Green Climate Fund Funding Proposal

Project/Programme Title:	**Enhancing community resilience and water security in the Upper Athi River Catchment Area, Kenya**
Country:	Kenya
Accredited Entity:	National Environmental Management Authority
Date of Submission:	February 2021
Document:	Economic and Financial Analysis of the funding proposal

Contents

Abbreviations and acronyms

AEV	Annual Economic Value
ARCA	Athi River Catchment Area
BCA	Benefits Costs Analysis
BCR	Benefits Costs Ratio
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CBA	Costs Benefits Analysis
EWS	Early Warning System
GCF	Green Climate Fund
IRR	Internal Rate of Return
KSHS	Kenya Shillings
NPV	Net Present Value
SEI	Stockholm Environment Institute
USD	United States Dollar
WRUAs	Water Resource User Associations

A. Introduction

A.1. About the project

1. Along the Athi River Catchment Area, there are 12 counties. Historically, drought and flooding risks were the highest in Kiambu, Machakos, Nairobi, and Nyandarua (main beneficiaries), in that order. Droughts and floods are likely to rise in the future, especially in Kiambu and Machakos County. Consequently, the water infrastructure of the study area has suffered damage or has not had enough capacity to withstand these droughts and floods; for example, the water storage or potable water supply infrastructure have been insufficient. Irregularity of water supply due to climate change has threatened the sustainability of those counties and has also caused waterborne diseases. Impacts on the quantity and quality of water are also expected due to changes in temperature, precipitation, floods and droughts in the area.

2. With climate extremes expected to increase, climate-informed water management, climate-resilient water infrastructure will be critical in order to prepare for and respond to floods and droughts. The project therefore seeks to enhance **community resilience and water security in the Upper Athi River Catchment Area** through interventions across three Outputs:
   - Output 1: enhance hydrological and meteorological monitoring system to support decision making, planning and policy development in water and climate change sector.
   - Output 2: improve climate water resilience by building, enhancing and rehabilitating prioritized water infrastructure and implementing conservation activities in the catchment.
   - Output 3: Strengthen water and adaptation planning, institutional and regulatory framework to respond to changing climatic conditions.

3. The project would directly benefit **1,156,620** people in the project site are (Kiambu, Machakos, Nairobi, and Nyandarua), with indirect benefit reaching **3,693,380** people in/from 4 counties within the catchment.

4. The Project supports the implementation and operationalization of several key national policies strategies and plan, including the National Climate Change Response Strategy (NCCRS), National Climate Change Action Plan (NCCAP), National Adaptation Plan (NAP), the Intended Nationally Determined Contribution (INDC) and the National Water Master Plan (NWMP) 2030.

5. Capacity building of national level institutions will be an upscale of the ongoing Kenya's approved GCF NAP Readiness that has focused on training county government officials on climate change and climate finance. The proposal plans to support capacity building and training for relevant water governance structures and communities within the project area (Water Resource Users Associations -WRUAs, County Environment Committees - CECs, County Adaptation Committees, Community Based Organizations -CBOs.

A.2. Methodology

6. The analysis did not carry out a financial analysis as all expenditures incurred under the project and revenues resulting from it could not be taken into account. It thus undertook an economic analysis.

7. The analysis adopted the Benefits-Costs Analysis (BCA) approach. In particular, the analysis used the following criterion tools: - The Net Present Value (NPV); Internal Rate of Return (IRR); Discounted Payback Period; Annual Economic Value; and, Benefit-Costs ratio.

8. Microsoft Excel was used to do the analysis and the spreadsheets are provided.

A.3. Assumptions used for analysis

9. The analysis took into account the following general assumptions : -
   - **Project duration:** The project life is given as four years. However, the analysis assumes that the government will continue supporting the project even after the project life. The analysis has also assumed a maximum timeline of 30 years.
   - **Factoring inflation:** Where inflation has been factored, the analysis has used the average annual Inflation rate for the last 5 years (2015 to July 2019) for Kenya which stood at 6.156%.[1] To convert the 2009 reported costs of floods to real terms, the study has used Kenya's consumer Price Index (CPI) for 2009 which stood at 102.10 and for 2019 which stood at 159.60. [2]
   - **Population growth rate:** Where the population has been assumed to grow over time, the average annual population growth rate for Kenya for the last 5 years (2015 – 2019) has been used I.e. 2.38%.[3]
   - **Discount rate:** To calculate the present value of benefits and costs, the study has used the discount rate of 12% as base case scenario. The estimated discount ranges from 10%

[1] Source: Source - https://www.statista.com/statistics/451115/inflation-rate-in-kenya/
[2] Source: http://www.knbs.or.ke/index.php?option=com_phocadownload&view=category&id=8&Itemid=562
[3] Source: World Bank - http://data.worldbank.org/indicator/SP.POP.GROW?locations=KE

to 14.5% and thus a 12% real discount rate is used as an appropriate rate for Kenya to be used in project evaluation, and investment decision making (Ghanbariamin, 2015).

- **Exchange rate:** To convert Kenya Shillings (Kshs) into US dollars (USD) and vice versa, the analysis has used the KSHS/USD exchange rate of 77.34 as the mean exchange rate for 2009[4] and 110.0071 as the mean exchange rate on 2nd February 2021[5]. The analysis has also assumed that the exchange rate will remain fixed over the coming years.

B. Costs and Benefits

B.1. Costs

10. The analysis has used the project budget figures as the costs figures. The budget figures are an aggregation of what is expected from the GCF and the co-financing from the Government of Kenya (GoK).

11. **GCF funding**: The total GCF funding is sort for the four years is USD 9,853,497.21 broken down as shown in *Table 2.1*

Table 2.1: ***GCF Funding***

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
USD	**5,622,366**	**3,007,982**	**1,153,627**	**1,025,658**	**1,507,936.68**	**10,809,633**

12. **GoK co-financing**: The Gok is expected to offer support to the project from Year 1 and throughout the project in terms of office space, staff time, vehicles, and utilities. These figures have been estimated as at Year 0 and grown over time with the average inflation rate. The figures for Year 0 are presented in *Table 2.2*. The analysis has also assumed that the Gok will support the project from Year 5 to a tune of USD 531,784 and this figure has been assumed will remain constant for a lack of a better estimate. This operations and maintenance (O&M) estimate supported by an O&M plan (attached)

Table 2.2: ***Gok support to the project in year 0***

Item	USD	Description
Office Space	**27,000.00**	USD 45,000million per month * 12 months * 5% of office space

[4] Source: https://www.centralbank.go.ke/index.php/rate-and-statistics/exchange-rates-2?yr=2009
[5] Source: Exchange rate as at 2nd February 2021. Source: https://www.centralbank.go.ke/rates/forex-exchange-rates/

Staff time	**30,000.00**	50 staff * Average salary of USD 1,000 per month * 12 months * 5% of staff time.
Gok Vehicles	**1,500.00**	3 vehicles, worth USD 50,000 each, depreciated over 5 years (20% pa), and used for the project only 5% of the time.
Utilities	**2,400.00**	Utilities estimated at USD 200 per month for 12 months.
Totals	**60,900.00**	

13. **Total financing**: *Table 2.3* thus represents the total financing (costs of the project) from Year 1 to Year 30.

Table 2.3: Total costs of the project (Year 0 – Year 30)

Year	Total costs (Budget) USD - Un-discounted
Year 0	-
Year 1	**5,687,015**
Year 2	**3,076,611**
Year 3	**1,226,481**
Year 4	**1,102,997**
Year 5	**613,883**
Year 6	**618,937**
Year 7	**624,302**
Year 8	**629,998**
Year 9	**636,044**
Year 10	**642,462**
Year 11	**649,276**
Year 12	**656,508**
Year 13	**664,186**
Year 14	**672,337**
Year 15	**680,990**
Year 16	**690,175**
Year 17	**699,925**
Year 18	**710,276**
Year 19	**721,264**
Year 20	**732,928**

Year 21	**745,311**
Year 22	**758,456**
Year 23	**772,409**
Year 24	**787,222**
Year 25	**802,947**
Year 26	**819,640**
Year 27	**837,360**
Year 28	**856,172**
Year 29	**876,141**
Year 30	**897,340**

B.2. Benefits

14. Numerous benefits/outcomes (environmental, social, and economic) are expected to accrue from the successful implementation of the project. The analysis has however singled out three key benefits that have been monetized and assessed. These are - I.e. Flood related benefits, Health related benefits, and time savings benefits.

B.2.1. Flood related benefits

15. The project is aimed at providing timely early warning information to the downstream beneficiaries to act whenever there is likelihood of a flood in an area. The project intends to give early warning signals to the families and thus expect to reduce the losses from floods.

16. The flood related benefits are based on the anticipated saving from potential losses if families do not act in time to floods. It is anticipated that if families received timely information they can move their valuable to safety and reduce potential losses.

17. The Athi River Catchment Area has four potential flood risk areas in Kiambu, Machakos, Nairobi, and Nyandarua. The floods in Nairobi are mainly due to poor drainage in the city and although to some extent the Early Warning System (EWS) may have impact, it may not have as much impact as in the case of the other counties.

18. The population in the targeted counties is about 4,176,013. The project took a conservative figure of 10% of this population with the assumption that this number will utilize the EWS information to move property. The targeted population has also been assumed to grow in numbers of time at the average annual population growth rate.

19. The cost saved was calculated based on SEI (2009). According to the report, the 1997/98 floods in Kenya affected almost 1 million people and were estimated to have total economic costs of USD 0.850 billion to USD 1.213 billion arising from damage to infrastructure (roads buildings and communications), public health effects (including fatalities) and loss of crops. For lack of better alternative, the analysis used this data to calculate the per capita cost of floods in Kenya which stood at USD 2,276.85 in real terms. Again due to lack of data on variability of floods occurrences, intensities, and subsequent losses, the analysis has assumed that the per capita costs will remain fixed over the years.

20. The project team also took a conservative figure of 5% of the total property that the families could save from floods in responding to the EWS. The analysis further assumed that only 5% of the cost saved could be fully attributed to the project. The costs saved (and thus benefits) by the households as a result of project intervention is indicated in *Table 2.3.*

B.2.2. Health related benefits

21. The health related benefits were calculated based on the cost saved from reduced diarrhea incidents in the household, thus reduced treatment cost.

22. Protected water sources such as borehole, and springs would significantly reduce the level of water borne diseases[6] and households would use clean containers to collect water from the water sources and thus reduce the risk of contaminating the water.

23. The factor of population growth was calculated for the spring sources as the water supply from this source was significantly higher than the current population and even with this growth factor keyed in, the water supply from this source can supply households growth for over 40 years, assuming a 2.65% growth rate (average population growth rate).

24. To monetize these benefits the analysis relied on a study by Cook, Kimuyu, & Whittington (2015) on the health benefits related to improved water supply, a case study of Meru county. The assumption made here is that the cost is applicable to the context of Athi River Catchment Area and thus could be used to deduce the health benefit for the families utilizing the water sources.

25. The project intends to rehabilitate stalled boreholes in the catchment and it is estimated that about 36,500 individuals will benefit from this sources. Since the water expected from

[6] Several studies have been done around this and it has been accepted that ground water is the best source of water as the water is filtered as it get to the aquifers and is thus purified.

this source can just sufficiently support these individuals, it is assumed that only this number will benefit from this source and no increment in population size is factor in for this source as shown in the calculation. As mentioned above, it is expected that the water from the springs is more than adequate to benefit up to 1.6 million individuals.

26. From the Meru study it was noted that families that fell sick and reported diarrhea spent about USD 4.74 per week on treatment. The analysis made an assumption that 50% of the cases reported could directly be linked to water quality issues and thus USD 2.37 could be attributed to the water quality issues. As mentioned above, the spring source is could initially benefit about 100,000 individuals benefit from it. Since the water from this sources can supply up to 1.6 million individuals the population growth factor was imputed for this source. However, the supply from the boreholes was assumed to be adequate for about 36,500 individuals and this is what was taken to do the calculation for the boreholes. The Meru study showed that of the population interviewed, only 7.5% reported diarrhea incidents. The analysis has taken a conservative approach and used 3% as the diarrhea incidents that would be averted due to the project intervention.

B.2.3. Times savings benefits

27. From the same study in Meru, calculation of travel time saved by beneficiaries if the water source was within the premises was used for the calculation.

28. The project intends to work on five different water sources i.e. rain water harvesting, boreholes, springs, water pans, sand dams, and pipeline. The baseline population to benefit from the interventions is as follows: 20,000 (rain water harvesting), 11,850 (boreholes), 8,200 (springs), 139,720 (water pans), 1,500 (sand dams), and 11,500 (pipeline). Thus, the total population benefiting from this project is about 181,270 individuals under the baseline year.

29. The study indicated that on average, the walking and wait time cost saved by families in Meru per month during the dry season is USD 40 and USD 11 during the rainy season. The targeted areas experience 7 dry months and 5 wet months in a year.

30. For the purposes of calculation time savings benefits, the analysis has assumed that only 10% of the total population within the targeted areas would significantly reduce the time to the water sources and wait time to almost zero. Further the analysis has taken a conservative estimate of 10% as the times savings that could be wholly attributed to the project.

B.2.4. Total benefits

31. The total benefits of the project are thus the aggregation of the three economic benefits as indicated in *Table 2.4.*

Table 2.4: *Total benefits of the project*

Year	Flood related benefits (USD)	Health related benefits (USD)	Time savings benefits (USD)	Total benefits (USD)
Year 0	-	-	-	**-**
Year 1	-	-	-	**-**
Year 2	1,751,647	-	620,719	**2,372,367**
Year 3	1,793,337	215,775	637,137	**2,646,249**
Year 4	1,836,018	221,561	653,989	**2,711,569**
Year 5	1,879,715	227,502	671,287	**2,778,505**
Year 6	1,924,453	233,602	689,043	**2,847,098**
Year 7	1,970,255	239,866	707,268	**2,917,388**
Year 8	2,017,147	246,297	725,975	**2,989,419**
Year 9	2,065,155	252,900	745,177	**3,063,232**
Year 10	2,114,305	259,681	764,887	**3,138,873**
Year 11	2,164,626	266,642	785,119	**3,216,387**
Year 12	2,216,144	273,791	805,885	**3,295,820**
Year 13	2,268,888	281,131	827,201	**3,377,220**
Year 14	2,322,888	288,667	849,080	**3,460,635**
Year 15	2,378,172	296,406	871,538	**3,546,116**
Year 16	2,434,773	304,351	894,591	**3,633,715**
Year 17	2,492,721	312,510	918,252	**3,723,483**
Year 18	2,552,047	320,887	942,540	**3,815,475**
Year 19	2,612,786	329,489	967,470	**3,909,745**
Year 20	2,674,970	338,321	993,060	**4,006,351**
Year 21	2,738,635	347,389	1,019,326	**4,105,350**
Year 22	2,803,814	356,701	1,046,288	**4,206,802**
Year 23	2,870,545	366,262	1,073,962	**4,310,769**
Year 24	2,938,864	376,079	1,102,368	**4,417,311**
Year 25	3,008,809	386,159	1,131,526	**4,526,494**
Year 26	3,080,418	396,509	1,161,455	**4,638,382**
Year 27	3,153,732	407,137	1,192,175	**4,753,044**
Year 28	3,228,791	418,049	1,223,708	**4,870,548**
Year 29	3,305,636	429,253	1,256,075	**4,990,965**
Year 30	3,384,311	440,758	1,289,298	**5,114,367**

C. Economic analysis

32. The economic analysis was done at 30, 20 and 15 years and the results are presented in *Table 3.1*.

Table 3.1: ***Economic analysis results***

	30 years, 12% discount rate	20 years 12% discount rate	15 years 12% discount rate
NPV (USD)	9,747,248.48	7,585,142.92	5,551,275.52
IRR	13%	12%	11%
Discounted payback period	7.22	7.22	7.22
AEV (USD)	1,210,059.08	1,015,489.68	815,061.81
Benefits/Costs Ratio	1.78	1.63	1.48

33. From the results, the project is economically viable at 30, 20 and 15 years. The NPV values are all positive, the IRR values are all greater than the discount rates and the BCR is greater than 1.

34. Besides the three key benefits used for analysis, other benefits (Economic, Environmental and Social) are due from the successful implementation of the project. These benefits were not quantified and thus not monetized. Some of the economic benefits not included for the analysis are:-
    - Reduction of economic losses from flooding events due to climate information as there will also be a decrease in loss of assets and lives;
    - Improved livelihoods from tree nursery establishment by Water Resource User Associations (WRUAs); and
    - Enhanced agricultural productivity from catchment rehabilitation which is expected to improve soil fertility. Enhanced productivity is expected to increase food security and incomes in the target areas.

35. Environmental benefits expected from the project and that have not captured in the analysis include: -
    - Improved biodiversity in catchment forests;
    - Improved river water quality due to stabilization and rehabilitation of riparian areas;
    - Reduction of biodiversity loss in catchment forests and national reserves and parks; and,
    - Improved soil fertility due to catchment rehabilitation measures.

36. Unquantified social benefits also due from the project include:-

- Increased capacity and awareness on water efficiency and conservation from awareness raising activities implemented through local institutions; and,
- Increased awareness and knowledge at institutional and community level on climate change risks to water availability.

D. Sensitivity analysis

37. Sensitivity analysis was undertaken on the discount rate and the inflation rate. On the discount rate, the analysis tested two scenarios – scenario 1 discount rate at 10% and at scenario 2, discount rate at 14.5%.[7] On the inflation rate, the analysis tested one scenario in which inflation was taken out (i.e. zero inflation). The results are indicated in *Table 4.1* and *Table 4.2.*

Table 4.1: Sensitivity analysis on the discount rate

	30 years, factoring in inflation			**15 years, factoring in inflation**		
	12% discount rate	10% discount rate	14.5% discount rate	12% discount rate	10% discount rate	14.5% discount rate
NPV (USD)	9,747,248.48	13,274,827.71	6,403,153.95	5,551,275.52	7,119,851.91	3,791,428.95
IRR	13%	15%	10%	11%	13%	9%
Discounted payback period	7.22	6.88	7.88	7.22	6.88	7.88
AEV (USD)	1,210,059.08	1,408,183.74	944,717.96	815,061.81	936,073.82	632,774.07
Benefits-Costs Ratio	1.78	1.98	1.56	1.48	1.58	1.35

Table 4.2: Sensitivity analysis on the inflation rate

	30 years		**15 years**	
	Inflation rate – 6.156%	**Zero inflation rate**	**Inflation rate – 6.156%**	**Zero inflation rate**
NPV (USD)	9,747,248.48	10,141,293.99	5,551,275.52	5,747,575.19
IRR	13%	13%	11%	12%
Discounted payback period	7.22	7.15	7.22	7.15

[7] Ghanbariamin (2015) found out that the appropriate discount rate to be used in project evaluation, and investment decision making in Kenya ranged from 10% to 14.5%.

AEV (USD)	1,210,059.08	1,258,977.33	815,061.81	843,883.36
Benefits-Costs Ratio	1.78	1.84	1.48	1.51

38. Under all scenarios, the project remains economically viable as shown by the sensitivity analysis results. The NPV remains positive, the IRR is greater than the discount rates in all cases, and the Benefits Costs ration in all cases is greater than 1.

REFERENCES

Cook, J., Kimuyu, P., & Whittington, D. (May 2015). The Costs of Coping with Poor Water Supply in Rural Kenya. *Environment for Development, Discussion Paper Series*. Retrieved August 30, 2016, from http://www.rff.org/files/sharepoint/WorkImages/Download/EfD-DP-15-09.pdf

Ghanbariamin, R. (2015). *Estimating the Economic Opportunity Cost of Capital for Kenya.* Eastern Mediterranean University, Gazimagusa, North Cyprus. n.p. Retrieved September 07, 2016, from http://i-rep.emu.edu.tr:8080/xmlui/handle/11129/1775

SEI. (2009). *Economics of Climate Change, Kenya.* Project report.