4,542,077	Not Calculated	40%	Not Calculated	1.6	Not Calculated	6.32	Not Calculated	Not Calculated

3. Sensitivity Analysis

The sensitivity analysis for the entire project investment is presented in this section. The sensitivity analysis is carried out to text the robustness of the overall project investment and measure variations due to unforeseen factors and relevant risks.

Sensitivity analysis has also been carried out around the carbon pricing using both low and high shadow prices.

3.1. Sensitivity analysis on costs and benefits

The sensitivity analysis presented in this section takes into account 3 scenarios; (i) change in benefits, (ii) change in costs and (iii) delayed implementation.

A change in project benefits by 20 per cent increase in costs and decrease in benefits using the same proportion yields an ERR of 22 per cent and 21 per cent with a positive NPV of US$235.4 million and US$184.3 million respectively. An increase in project benefits by 10 per cent or 20 per cent yields a higher of 26 percent & 27 per cent respectively both with positive NPV. A delay in project benefits by 1 & 2 years still yields positive results as it yields 21 per cent and 19 per cent both scenarios posting positive net present values. Results of the sensitivity analysis indicate that the project remains economically viable under the various assumptions considered. The summary of the sensitivity analysis is presented in the table below.

Table 3: Result of the overall sensitivity analysis

Year	1	2	3	4	5	6	7	8	9	10	11-20.
Incremental Benefits	$ (19,733)	$ (17,871)	$ (7,408)	$ 31,478	$ 41,713	$ 46,673	$ 46,957	$ 46,957	$ 46,957	$ 46,957	$ 46,957
benefits +10%	$ (21,707)	$ (19,658)	$ (8,149)	$ 34,626	$ 45,884	$ 51,340	$ 51,652	$ 51,652	$ 51,652	$ 51,652	$ 51,652
benefits +20%	$ (23,680)	$ (21,445)	$ (8,889)	$ 37,773	$ 50,055	$ 56,007	$ 56,348	$ 56,348	$ 56,348	$ 56,348	$ 56,348
Mild scenario	$ (17,760)	$ (16,084)	$ (6,667)	$ 28,330	$ 37,541	$ 42,006	$ 42,261	$ 42,261	$ 42,261	$ 42,261	$ 42,261
Medium scenario	$ (15,787)	$ (14,297)	$ (5,926)	$ 25,182	$ 33,370	$ 37,338	$ 37,565	$ 37,565	$ 37,565	$ 37,565	$ 37,565
High scenario	$ (13,813)	$ (12,510)	$ (5,185)	$ 22,034	$ 29,199	$ 32,671	$ 32,870	$ 32,870	$ 32,870	$ 32,870	$ 32,870
Project Costs	$ 16,683	$ 20,961	$ 20,880	$ 19,655	$ 19,359	$ 17,885	$ 894	$ 894	$ 894	$ 894	$ 894
costs +10%	$ 18,351	$ 23,057	$ 22,968	$ 21,620	$ 21,295	$ 19,674	$ 984	$ 984	$ 984	$ 984	$ 984
costs +20%	$ 20,019	$ 25,153	$ 25,056	$ 23,586	$ 23,231	$ 21,462	$ 1,073	$ 1,073	$ 1,073	$ 1,073	$ 1,073
costs +30%	$ 25,024	$ 31,441	$ 31,320	$ 29,482	$ 29,038	$ 23,251	$ 1,163	$ 1,163	$ 1,163	$ 1,163	$ 1,163
Net cash flow											
base scenario	$ (36,416)	$ (38,832)	$ (28,288)	$ 11,823	$ 22,354	$ 28,788	$ 46,063	$ 46,063	$ 46,063	$ 46,063	$ 46,063
costs +10%	$ (38,085)	$ (40,928)	$ (30,376)	$ 9,858	$ 20,418	$ 26,999	$ 45,973	$ 45,973	$ 45,973	$ 45,973	$ 45,973
costs +20%	$ (39,753)	$ (43,024)	$ (32,464)	$ 7,892	$ 18,482	$ 25,211	$ 45,884	$ 45,884	$ 45,884	$ 45,884	$ 45,884
costs +30%	$ (44,758)	$ (49,312)	$ (38,728)	$ 1,996	$ 12,674	$ 23,422	$ 45,794	$ 45,794	$ 45,794	$ 45,794	$ 45,794
benefits +10%	$ (38,390)	$ (40,619)	$ (29,029)	$ 14,971	$ 26,525	$ 33,455	$ 50,758	$ 50,758	$ 50,758	$ 50,758	$ 50,758
benefits +20%	$ (40,363)	$ (42,406)	$ (29,770)	$ 18,119	$ 30,696	$ 38,122	$ 55,454	$ 55,454	$ 55,454	$ 55,454	$ 55,454
benefits -10%	$ (34,443)	$ (37,045)	$ (27,547)	$ 8,675	$ 18,183	$ 24,120	$ 41,367	$ 41,367	$ 41,367	$ 41,367	$ 41,367
benefits -20%	$ (32,470)	$ (35,258)	$ (26,806)	$ 5,527	$ 14,011	$ 19,453	$ 36,671	$ 36,671	$ 36,671	$ 36,671	$ 36,671
benefits -30%	$ (30,496)	$ (33,471)	$ (26,066)	$ 2,380	$ 9,840	$ 14,786	$ 31,975	$ 31,975	$ 31,975	$ 31,975	$ 31,975
benefits delayed 1 year	$ (16,683)	$ (40,694)	$ (38,751)	$ (27,063)	$ 12,119	$ 23,828	$ 45,779	$ 46,063	$ 46,063	$ 46,063	$ 46,063
benefits delayed 2 years	$ (16,683)	$ (20,961)	$ (40,614)	$ (37,526)	$ (26,767)	$ 13,593	$ 40,818	$ 45,779	$ 46,063	$ 46,063	$ 46,063

Discount rate	**6%**										
Sensitivity Analysis	**Base case**	**Costs Increase**			**Benefits Increase**		**Decrease of Benefits**			**Delay of Benefits**	
		+10%	**+20%**	**+50%**	**+10%**	**+20%**	**-10%**	**-20%**	**- 30%**	**1 year**	**2 years**
IRR (%)	**24%**	23%	22%	18%	26%	27%	23%	21.0%	19%	21%	19%
NPV (USD 000)	**255,526**	**245,483**	**235,440**	**209,006**	**291,121**	**326,717**	**219,931**	**184,335**	**148,740**	**221,565**	**189,526**

4. Climate mitigation assessment

According to the EX-ACT analysis (Annex 17), investments in agriculture for the Madagascar DEFIS+ project shows a potential for mitigation around 1 962 224 tCO2-eq during the lifetime of the project (20 years).

When considering the investments in water and road management, IT2 has the potential of reducing CO_2 emissions by replacing motor pumps with solar pumps, while IT3, IT4, IT5, and IT6 consider carbon sequestration from increased crop productivity. During the lifetime of these investments (20 years) our analysis forecasts a reduction of 338,419 tCO2eq, increasing the climate mitigation potential of the DEFIS+ project to 2,601,977 tCO2eq.

ITs	Total tCO2eq
IT2	3,762
IT3	54,987
IT4	238,429
IT5	13,747
IT6	27,493
Total	**338,419**

Table 4: Climate mitigation potential of selected ITs in 20 years

Annex I: Description of the investments analyzed, and assumptions.

IT 1 Improved drainage network

INVESTMENTS	
Capital costs	Annex 4 DEFIS+ Detailed Budget
Professional/ Contractual Services	We assumed that the annual O&M costs amount to 10% of the capital costs
AVOIDED COSTS	
Avoided costs of flood	The annual value of avoided flood events by ha was retrieved from a publication of the Ministry of Natural Resources – Rwanda (2014)
REVENUES	
Increased land productivity	Baseline productivity values of Vanilla have been retrieved from retrieved from FAOSTAT (FAO, 2021), while for the other crops we used the values found in the excel file “DEFIS+ EFA_3001”. We multiplied the baseline productivity values of the crops by 15%, which represents the recorded crop decline due to recent flooding in East Africa (Crop Monitor , 2020). In this way, we found the number of kg of crops (kg/ha) that would not be lost thanks to the investment. Next, we multiplied this value by the crop price, retrieved from SelinaWamucii(Selina Wamucii, 2021) in the case of Vanilla, and from the excel file “DEFIS+ EFA_3001” in the case of the other crops.

IT 2 Construct irrigation schemes using improved technologies (drip irrigation, solar pumps)

INVESTMENTS	
Capital costs	Reference obtained from AVSF (2013)
Professional/ Contractual Services	We assumed that the annual O&M costs amount to 10% of the capital costs
AVOIDED COSTS	
Avoided costs of electricity (if motorpumps are replaced)	This value was calculated by multiplying the following data: - Gas prices in Madagascar (Ar/L) (NUMBEO, 2022) - Ar to USD: 0.00026 - Fuel required to pump 1m^3 of water (l fuel*m^3 water) (Burney, Woltering, Burke, Naylor, & Pasternak, 2010) - m^3 of water extracted daily by a Solar Pump kit (AVSF, 2013) - 110, average days in a year when irrigation is required
Avoided CO_2 emissions (if motorpumps are replaced)	To begin with, we calculated the annual Kg of CO_2 emitted by one motorpump. To do so, we multiplied the Carbon Dioxide emitted by burning 1l of Diesel (2.6 kg) (University of Calgary, 2015), by the following data: - Fuel required to pump 1m^3 of water (l fuel*m^3 water) (Burney, Woltering, Burke, Naylor, & Pasternak, 2010) - m^3 of water extracted daily by a Solar Pump kit (AVSF, 2013) - 110, average days in a year when irrigation is required In this way, we calculated the annual Kg of CO_2 emitted by one motorpump. Next, we multiplied that value by the cost per ton of CO_2(retrieved from the World Bank).
REVENUES	
Increased land productivity	Baseline productivity values of Vanilla have been retrieved from retrieved from FAOSTAT (FAO, 2021), while for the other crops we used the values found in the excel file “DEFIS+ EFA_3001”. We multiplied the baseline productivity value of the crops (retrieved from FAOSTAT (FAO, 2021)) by 13.6%, which represents the recorded increase in the value of crop production per capita in Madagascar due to a project focused on irrigation (3ie, 2018). In this way, we found the number of kg of crops (kg/ha) that would not be lost thanks to the investment. Next, we multiplied this value by the crop price, retrieved from SelinaWamucii(Selina Wamucii, 2021) in the case of Vanilla, and from the excel file “DEFIS+ EFA_3001” in the case of the other crops.

IT 3 Installation of de-silting systems

INVESTMENTS	
Capital costs	Annex 4 DEFIS+ Detailed Budget
Professional/ Contractual Services	We assumed that the annual O&M costs amount to 10% of the capital costs
AVOIDED COSTS	
Avoided costs of flood	The annual value of avoided flood events by ha was retrieved from a publication of the Ministry of Natural Resources – Rwanda (2014)
Increased CO_2 sequestration	Grewer et al (2018) reported the annual GHG impacts per hectare from changes in agricultural practices (in this case Improved water management). We multiplied that value by the cost per ton of CO_2(retrieved from the World Bank).
REVENUES	
Increased land productivity	Baseline productivity values of Vanilla have been retrieved from retrieved from FAOSTAT (FAO, 2021), while for the other crops we used the values found in the excel file "DEFIS+ EFA_3001". We multiplied the baseline productivity value of the crops (retrieved from FAOSTAT (FAO, 2021)) by 20%, which represents the assumed value of "avoided impact of reduced water flow". In this way, we found the number of kg of crops (kg/ha) that would not be lost thanks to the investment. Next, we multiplied this value by the crop price, retrieved from SelinaWamucii(Selina Wamucii, 2021) in the case of Vanilla, and from the excel file "DEFIS+ EFA_3001" in the case of the other crops.

IT 4 Landscape restoration and reforestation (anti erosion)

INVESTMENTS	
Capital costs	Annex 4 DEFIS+ Detailed Budget
Professional/ Contractual Services	Annex 4 DEFIS+ Detailed Budget March 2021) GCF comments AE responses Aug2021
AVOIDED COSTS	
Avoided water pollution	Value retrieved from Curtis (2004)
Increased CO_2 sequestration	Grewer et al (2018) reported the annual GHG impacts per hectare from changes in agricultural practices (in this case "Increased biomass through agroforestry"). We multiplied that value by the cost per ton of CO_2(retrieved from the World Bank).
REVENUES	
Increased land productivity	Baseline productivity values of Vanilla have been retrieved from retrieved from FAOSTAT (FAO, 2021), while for the other crops we used the values found in the excel file "DEFIS+ EFA_3001". To calculate the added revenues from crops, we multiplied the baseline productivity values by the following values (summed up and then divided by 3): - 28%, which represents the mean value of avoided drought-induced stress thanks to agroforestry (Reyes, Gosme, Wolz, Lecomte, & Dupraz, 2021) - 139%, which represents the mean value of yield increase in Rwanda thanks to a project that aimed to reduce erosion (Delgado, Wolosin, & Purvis, 2015) - 28%, which represents the yield increase thanks to the windbreaking effect of trees (Thevs, Aliev, & Lleshi, 2021) In this way, we found the number of kg of crops (kg/ha) that would not be lost thanks to the investment. Next, we multiplied this value by the crop price, retrieved from SelinaWamucii(Selina Wamucii, 2021) in the case of Vanilla, and from the excel file "DEFIS+ EFA_3001" in the case of the other crops.

IT 5 Water tanks for micro irrigation

INVESTMENTS	
Capital costs	Assumed
Professional/ Contractual Services	We assumed that the annual O&M costs amount to 10% of the capital costs
AVOIDED COSTS	
Reduced nutrient concentration (higher N uptake)	We multiplied the price of Urea in Madagascar (JICA, 2020) by the simulated application of urea in farms in Madagascar (Alvarez, et al., 2014), and by 20%, which is the assumed savings of fertilizers thanks to water tanks.
Increased CO_2 sequestration	Grewer et al (2018) reported the annual GHG impacts per hectare from changes in agricultural practices (in this case “Improved water management”). We multiplied that value by the cost per ton of CO_2(retrieved from the World Bank).
REVENUES	
Increased land productivity	Baseline productivity values of Vanilla have been retrieved from retrieved from FAOSTAT (FAO, 2021), while for the other crops we used the values found in the excel file “DEFIS+ EFA_3001”. We multiplied the baseline productivity value of the crops (retrieved from FAOSTAT (FAO, 2021)) by 13.6%, which represents the recorded increase in the value of crop production per capita in Madagascar due to a project focused on irrigation (3ie, 2018). In this way, we found the number of kg of crops (kg/ha) that would not be lost thanks to the investment. Next, we multiplied this value by the crop price, retrieved from SelinaWamucii(Selina Wamucii, 2021) in the case of Vanilla, and from the excel file “DEFIS+ EFA_3001” in the case of the other crops

IT 6 Rehabilitation of irrigation perimeters

INVESTMENTS	
Capital costs	Assumed
Professional/ Contractual Services	We assumed that the annual O&M costs amount to 10% of the capital costs
AVOIDED COSTS	
Reduced nutrient concentration (higher N uptake)	We multiplied the price of Urea in Madagascar (JICA, 2020) by the simulated application of urea in farms in Madagascar (Alvarez, et al., 2014), and by 37.5%, which is the average savings of fertilizers that can be achieved through drip irrigation (Debnath & Mohiuddin, 2020).
Increased CO_2 sequestration	Grewer et al (2018) reported the annual GHG impacts per hectare from changes in agricultural practices (in this case "Improved water management"). We multiplied that value by the cost per ton of CO_2 (retrieved from the World Bank).
REVENUES	
Increased land productivity	Baseline productivity values of Vanilla have been retrieved from retrieved from FAOSTAT (FAO, 2021), while for the other crops we used the values found in the excel file "DEFIS+ EFA_3001". We multiplied the baseline productivity value of the crops (retrieved from FAOSTAT (FAO, 2021)) by 13.6%, which represents the recorded increase in the value of crop production per capita in Madagascar due to a project focused on irrigation (3ie, 2018). In this way, we found the number of kg of crops (kg/ha) that would not be lost thanks to the investment. Next, we multiplied this value by the crop price, retrieved from SelinaWamucii(Selina Wamucii, 2021) in the case of Vanilla, and from the excel file "DEFIS+ EFA_3001" in the case of the other crops

IT 7 Construction of ridge ditches for improved drainage

INVESTMENTS	
Capital costs	1,800 USD/km (van Steenbergen, et al., 2021)
O&M costs	We assumed that the annual O&M costs amount to USD 700 per year
AVOIDED COSTS	
Reduced damages	The values of erosion, flooding, sedimentation, and climate change, as well as the reduced costs of less time of roads, have been retrieved from table 1.3 shown in World Bank report (van Steenbergen, et al., 2021)
Avoided costs of travel interruption in one year	For this avoided cost we considered primary, secondary, and tertiary roads. Please note that only primary roads have been considered in the assessment. However, a potential user may want to use the values for secondary or tertiary roads. We assumed that tertiary roads are unpaved. From the World Bank we retrieved the estimated traffic volumes (vehicle/day) on paved and unpaved roads in Madagascar (Cervigni, Losos, Neumann, & Chinowsky, 2016). The same reference indicates the estimate of the value of a day of disruption per vehicle (paved roads), while we made an assumption for unpaved roads. These values have been then multiplied by the disruption days due to flooding in SSA divided by the length of the road network in SSA obtaining the disruption days per km (we made low and high assumptions on disruption based on which road we considered). In this way, we calculated the avoided costs of travel interruption in one year for each road. Disruption days due to flooding have been calculated as follows: Disruption days due to flooding in the PIDA+ network divided by 35 (number of years from 2015 to 2050) - (van Steenbergen, et al., 2021). The same reference indicates the length of the road network in SSA.
REVENUES	
Improved market access	Baseline productivity values of Vanilla have been retrieved from retrieved from FAOSTAT (FAO, 2021), while for the other crops we used the values found in the excel file “DEFIS+ EFA_3001”. We assumed a fixed price increase due to market access. To calculate the productivity increase, we multiplied the baseline productivity value by the % of avoided disrupted days due to flooding in a year divided by 365 (we assumed that a disruption event occurs every year) and that if 1km is disrupted, then the whole road is impassible. Next, we multiplied this value by the crop price, retrieved from SelinaWamucii(Selina Wamucii, 2021) in the case of Vanilla, and from the excel file “DEFIS+ EFA_3001” in the case of the other crops

IT 8 Runoff water collection

INVESTMENTS	
Capital costs	1,800 USD/km (van Steenbergen, et al., 2021)
O&M costs	We assumed that the annual O&M costs amount to USD 700 per year
AVOIDED COSTS	
Reduced damages	The values of erosion, flooding, sedimentation, and climate change, as well as the reduced costs of less time of roads, have been retrieved from table 1.3 shown in World Bank report (van Steenbergen, et al., 2021)
Avoided costs of travel interruption in one year	For this avoided cost we considered primary, secondary, and tertiary roads. Please note that only primary roads have been considered in the assessment. However, a potential user may want to use the values for secondary or tertiary roads. We assumed that tertiary roads are unpaved. From the World Bank we retrieved the estimated traffic volumes (vehicle/day) on paved and unpaved roads in Madagascar (Cervigni, Losos, Neumann, & Chinowsky, 2016). The same reference indicates the estimate of the value of a day of disruption per vehicle (paved roads), while we made an assumption for unpaved roads. These values have been then multiplied by the disruption days due to flooding in SSA divided by the length of the road network in SSA obtaining the disruption days per km (we made low and high assumptions on disruption based on which road we considered). In this way, we calculated the avoided costs of travel interruption in one year for each road. Disruption days due to flooding have been calculated as follows: Disruption days due to flooding in the PIDA+ network divided by 35 (number of years from 2015 to 2050) - (van Steenbergen, et al., 2021). The same reference indicates the length of the road network in SSA.
REVENUES	
Improved market access	Baseline productivity values of Vanilla have been retrieved from retrieved from FAOSTAT (FAO, 2021), while for the other crops we used the values found in the excel file “DEFIS+ EFA_3001”. We assumed a fixed price increase due to market access. To calculate the productivity increase, we multiplied the baseline productivity value by the % of avoided disrupted days due to flooding in a year divided by 365 (we assumed that a disruption event occurs every year) and that if 1km is disrupted, then the whole road is impassibleNext, we multiplied this value by the crop price, retrieved from SelinaWamucii(Selina Wamucii, 2021) in the case of Vanilla, and from the excel file “DEFIS+ EFA_3001” in the case of the other crops.

IT 9 Road improved drainage and reinforcement during the rehabilitation

INVESTMENTS	
Capital costs	Capital costs (USD/km) have been calculated as the sum of labor cost (suggested by MetaMeta) and the cost of 1km of asphalt (Tadamun, 2015) (exchange EGP to USD: 0.0064). These costs appeared to be too high for asphalt. Therefore, we applied them to a pavement made of rubble masonry.
O&M costs	We assumed that the annual O&M costs amount to 10% of the capital costs
AVOIDED COSTS	
Avoided costs of travel interruption in one year	For this avoided cost we considered primary, secondary, and tertiary roads. Please note that only primary roads have been considered in the assessment. However, a potential user may want to use the values for secondary or tertiary roads. We assumed that tertiary roads are unpaved. From the World Bank we retrieved the estimated traffic volumes (vehicle/day) on paved and unpaved roads in Madagascar (Cervigni, Losos, Neumann, & Chinowsky, 2016). The same reference indicates the estimate of the value of a day of disruption per vehicle (paved roads), while we made an assumption for unpaved roads. These values have been then multiplied by the disruption days due to flooding, temperature, and precipitation in SSA divided by the length of the road network in SSA obtaining the disruption days per km (we made low and high assumptions on disruption based on which road we considered). In this way, we calculated the avoided costs of travel interruption in one year for each road. Disruption days due to flooding have been calculated as follows: Disruption days due to flooding, precipitation, and temperature in the PIDA+ network divided by 35 (number of years from 2015 to 2050) - (van Steenbergen, et al., 2021). The same reference indicates the length of the road network in SSA.
REVENUES	
Jobs and income creation	We assumed that the total benefits of jobs and income creation amount to 30% of the labor capital costs

IT 10 Storage infrastructure for road construction and rehabilitation (to allow faster actions)

INVESTMENTS	
Capital costs	(Roadsforwater, 2014)
O&M costs	We assumed that the annual O&M costs amount to 10% of the capital costs
AVOIDED COSTS	
Avoided costs of travel interruption in one year	For this avoided cost we considered primary, secondary, and tertiary roads. Please note that only primary roads have been considered in the assessment. However, a potential user may want to use the values for secondary or tertiary roads. We assumed that tertiary roads are unpaved. From the World Bank we retrieved the estimated traffic volumes (vehicle/day) on paved and unpaved roads in Madagascar (Cervigni, Losos, Neumann, & Chinowsky, 2016). The same reference indicates the estimate of the value of a day of disruption per vehicle (paved roads), while we made an assumption for unpaved roads. These values have been then multiplied by the disruption days due to flooding, temperature, and precipitation in SSA divided by the length of the road network in SSA obtaining the disruption days per km (we made low and high assumptions on disruption based on which road we considered). In this way, we calculated the avoided costs of travel interruption in one year for each road. Disruption days due to flooding have been calculated as follows: Disruption days due to flooding, precipitation, and temperature in the PIDA+ network divided by 35 (number of years from 2015 to 2050) - (van Steenbergen, et al., 2021). The same reference indicates the length of the road network in SSA.
REVENUES	
Improved market access	Baseline productivity values of Vanilla have been retrieved from retrieved from FAOSTAT (FAO, 2021), while for the other crops we used the values found in the excel file “DEFIS+ EFA_3001”. We assumed a fixed price increase due to market access. To calculate the productivity increase, we multiplied the baseline productivity value by the % of avoided disrupted days due to flooding in a year divided by 365 (we assumed that a disruption event occurs every year) and that if 1km is disrupted, then the whole road is impassibleNext, we multiplied this value by the crop price, retrieved from SelinaWamucii(Selina Wamucii, 2021) in the case of Vanilla, and from the excel file “DEFIS+ EFA_3001” in the case of the other crops.

Annex II: Numerical assumptions for the economic and financial analysis

Data for calculating the costs, benefits, and avoided costs of the different investment types (ITs) were retrieved from peer-reviewed studies and grey literature.

The full description of the sources can be found in Annex I

Tables from *Table 5* to *Table 14* present the monetary costs, benefits, and avoided costs of each IT. The lifetime of the investment was assumed to be 20 years for each IT.

The following notes should be considered when reviewing assumptions and results of the analysis.

- We assumed that the financial discount rate of all investments is 8.5%
- We assumed that the social discount rate of all investments is 6.0%
- Values highlighted in grey have not been used.
- We prepared different CBAs considering the Revenues of only Vanilla, Maize, Rice, Onion, and Cassava. The prices and productivity values of all crops have been retrieved from the "DEFIS+ EFA_3001" project, except for Vanilla, whose values have been retrieved from FAOSTAT. Please note that the baseline productivity values retrieved from the "DEFIS+ EFA_3001" project already consider the increased yields from that project; therefore, we assume that there is a synergy with the ITs here considered. These crops have been considered in all the investments except IT9.
- Unless noted otherwise, we consider that each crop contributes by 20% to the total Revenues.
- The values of "Increased CO_2 sequestration", where indicated in the tables below "See Carbon and SCC", have been calculated by multiplying the annual CO_2 sequestration of specific investments by the economic value of carbon and by an annual rate of change. More information on the sources can be found in Annex I, while the values can be visualized in the spreadsheet models.
- When the investments related to road management considered the benefits from "improved market access" we made a conservative assumption where 1km of road serves 50ha of agricultural land.
- The "programme" analyses consider the total new items (ha or km) that can be supported by the project. We considered that the project covers only the capital cost, while the O&M costs are covered by the recipient throughout the lifetime of the investment.

IT 1: Improved drainage network

Table 5: IT1 Improved drainage network – Summary of benefits

	Units	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032-2042.
Farm Benefits - Ivestment Type 1 (Amount in US$ '000)											
Vanilla	USD	$ 426	$ 1,540	$ 2,310	$ 4,457	$ 5,572	$ 5,572	$ 5,572	$ 5,572	$ 5,572	$ 5,572
Maize	USD	$ 96	$ 300	$ 1,266	$ 2,123	$ 2,653	$ 2,653	$ 2,653	$ 2,653	$ 2,653	$ 2,653
Rice	USD	$ 152	$ 714	$ 1,380	$ 3,074	$ 3,843	$ 3,843	$ 3,843	$ 3,843	$ 3,843	$ 3,843
Onion	USD	$ 110	$ 1,090	$ 2,288	$ 3,920	$ 4,900	$ 4,900	$ 4,900	$ 4,900	$ 4,900	$ 4,900
Cassava	USD	$ 1,164	$ 2,749	$ 4,755	$ 8,022	$ 10,028	$ 10,028	$ 10,028	$ 10,028	$ 10,028	$ 10,028
Avoided Costs of Flood	**USD**	$ 167	$ 334	$ 501	$ 669	$ 836	$ 836	$ 836	$ 836	$ 836	$ 836
Total Incremental Benefits	**USD**	**$ 2,114**	**$ 6,728**	**$12,500**	**$22,266**	**$ 27,832**	**$ 27,832**	**$ 27,832**	**$ 27,832**	**$ 27,832**	**$ 27,832**
Costs											
Capital Expenditure	**USD**	**$ 976**	**$ 976**	**$ 976**	**$ 976**	**$ 976**					
Vanilla	USD	$ 863	$ 1,726	$ 2,589	$ 3,452	$ 4,316	$ 4,316	$ 4,316	$ 4,316	$ 4,316	$ 4,316
Maize	USD	$ 384	$ 769	$ 1,153	$ 1,538	$ 1,922	$ 1,922	$ 1,922	$ 1,922	$ 1,922	$ 1,922
Rice	USD	$ 520	$ 1,040	$ 1,561	$ 2,081	$ 2,601	$ 2,601	$ 2,601	$ 2,601	$ 2,601	$ 2,601
Onion	USD	$ 766	$ 1,533	$ 2,299	$ 3,066	$ 3,832	$ 3,832	$ 3,832	$ 3,832	$ 3,832	$ 3,832
Cassava	USD	$ 1,883	$ 3,766	$ 5,648	$ 7,531	$ 9,414	$ 9,414	$ 9,414	$ 9,414	$ 9,414	$ 9,414
Total COSTS (USD)	**USD**	**$ 5,393**	**$ 9,810**	**$14,227**	**$18,644**	**$ 23,061**	**$ 22,085**	**$ 22,085**	**$ 22,085**	**$ 22,085**	**$ 22,085**
Net Incremental Benefits	**USD**	**$(3,279)**	**$(3,082)**	**$ (1,727)**	**$ 3,622**	**$ 4,771**	**$ 5,747**	**$ 5,747**	**$ 5,747**	**$ 5,747**	**$ 5,747**

Economic Sustainability Metrics - Without Emissions		
Discount Rate	**6%**	
Values in USD		
ENPV	**40,859**	*USD*
ERR	**40%**	*%*
EMIRR	**17%**	*%*
B/C Ratio	**1.21**	

IT 2 Construct irrigation schemes using improved technologies (drip irrigation, solar pumps)

Table 6: IT2 Construct irrigation schemes using improved technologies - – Summary of benefits

	Units										
		2023	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032-2042.**
Incremental Benefits - Investment Type 2											
Vanilla	USD	$ 628	$ 2,272	$ 3,409	$ 6,577	$ 8,221	$ 8,221	$ 8,221	$ 8,221	$ 8,221	$ 8,221
Maize	USD	$ 141	$ 443	$ 1,867	$ 3,132	$ 3,915	$ 3,915	$ 3,915	$ 3,915	$ 3,915	$ 3,915
Rice	USD	$ 224	$ 1,054	$ 2,036	$ 4,536	$ 5,670	$ 5,670	$ 5,670	$ 5,670	$ 5,670	$ 5,670
Onion	USD	$ 162	$ 1,608	$ 3,375	$ 5,784	$ 7,230	$ 7,230	$ 7,230	$ 7,230	$ 7,230	$ 7,230
Cassava	USD	$ 1,718	$ 4,056	$ 7,015	$ 11,836	$ 14,796	$ 14,796	$ 14,796	$ 14,796	$ 14,796	$ 14,796
Benefits from avoidabble costs of electricity	**USD**	$ 318	$ 636	$ 954	$ 1,272	$ 1,589	$ 1,589	$ 1,589	$ 1,589	$ 1,589	$ 1,589
Total Incremental Benefits	**USD**	**$ 3,190**	**$10,069**	**$18,656**	**$ 33,136**	**$ 41,420**	**$ 41,420**	**$ 41,420**	**$ 41,420**	**$ 41,420**	**$ 41,420**
Costs											
Capital Investment	USD	$ 1,240	$ 1,240	$ 1,240	$ 1,240	$ 1,240					
Vanilla	USD	$ 1,273	$ 2,547	$ 3,820	$ 5,094	$ 6,367	$ 6,367	$ 6,367	$ 6,367	$ 6,367	$ 6,367
Maize	USD	$ 586	$ 1,171	$ 1,757	$ 2,343	$ 2,929	$ 2,929	$ 2,929	$ 2,929	$ 2,929	$ 2,929
Rice	USD	$ 768	$ 1,535	$ 2,303	$ 3,070	$ 3,838	$ 3,838	$ 3,838	$ 3,838	$ 3,838	$ 3,838
Onion	USD	$ 1,102	$ 2,204	$ 3,306	$ 4,407	$ 5,509	$ 5,509	$ 5,509	$ 5,509	$ 5,509	$ 5,509
Cassava	USD	$ 2,677	$ 5,353	$ 8,030	$ 10,707	$ 13,384	$ 13,384	$ 13,384	$ 13,384	$ 13,384	$ 13,384
Total COSTS (USD)	**USD**	**$ 7,645**	**$14,051**	**$20,456**	**$ 26,861**	**$ 33,267**	**$ 32,026**	**$ 32,026**	**$ 32,026**	**$ 32,026**	**$ 32,026**
Net Incremental Benefits	**USD**	**$(4,455)**	**$ (3,982)**	**$ (1,800)**	**$ 6,275**	**$ 8,153**	**$ 9,394**	**$ 9,394**	**$ 9,394**	**$ 9,394**	**$ 9,394**
Net Value Emmision (low Carbon Price/ton) Million US$	**USD**	$ 99	$ 204	$ 313	$ 427	$ 545	$ 558	$ 570	$ 582	$ 594	$ 606
Net Value Emmision (high Carbon Price/ton) Million US$	**USD**	$ 199	$ 407	$ 625	$ 844	$ 1,079	$ 1,103	$ 1,139	$ 1,164	$ 1,188	$ 1,212
Incremental Net benefit from Project in $ with low Carbon Price/ton(Cash flow)		**$(4,356)**	**$ (3,778)**	**$ (1,487)**	**$ 6,701**	**$ 8,699**	**$ 9,951**	**$ 9,963**	**$ 9,975**	**$ 9,988**	**$ 10,000**
Incremental Net benefit from Project in $ with high Carbon Price/ton (Cash flow)		**$(4,256)**	**$ (3,575)**	**$ (1,175)**	**$ 7,118**	**$ 9,232**	**$ 10,497**	**$ 10,533**	**$ 10,557**	**$ 10,581**	**$ 10,606**

Economic Sustainability Metrics - Without Emissions		
Discount Rate	**6%**	
Values in USD		
ENPV	**$ 69,979**	*USD*
ERR	**47%**	*%*
EMIRR	**19%**	*%*
B/C Ratio	**1.249**	

Economic Sustainability Metrics - With Low Carbon Emission		
Discount Rate	**6%**	
Values in USD		
ENPV	**75,878**	*USD*
ERR	**50%**	*%*
EMIRR	**19%**	*%*

Economic Sustainability Metrics - With High Carbon Emission		
Discount Rate	**6%**	
Values in USD		
ENPV	**81,758**	*USD*
ERR	**54%**	*%*
EMIRR	**20%**	*%*

IT 3 Installation of de-silting systems

Table 7: IT3 Installation of de-silting systems - – Summary of benefits

	Units	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032-2042.
Incremental Benefits - Investment Type 3 (Amount in US$ '000)											
Vanilla	USD	$ 80	$ 371	$ 715	$ 1,164	$ 1,455	$ 1,455	$ 1,455	$ 1,455	$ 1,455	$ 1,455
Maize	USD	$ 27	$ 86	$ 362	$ 607	$ 759	$ 759	$ 759	$ 759	$ 759	$ 759
Rice	USD	$ 43	$ 204	$ 395	$ 879	$ 1,099	$ 1,099	$ 1,099	$ 1,099	$ 1,099	$ 1,099
Onion	USD	$ 31	$ 312	$ 654	$ 1,121	$ 1,402	$ 1,402	$ 1,402	$ 1,402	$ 1,402	$ 1,402
Cassava	USD	$ 333	$ 786	$ 1,360	$ 2,295	$ 2,869	$ 2,869	$ 2,869	$ 2,869	$ 2,869	$ 2,869
Benefits from avoidabble costs of flooding	**USD**	$ 48	$ 96	$ 143	$ 191	$ 239	$ 239	$ 239	$ 239	$ 239	$ 239
Total Incremental Benefits	**USD**	$ 563	$ 1,855	$ 3,630	$ 6,258	$ 7,823	$ 7,823	$ 7,823	$ 7,823	$ 7,823	$ 7,823
Costs											
Capital Investment	USD	$ 175	$ 175	$ 175	$ 175	$ 175					
Vanilla	USD	$ 247	$ 494	$ 741	$ 988	$ 1,234	$ 1,234	$ 1,234	$ 1,234	$ 1,234	$ 1,234
Maize	USD	$ 114	$ 227	$ 341	$ 454	$ 568	$ 568	$ 568	$ 568	$ 568	$ 568
Rice	USD	$ 149	$ 298	$ 446	$ 595	$ 744	$ 744	$ 744	$ 744	$ 744	$ 744
Onion	USD	$ 214	$ 427	$ 641	$ 855	$ 1,068	$ 1,068	$ 1,068	$ 1,068	$ 1,068	$ 1,068
Cassava	USD	$ 519	$ 1,038	$ 1,557	$ 2,076	$ 2,595	$ 2,595	$ 2,595	$ 2,595	$ 2,595	$ 2,595
Total COSTS (USD)	**USD**	$ 1,416	$ 2,658	$ 3,900	$ 5,142	$ 6,384	$ 6,210	$ 6,210	$ 6,210	$ 6,210	$ 6,210
Net Incremental Benefits	**USD**	$ (853)	$ (803)	$ (271)	$ 1,116	$ 1,439	$ 1,613	$ 1,613	$ 1,613	$ 1,613	$ 1,613
Net Value Emmision (low Carbon Price/ton) Million US$	**USD**	$ 19	$ 39	$ 61	$ 83	$ 106	$ 108	$ 110	$ 113	$ 115	$ 118
Net Value Emmision (high Carbon Price/ton) Million US$	**USD**	$ 39	$ 79	$ 121	$ 164	$ 209	$ 214	$ 221	$ 226	$ 230	$ 235
Incremental Net benefit from Project in $ with low Carbon Price/ton(Cash flow)		$ (834)	$ (764)	$ (210)	$ 1,199	$ 1,545	$ 1,722	$ 1,724	$ 1,726	$ 1,729	$ 1,731
Incremental Net benefit from Project in $ with high Carbon Price/ton (Cash flow)		$ (815)	$ (724)	$ (149)	$ 1,280	$ 1,648	$ 1,827	$ 1,834	$ 1,839	$ 1,844	$ 1,848

Economic Sustainability Metrics - Without Emissions		
Discount Rate	**6%**	
Values in USD		
ENPV	**11,922**	*USD*
ERR	**44%**	*%*
EMIRR	**18%**	*%*
B/C Ratio	**1.22**	

Economic Sustainability Metrics - With Low Carbon Emission		
Discount Rate	**6%**	
Values in USD		
ENPV	**13,065**	*USD*
ERR	**48%**	*%*
EMIRR	**19%**	*%*

Economic Sustainability Metrics - With High Carbon Emission		
Discount Rate	**6%**	
Values in USD		
ENPV	**14,205**	*USD*
ERR	**51%**	*%*
EMIRR	**20%**	*%*

IT 4 Landscape restoration and reforestation (anti erosion)

Table 8: IT4 Landscape restoration and reforestation (anti erosion) – Summary of benefits

	Unit	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032-2042.
Incremental Benefits - Ivestment Type 4 (Amount in US$ '000)											
Vanilla	USD	$ 565	$ 2,045	$ 3,068	$ 5,919	$ 7,399	$ 7,399	$ 7,399	$ 7,399	$ 7,399	$ 7,399
Maize	USD	$ 127	$ 398	$ 1,681	$ 2,819	$ 3,523	$ 3,523	$ 3,523	$ 3,523	$ 3,523	$ 3,523
Rice	USD	$ 201	$ 949	$ 1,833	$ 4,082	$ 5,103	$ 5,103	$ 5,103	$ 5,103	$ 5,103	$ 5,103
Onion	USD	$ 146	$ 1,447	$ 3,038	$ 5,206	$ 6,507	$ 6,507	$ 6,507	$ 6,507	$ 6,507	$ 6,507
Cassava	USD	$ 1,546	$ 3,650	$ 6,313	$ 10,653	$ 13,316	$ 13,316	$ 13,316	$ 13,316	$ 13,316	$ 13,316
Benefits from Reduced nutrient concentration (higher N uptake)	**USD**	$ 14	$ 28	$ 42	$ 57	$ 71	$ 71	$ 71	$ 71	$ 71	$ 71
Total Incremental Benefits	**USD**	**$ 2,599**	**$ 8,518**	**$15,974**	**$ 28,735**	**$ 35,918**	**$ 35,918**	**$ 35,918**	**$ 35,918**	**$ 35,918**	**$ 35,918**
Costs											
Capital Expenditure	**USD**	$ 857	$ 857	$ 857	$ 857	$ 857					
Vanilla	USD	$ 1,146	$ 2,292	$ 3,438	$ 4,584	$ 5,731	$ 5,731	$ 5,731	$ 5,731	$ 5,731	$ 5,731
Maize	USD	$ 527	$ 1,054	$ 1,581	$ 2,109	$ 2,636	$ 2,636	$ 2,636	$ 2,636	$ 2,636	$ 2,636
Rice	USD	$ 691	$ 1,382	$ 2,072	$ 2,763	$ 3,454	$ 3,454	$ 3,454	$ 3,454	$ 3,454	$ 3,454
Onion	USD	$ 992	$ 1,983	$ 2,975	$ 3,967	$ 4,958	$ 4,958	$ 4,958	$ 4,958	$ 4,958	$ 4,958
Cassava	USD	$ 2,409	$ 4,818	$ 7,227	$ 9,636	$ 12,045	$ 12,045	$ 12,045	$ 12,045	$ 12,045	$ 12,045
Total COSTS (USD)	**USD**	**$ 6,621**	**$12,386**	**$18,151**	**$ 23,916**	**$ 29,681**	**$ 28,824**	**$ 28,824**	**$ 28,824**	**$ 28,824**	**$ 28,824**
Net Incremental Benefits	**USD**	**$(4,022)**	**$ (3,868)**	**$ (2,177)**	**$ 4,819**	**$ 6,238**	**$ 7,094**	**$ 7,094**	**$ 7,094**	**$ 7,094**	**$ 7,094**
Net Value Emmision (low Carbon Price/ton) Million US$	**USD**	$ 89	$ 183	$ 281	$ 384	$ 491	$ 502	$ 513	$ 524	$ 535	$ 545
Net Value Emmision (high Carbon Price/ton) Million US$	**USD**	$ 179	$ 367	$ 563	$ 759	$ 971	$ 993	$ 1,025	$ 1,047	$ 1,069	$ 1,091
Incremental Net benefit from Project in $ with low Carbon Price/ton(Cas	**USD**	**$(3,933)**	**$ (3,685)**	**$ (1,895)**	**$ 5,203**	**$ 6,729**	**$ 7,596**	**$ 7,607**	**$ 7,618**	**$ 7,629**	**$ 7,640**
Incremental Net benefit from Project in $ with high Carbon Price/ton (Ca	**USD**	**$(3,843)**	**$ (3,502)**	**$ (1,614)**	**$ 5,578**	**$ 7,209**	**$ 8,087**	**$ 8,120**	**$ 8,142**	**$ 8,163**	**$ 8,185**

Economic Sustainability Metrics - Without Emissions		
Discount Rate	**6%**	
Values in USD		
ENPV	**50,901**	*USD*
ERR	**40%**	*%*
EMIRR	**17%**	*%*
B/C Ratio	**1.21**	

Economic Sustainability Metrics - With Low Carbon Emission		
Discount Rate	**6%**	
Values in USD		
ENPV	**56,210**	*USD*
ERR	**44%**	*%*
EMIRR	**18%**	*%*

Economic Sustainability Metrics - With High Carbon Emission		
Discount Rate	**6%**	
Values in USD		
ENPV	**61,502**	*USD*
ERR	**47%**	*%*
EMIRR	**19%**	*%*

IT 5 Water tanks for micro irrigation

Table 9: IT5 Water tanks for micro irrigation – Summary of benefits

	Unit	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032-2042.
Incremental Benefits - Ivestment Type 5 (Amount in US$ '000)											
Vanilla	USD	$ 3	$ 57	$ 137	$ 274	$ 274	$ 274	$ 274	$ 274	$ 274	$ 274
Maize	USD	$ 1	$ 11	$ 75	$ 130	$ 130	$ 130	$ 130	$ 130	$ 130	$ 130
Rice	USD	$ 1	$ 26	$ 82	$ 189	$ 189	$ 189	$ 189	$ 189	$ 189	$ 189
Onion	USD	$ 1	$ 40	$ 136	$ 241	$ 241	$ 241	$ 241	$ 241	$ 241	$ 241
Cassava	USD	$ 14	$ 161	$ 426	$ 692	$ 692	$ 692	$ 692	$ 692	$ 692	$ 692
Reduced nutrient concentration (higher N uptake)	**USD**	$ 0	$ 2	$ 4	$ 6	$ 6	$ 6	$ 6	$ 6	$ 6	$ 6
Total Incremental Benefits	**USD**	$ 20	$ 297	$ 860	$ 1,533	$ 1,533	$ 1,533	$ 1,533	$ 1,533	$ 1,533	$ 1,533
Costs											
Capital Expenditure	USD	$ 102	$ 933	$ 1,469	$ 956						
Vanilla	USD	$ 6	$ 64	$ 154	$ 212	$ 212	$ 212	$ 212	$ 212	$ 212	$ 212
Maize	USD	$ 3	$ 29	$ 71	$ 98	$ 98	$ 98	$ 98	$ 98	$ 98	$ 98
Rice	USD	$ 4	$ 38	$ 93	$ 128	$ 128	$ 128	$ 128	$ 128	$ 128	$ 128
Onion	USD	$ 6	$ 56	$ 136	$ 188	$ 188	$ 188	$ 188	$ 188	$ 188	$ 188
Cassava	USD	$ 13	$ 134	$ 324	$ 447	$ 447	$ 447	$ 447	$ 447	$ 447	$ 447
Total COSTS (USD)	**USD**	$ 134	$ 1,255	$ 2,246	$ 2,029	$ 1,074	$ 1,074	$ 1,074	$ 1,074	$ 1,074	$ 1,074
Net Incremental Benefits	**USD**	$ (114)	$ (958)	$ (1,386)	$ (497)	$ 459	$ 459	$ 459	$ 459	$ 459	$ 459
Net Value Emmision (low Carbon Price/ton) Million US$	**USD**	$ 0.49	$ 5.08	$ 12.58	$ 17.78	$ 18.18	$ 18.59	$ 18.99	$ 19.39	$ 19.80	$ 20.20
Net Value Emmision (high Carbon Price/ton) Million US$	**USD**	$ 0.98	$ 10.16	$ 25.15	$ 35.15	$ 35.96	$ 36.77	$ 37.98	$ 38.79	$ 39.60	$ 40.40
Incremental Net benefit from Project in $ with low Carbon Price/ton(Cash flow)		$ (114)	$ (953)	$ (1,373)	$ (479)	$ 477	$ 478	$ 478	$ 478	$ 479	$ 479
Incremental Net benefit from Project in $ with high Carbon Price/ton (Cash flow)		$ (113)	$ (948)	$ (1,361)	$ (462)	$ 495	$ 496	$ 497	$ 498	$ 499	$ 500

Economic Sustainability Metrics - Without Emissions		
Discount Rate	**6%**	
Values in USD		
ENPV	**1,158**	*USD*
ERR	**11%**	*%*
EMIRR	**8%**	*%*
	1.19	

Economic Sustainability Metrics - With Low Carbon Emission		
Discount Rate	**6%**	
Values in USD		
ENPV	**1,355**	*USD*
ERR	**12%**	*%*
EMIRR	**8%**	*%*

Economic Sustainability Metrics - With High Carbon Emission		
Discount Rate	**6%**	
Values in USD		
ENPV	**1,551**	*USD*
ERR	**13%**	*%*
EMIRR	**9%**	*%*

IT 6 Rehabilitation of irrigation perimeters

Table 10: IT6 Rehabilitation of irrigation perimeters – Summary of benefits

	Units	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032-2042.
Incremental Benefits - Investment Type 6 (Amount in US$ '000)											
Vanilla	USD	$ 1,136	$ 4,108	$ 6,162	$ 11,889	$ 14,861	$ 14,861	$ 14,861	$ 14,861	$ 14,861	$ 14,861
Maize	USD	$ 255	$ 800	$ 3,376	$ 5,662	$ 7,077	$ 7,077	$ 7,077	$ 7,077	$ 7,077	$ 7,077
Rice	USD	$ 404	$ 1,906	$ 3,681	$ 8,200	$ 10,250	$ 10,250	$ 10,250	$ 10,250	$ 10,250	$ 10,250
Onion	USD	$ 293	$ 2,907	$ 6,101	$ 10,456	$ 13,070	$ 13,070	$ 13,070	$ 13,070	$ 13,070	$ 13,070
Cassava	USD	$ 3,105	$ 7,332	$ 12,681	$ 21,398	$ 26,747	$ 26,747	$ 26,747	$ 26,747	$ 26,747	$ 26,747
Reduced nutrient concentration (higher N uptake)	**USD**	$ 120	$ 241	$ 361	$ 482	$ 602	$ 602	$ 602	$ 602	$ 602	$ 602
Total Incremental Benefits	**USD**	**$ 5,313**	**$17,294**	**$ 32,363**	**$ 58,086**	**$ 72,607**	**$ 72,607**	**$ 72,607**	**$ 72,607**	**$ 72,607**	**$ 72,607**
Costs											
Capital Investment	USD	$ 1,164	$ 1,164	$ 1,164	$ 1,164	$ 1,164					
Vanilla	USD	$ 2,302	$ 4,604	$ 6,906	$ 9,208	$ 11,511	$ 11,511	$ 11,511	$ 11,511	$ 11,511	$ 11,511
Maize	USD	$ 1,059	$ 2,118	$ 3,177	$ 4,235	$ 5,294	$ 5,294	$ 5,294	$ 5,294	$ 5,294	$ 5,294
Rice	USD	$ 1,388	$ 2,775	$ 4,163	$ 5,550	$ 6,938	$ 6,938	$ 6,938	$ 6,938	$ 6,938	$ 6,938
Onion	USD	$ 2,044	$ 4,088	$ 6,132	$ 8,176	$ 10,220	$ 10,220	$ 10,220	$ 10,220	$ 10,220	$ 10,220
Cassava	USD	$ 4,839	$ 9,678	$ 14,517	$ 19,356	$ 24,194	$ 24,194	$ 24,194	$ 24,194	$ 24,194	$ 24,194
Total COSTS (USD)	**USD**	**$12,796**	**$24,427**	**$ 36,059**	**$ 47,690**	**$ 59,322**	**$ 58,157**	**$ 58,157**	**$ 58,157**	**$ 58,157**	**$ 58,157**
Net Incremental Benefits	**USD**	**$ (7,482)**	**$ (7,133)**	**$ (3,695)**	**$ 10,396**	**$ 13,286**	**$ 14,450**	**$ 14,450**	**$ 14,450**	**$ 14,450**	**$ 14,450**
Net Value Emmision (low Carbon Price/ton) Million US$	**USD**	$ 180	$ 368	$ 565	$ 771	$ 986	$ 1,008	$ 1,030	$ 1,052	$ 1,074	$ 1,096
Net Value Emmision (high Carbon Price/ton) Million US$	**USD**	$ 359	$ 736	$ 1,131	$ 1,525	$ 1,950	$ 1,994	$ 2,060	$ 2,104	$ 2,147	$ 2,191
Incremental Net benefit from Project in $ with low Carbon Price/ton(Cash flow)		**$ (7,303)**	**$ (6,765)**	**$ (3,130)**	**$ 11,167**	**$ 14,272**	**$ 15,458**	**$ 15,480**	**$ 15,502**	**$ 15,524**	**$ 15,545**
Incremental Net benefit from Project in $ with high Carbon Price/ton (Cash flow)		**$ (7,123)**	**$ (6,397)**	**$ (2,565)**	**$ 11,921**	**$ 15,236**	**$ 16,444**	**$ 16,510**	**$ 16,553**	**$ 16,597**	**$ 16,641**

Economic Sustainability Metrics - Without Emissions		
Discount Rate	**6%**	
Values in USD		
ENPV	**106,523**	*USD*
ERR	**44%**	*%*
EMIRR	**18%**	*%*
B/C Ratio	**1.21**	*%*

Economic Sustainability Metrics - With Low Carbon Emission		
Discount Rate	**6%**	
Values in USD		
ENPV	**117,186**	*USD*
ERR	**48%**	*%*
EMIRR	**19%**	*%*

Economic Sustainability Metrics - With High Carbon Emission		
Discount Rate	**6%**	
Values in USD		
ENPV	**127,816**	*USD*
ERR	**51%**	*%*
EMIRR	**20%**	*%*

IT 7 Construction of ridge ditches for improved drainage

Table 11: IT7 Construction of ridge ditches for improved drainage – Summary of benefits

	Unit	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032-2042.
Incremental Benefits - Investment Type 7 (Amount in US$ '000)											
Vanilla	USD	$ 25	$ 115	$ 221	$ 360	$ 450	$ 450	$ 450	$ 450	$ 450	$ 450
Maize	USD	$ 8	$ 27	$ 112	$ 188	$ 235	$ 235	$ 235	$ 235	$ 235	$ 235
Rice	USD	$ 13	$ 63	$ 122	$ 272	$ 340	$ 340	$ 340	$ 340	$ 340	$ 340
Onion	USD	$ 10	$ 97	$ 203	$ 347	$ 434	$ 434	$ 434	$ 434	$ 434	$ 434
Cassava	USD	$ 103	$ 243	$ 421	$ 710	$ 888	$ 888	$ 888	$ 888	$ 888	$ 888
Avoided costs of travel interruption in one year - primary road	**USD**	$ 137	$ 275	$ 412	$ 549	$ 687	$ 687	$ 687	$ 687	$ 687	$ 687
Total Incremental Benefits	**USD**	**$ 297**	**$ 819**	**$ 1,491**	**$ 2,428**	**$ 3,034**	**$ 3,034**	**$ 3,034**	**$ 3,034**	**$ 3,034**	**$ 3,034**
Costs											
Capital Expenditure	USD	$ 276	$ 276	$ 276	$ 276	$ 276					
Vanilla	USD	$ 77	$ 154	$ 231	$ 308	$ 385	$ 385	$ 385	$ 385	$ 385	$ 385
Maize	USD	$ 35	$ 70	$ 105	$ 141	$ 176	$ 176	$ 176	$ 176	$ 176	$ 176
Rice	USD	$ 46	$ 92	$ 138	$ 184	$ 230	$ 230	$ 230	$ 230	$ 230	$ 230
Onion	USD	$ 68	$ 136	$ 204	$ 271	$ 339	$ 339	$ 339	$ 339	$ 339	$ 339
Cassava	USD	$ 161	$ 321	$ 482	$ 643	$ 803	$ 803	$ 803	$ 803	$ 803	$ 803
Total COSTS (USD)	**USD**	**$ 662**	**$ 1,049**	**$ 1,436**	**$ 1,823**	**$ 2,210**	**$ 1,934**	**$ 1,934**	**$ 1,934**	**$ 1,934**	**$ 1,934**
Net Incremental Benefits	**USD**	$ (366)	$ (230)	$ 55	$ 605	$ 825	$ 1,100	$ 1,100	$ 1,100	$ 1,100	$ 1,100

Economic Sustainability Metrics - Without Emissions		
Discount Rate	**6%**	
Values in USD		
ENPV	**8,578**	*USD*
ERR	**64%**	*%*
EMIRR	**23%**	*%*
B/C Ratio	**1.5**	

IT 8 Runoff water collection

Table 12: IT8 Runoff water collection – Summary of benefits

	Unit	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032-2042.**
Incremental Benefits - InvestmentType 8 (Amount in USD)											
Vanilla	USD	$ 2,792	$ 10,099	$ 15,149	$ 29,229	$ 36,536	$ 36,536	$ 36,536	$ 36,536	$ 36,536	$ 36,536
Maize	USD	$ 627	$ 1,967	$ 8,300	$ 13,919	$ 17,399	$ 17,399	$ 17,399	$ 17,399	$ 17,399	$ 17,399
Rice	USD	$ 994	$ 4,685	$ 9,050	$ 20,159	$ 25,199	$ 25,199	$ 25,199	$ 25,199	$ 25,199	$ 25,199
Onion	USD	$ 721	$ 7,147	$ 15,000	$ 25,706	$ 32,133	$ 32,133	$ 32,133	$ 32,133	$ 32,133	$ 32,133
Cassava	USD	$ 7,633	$ 18,026	$ 31,178	$ 52,606	$ 65,758	$ 65,758	$ 65,758	$ 65,758	$ 65,758	$ 65,758
Avoided costs of travel interruption in one year - primary road	**USD**	$ 5,094	$ 10,188	$ 15,282	$ 20,376	$ 25,469	$ 25,469	$ 25,469	$ 25,469	$ 25,469	$ 25,469
Total Incremental Benefits	**USD**	**$ 17,861**	**$ 52,112**	**$ 93,959**	**$ 161,995**	**$ 202,494**	**$ 202,494**	**$ 202,494**	**$ 202,494**	**$ 202,494**	**$ 202,494**
Costs											
Capital Expenditure	USD	$ 16,000	$ 16,000	$ 16,000	$ 16,000	$ 16,000	$ 16,000				
Vanilla	USD	$ 5,709	$ 11,417	$ 17,126	$ 22,835	$ 28,544	$ 28,544	$ 28,544	$ 28,544	$ 28,544	$ 28,544
Maize	USD	$ 2,603	$ 5,206	$ 7,810	$ 10,413	$ 13,016	$ 13,016	$ 13,016	$ 13,016	$ 13,016	$ 13,016
Rice	USD	$ 3,411	$ 6,823	$ 10,234	$ 13,645	$ 17,056	$ 17,056	$ 17,056	$ 17,056	$ 17,056	$ 17,056
Onion	USD	$ 5,025	$ 10,051	$ 15,076	$ 20,102	$ 25,127	$ 25,127	$ 25,127	$ 25,127	$ 25,127	$ 25,127
Cassava	USD	$ 11,896	$ 23,793	$ 35,689	$ 47,586	$ 59,482	$ 59,482	$ 59,482	$ 59,482	$ 59,482	$ 59,482
Total COSTS (USD)	**USD**	**$ 44,645**	**$ 73,290**	**$ 101,935**	**$ 130,581**	**$ 159,226**	**$ 159,226**	**$ 143,226**	**$ 143,226**	**$ 143,226**	**$ 143,226**
Net Incremental Benefits	**USD**	**(26,784)**	**(21,178)**	**(7,977)**	**31,415**	**43,269**	**43,269**	**59,269**	**59,269**	**59,269**	**59,269**

Economic Sustainability Metrics - Without Emissions		
Discount Rate	**6%**	
Values in USD		
ENPV	**442,702**	*USD*
ERR	**46%**	*%*
EMIRR	**19%**	*%*
B/C Ratio	**1.34**	

IT 9 Road improved drainage and reinforcement during the rehabilitation

Table 13: IT9 Paving or encroachment – Summary of benefits

	Unit of Measure	Unit Cost	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032-2042.
Number of Kilometers			**108**	**216**	**324**	**432**	**540**	**540**	**540**	**540**	**540**	**540**
Jobs and Income creation	Income/USD/Km	**USD**	$ 3,957	$ 7,914	$ 11,871	$ 15,828	$ 19,785	$ 19,785	$ 19,785	$ 19,785	$ 19,785	$ 19,785
Avoided costs of travel interruption in one year - primary and Secondary ro	Reduced damage	**USD**	$ 1,299,018	$ 2,598,036	$ 3,897,054	$ 5,196,072	$ 6,495,091	$ 6,495,091	$ 6,495,091	$ 6,495,091	$ 6,495,091	$ 6,495,091
TOTAL BENEFITS (REAL USD)		**USD**	$ 1,302,975	$ 2,605,950	$ 3,908,925	$ 5,211,900	$ 6,514,875	$ 6,514,875	$ 6,514,875	$ 6,514,875	$ 6,514,875	$ 6,514,875
COSTS												
Capital Investment		**USD**	$ 171,117	$ 171,117	$ 171,117	$ 171,117	$ 171,117	$ -				
Operation and Maintenance Costs		**USD**	$ -	$ 34,223	$ 51,335	$ 68,447	$ 85,558	$ 85,558	$ 85,558	$ 85,558	$ 85,558	$ 85,558
TOTAL COSTS (REAL USD)		**USD**	$ 171,117	$ 205,340	$ 222,452	$ 239,564	$ 256,675	$ 85,558	$ 85,558	$ 85,558	$ 85,558	$ 85,558
NET RESOURCE FLOW (USD REAL)		**USD**	$ 1,131,858	$ 2,400,610	$ 3,686,473	$ 4,972,337	$ 6,258,200	$ 6,429,317	$ 6,429,317	$ 6,429,317	$ 6,429,317	$ 6,429,317

Incremental Economic Sustainability Metrics (Aggregate)		
Discount Rate	**6%**	
Values in USD		
ENPV	**63,466,963**	*USD*
ERR	**#DIV/0!**	%
EMIRR	**#DIV/0!**	%
B/C Ratio	**50.2**	

ERR does not compute where the cash-flow is positive throughout

IT 10 Storage infrastructure for road construction and rehabilitation (to allow faster actions)

Table 14: IT10 Storage infrastructure for road construction and rehabilitation – Summary of benefits

	Unit	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032-2042.
Farm Benefits - Intervention 10 (Amount in US$ '000)											
Vanilla	USD	$ 38	$ 139	$ 208	$ 402	$ 502	$ 502	$ 502	$ 502	$ 502	$ 502
Maize	USD	$ 9	$ 27	$ 114	$ 191	$ 239	$ 239	$ 239	$ 239	$ 239	$ 239
Rice	USD	$ 14	$ 64	$ 124	$ 277	$ 346	$ 346	$ 346	$ 346	$ 346	$ 346
Onion	USD	$ 10	$ 98	$ 206	$ 353	$ 442	$ 442	$ 442	$ 442	$ 442	$ 442
Cassava	USD	$ 105	$ 248	$ 429	$ 723	$ 904	$ 904	$ 904	$ 904	$ 904	$ 904
Avoided costs of travel interruption in one year - primary road	**USD**	$ 220	$ 440	$ 660	$ 880	$ 1,100	$ 1,100	$ 1,100	$ 1,100	$ 1,100	$ 1,100
Total Incremental Benefits	**USD**	**$ 396**	**$ 1,016**	**$ 1,742**	**$ 2,827**	**$ 3,534**	**$ 3,534**	**$ 3,534**	**$ 3,534**	**$ 3,534**	**$ 3,534**
Costs											
Capital Expenditure	USD	$ 1,373	$ 1,373	$ 1,373	$ 1,373	$ 1,373					
Vanilla	USD	$ 78	$ 157	$ 235	$ 314	$ 392	$ 392	$ 392	$ 392	$ 392	$ 392
Maize	USD	$ 36	$ 72	$ 107	$ 143	$ 179	$ 179	$ 179	$ 179	$ 179	$ 179
Rice	USD	$ 47	$ 94	$ 141	$ 188	$ 235	$ 235	$ 235	$ 235	$ 235	$ 235
Onion	USD	$ 69	$ 138	$ 207	$ 276	$ 345	$ 345	$ 345	$ 345	$ 345	$ 345
Cassava	USD	$ 164	$ 327	$ 491	$ 654	$ 818	$ 818	$ 818	$ 818	$ 818	$ 818
Total COSTS (USD)	**USD**	$ 1,767	$ 2,160	$ 2,554	$ 2,948	$ 3,341	$ 1,969	$ 1,969	$ 1,969	$ 1,969	$ 1,969
Net Incremental Benefits	**USD**	$ (1,371)	$ (1,144)	$ (812)	$ (120)	$ 193	$ 1,566	$ 1,566	$ 1,566	$ 1,566	$ 1,566

Economic Sustainability Metrics - Without Emissions		
Discount Rate	**6%**	
Values in USD		
ENPV	**10,293**	*USD*
ERR	**23%**	*%*
EMIRR	**14%**	*%*
B/C Ratio	**1.48**	

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