Climate Resilient WASH and Disaster Management services for vulnerable children in the Central African Republic (CRDM-CAR)

Annex 3b – Economic and Financial Analysis

This version of annex 3b has been marked confidential.

Introduction

This annex is the narrative presentation of the Economic and Financial Analysis conducted for the project "Climate Resilient WASH and Disaster Management services for vulnerable children in the Central African Republic (CRDM-CAR)".

The Central African Republic (CAR) is among the world's poorest and most fragile nations, characterized by chronic insecurity, widespread poverty, and high vulnerability to climate change. The country is highly susceptible to climate hazards such as floods and droughts, which disrupt essential services, agriculture, and livelihoods, placing immense strain on an already vulnerable population. Access rates for Water, Sanitation, and Hygiene (WASH) are among the lowest in the world, leading to a high burden of preventable diseases and significant barriers to health, education, and overall human development.

The Theory of Change is phrased as: IF government and community actors in the Central African Republic are equipped, resourced and have the capacity to (i) use climate data for risk-informed planning, (ii) apply and finance standards for climate-resilient water, sanitation and hygiene (WASH) infrastructure, (iii) strengthen water-resources and disaster-risk management, and (iv) operate multi-hazard early warning systems, THEN households, schools and healthcare facilities in the targeted prefectures will have access to safer, more resilient and reliable WASH services and reduced losses from floods and droughts, BECAUSE policies, budgets, coordination and capacity will direct investments toward climate risk-appropriate designs, operation and maintenance (O&M) will be funded and enforced, demand for climate resilient WASH services will be created and timely warnings with community engagement will trigger protective actions.

To achieve this goal, the project is organized into two primary components:

Component 1: National policies/plans, systems, institutional capacities and information systems (enabling environment)

Component 2: Climate-resilient WASH services, urban drainage, WRM and local capacities (infrastructure, climate DRR and WRM)

Overview of the Economic and Financial Analysis

This Economic and Financial Analysis was conducted in the form of an integrated Cost Benefit Analysis (CBA). The CBA incorporates financial assessments, including the assessment of the investments, operational and maintenance costs, revenue generation, and more importantly includes economic consideration of non-marketable benefits that are directly linked to the investment and the interventions of the project.

The assessment utilises key financial metrics for the selected project interventions, i.e. the financial Internal Rate of Return (IRR) and Net-Present Value (NPV). As the analysis incorporates non-marketable societal benefits the relevant economic measures are presented as Economic Internal Rate of Return (EIRR) and Economic Net-Present Value (ENPV) to signify their consideration of societal factors.

The evaluation covers the following interventions supported by activities of the project:

- Activity 2.2.1: Improve and expand Bangui's drainage system – M1
- Activity 2.1.3: Construct and/or rehabilitate CR-WASH infrastructure in communities, schools, and healthcare facilities
    - Installation of latrines and rainwater collectors and waste incinerators health centres – M2
    - Installation of latrines and rainwater collectors in schools – M3
    - Constructions/rehabilitation of climate resilient network water systems and small-scale water system covering communities, schools, and healthcare facilities – M4 Large and M4 Small
- Activity 2.1.2: Promote CR-WASH and sanitation through climate-adapted community-led total sanitation (CLTS) and nationwide awareness-raising– M5

Each one of the above interventions has been evaluated for an appropriate lifetime of investment based on their specific characteristics. An overall economic assessment of the project was also conducted taking into consideration the non-investment costs and for a 15-year horizon.

The analysis rigorously examines the five investment interventions. Nevertheless, it should be emphasized that the analysis is an indicative assessment of the expected financial and economic impacts of the project design and that actual outcomes may differ from the estimates presented in the report.

Based on the analysis and for a discount rate of 5% the investments of approximately USD 40.25M have an ENPV equal to USD 34.26 million and an EIRR of 14%.

The results of the economic and financial analysis show that the project generates robust economic benefits from a societal perspective, brings about significant benefits in terms of public health, contributes to the long-term sustainability of the WASH sector in the CAR, and the GCF's goal of low-carbon and climate resilient development.

Methodological Approach

Overview of the approach

The Economic and Financial Analysis is based on an integrated Cost-Benefit Analysis (CBA) of selected measures to be supported by the project. The CBA approach integrates both marketable and non-marketable benefits to assess ex-ante the investments envisioned by the project. Taking into consideration the public goods that are generated by the project interventions, the integrated CBA approach is appropriate to assess the overall economic impact of the project and provides significant investment insights that can guide decision making. Therefore, the CBA analysis assesses the societal (economic) value of the project interventions.

The CBA is based on a counterfactual analysis and assesses the avoided negative impacts of climate-related events. The counterfactual for each measure assumes that the investment would most likely not occur and therefore the associated costs would take place. Figure 1 is a schematic overview of the counterfactual costs (Climate change impacts without adaptation) and the project scenario (investment costs and residual climate change impacts).

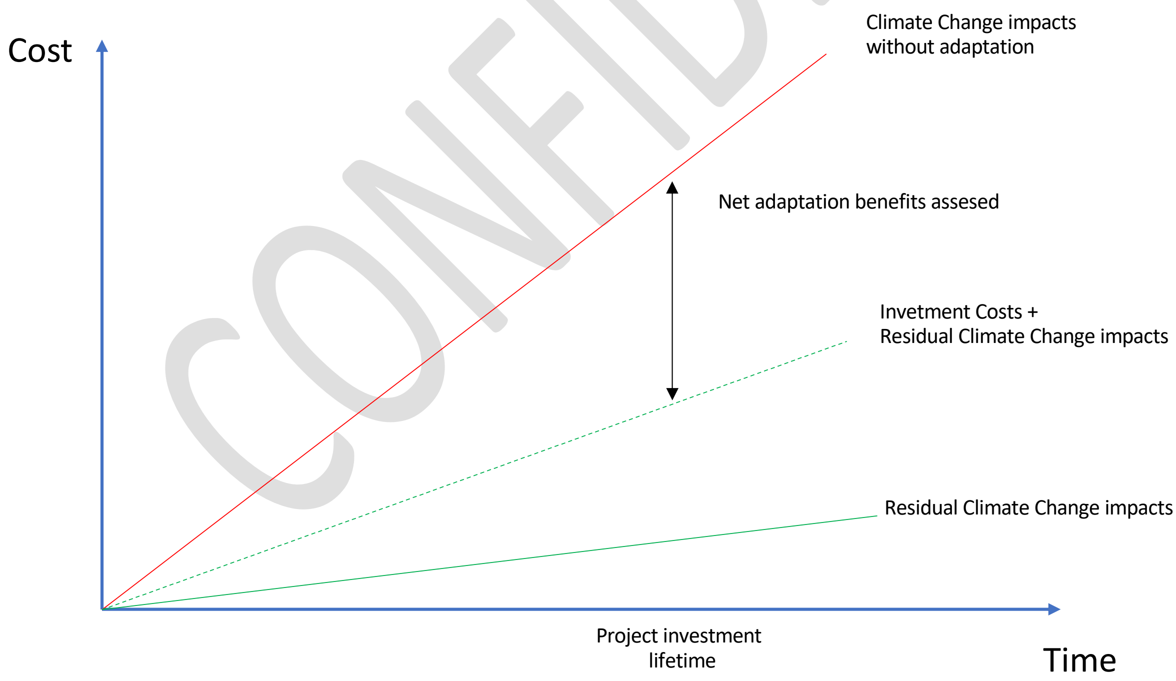

Figure 1: Schematic overview of the adaptation benefits assessed in the CBA

In our analysis we assess the economic net present value (ENPV) and the economic internal rate of return (EIRR) of the project interventions and the project as a whole. When the ENPV>0 for an appropriate discount rate the intervention/project is considered viable. The EIRR is defined as the discount rate (r) that produces a zero ENPV. Therefore, it represents the threshold interest rate in order for the intervention/ project to be profitable.

To account for the scarcity of available data and provide robust results a sensitivity analysis is conducted for both the ENPV and the EIRR. The sensitivity analysis takes into consideration reductions and increases of the investment costs and benefits for each measure assessed and for the project as a whole.

The focus of the adaptation investments under the project can be organised into five main categories:

- M1: Rehabilitation and construction of storm-water drainage in Bangui
- M2: Installation of rainwater collectors, latrines, and waste incinerators health centres
- M3: Installation of rainwater collectors and latrines in schools
- M4 Large: Construction/rehabilitation of climate resilient network water systems
- M4 Small: Construction/rehabilitation of climate resilient small-scale water system
- M5: Community engagement for ending open defecation

Based on the above, the project has the potential to generate a broad range of environmental, social, and economic benefits and co-benefits, some of which include:

- Avoided damages from floods in Bangui
- Decreased burden of disease due to improved safe water access and sanitation
    - In communities
    - Schools
    - Health facilities
- Decreased burden of disease due elimination of open defecation in communities

Economic analysis

An economic analysis of the project has been performed to assess the incremental benefits of adaptation to climate change for communities. The economic cost-benefit analysis uses a cash flow model employing measure-specific investment lifetimes for the various adaptation measures. These periods include all investment and operational costs of the project, as well as the monetised revenues from resulting externalities such as avoided losses.

Evaluated measures

As described in the Funding Proposal and Annex 2: Feasibility Study, there is a significant lack of WASH and drainage infrastructure on all levels and among all stakeholders. All the project's components are integrated and horizontal in their nature, focusing mainly on addressing climate-sensitive diseases and conditions. The proposed investments are necessary to help catalyse a paradigm shift in resilience in CAR. As already mentioned, all the components contain envisaged capital investments accompanied with comprehensive and tailored technical assistance.

Therefore, the approach undertaken for economic analysis of this project was based on testing the adaptation interventions that would reflect the most pressing adaptation needs. There are many activities under this project for which benefits will be achieved. However, it is not possible to monetise all of them and test it via economic and financial analysis. For the purpose of the economic analysis, five measures were identified. These measures were selected based on the project's climate rationale, project design, the outcomes of stakeholder consultations, the literature review. The following measures were assessed by the economic analysis:

- M1: Rehabilitation and construction of storm-water drainage in Bangui
- M2: Installation of rainwater collectors, latrines, and waste incinerators health centres
- M3: Installation of rainwater collectors and latrines in schools
- M4: Construction/rehabilitation of climate resilient network water systems and small-scale water system
- M5: Community engagement for ending open defecation

M1: Rehabilitation and construction of storm-water drainage in Bangui

The measure includes the rehabilitation and construction of new drainage infrastructure in Bangui. The new and rehabilitated infrastructure will provide direct adaptation benefits through reduced flood exposure risks for 100,000 inhabitants of Bangui.

The main benefits from the intervention will be the avoided damages from floods that are common in Bangui.

Counterfactual

The counterfactual for this measure is based on the estimated monetized expected losses and damages for the served proportion of the population. In the absence of the project, investment would most likely not occur and so benefits per unit of investment are based on the comparison of the "climate change impact" situation and the "with project" situation.

Assumptions

The economic cost-benefit analysis, over a 20-year period, was conducted for the implementation of storm-water drainage investments.

Table 1. Assumptions for Measure 1.

Parameter	**Sources and assumptions elaboration**	**Unit**	**Value**
Input data			
Discount rate	[The World Bank (2025) Central African Republic MPO]	%	5%
Cost of drainage investment	Project proposal	USD	$8,000,000
Lifetime of investment	[The World Bank (2024) Report No: PAD00166]	Years	20
Opex costs - as percentage of investment	Assumption	%	3%
Population benefiting by stormwater drainage	Logframe feasibility study	#	100,000
Opex costs	**Calculated**	**USD**	**$240,000**
Investment costs for stormwater drainage	**Calculated**	**USD**	**$8,000,000**

Benefits			
Reduced			

Annual recurrent losses from floods in Bangui (inflation adjusted CPI FRED)	GFDRR. (2022). Central African Republic– 2009– Subsequent to floods in Bangui, which left 14,500 people homeless, GFDRR supported a Joint Needs Assessment to assess and mitigate the impacts of recurrent flooding. https://www.gfdrr.org/en/central-african-r	USD	$15,954,641
Bangui population	OCHA (2002)ˇCentral African Republic - Subnational Population Statistics	#	812,407
Total value of annual avoided costs due to storm drainage	**Calculated**	**USD/year**	**$1,963,873**

Results

Table 2 Key Affordability analysis for drainage

Affordability analysis			
Daily income for those under poverty line	Feasibility study	XAF	722
XAF to USD	Xe Conversion rate (2/3/2026)	USD/XAF	0.0018
Maximum percentage of HH available income for Sanitation and drainage	WHO/UNICEF (2021) The Measurement and Monitoring of Water Supply, Sanitation and Hygiene (WASH) Affordability	%	2%
Maximum affordable tariff per day	**Calculated**	**USD/day**	**$0.026**
Daily tariff per beneficiary	**Calculated**	**USD/day**	**$0.007**
Check	**Calculated**	Y/N	YES

The benefits were calculated based on the development of an operational storm-water drainage system.

Table 3 Key Performance Indicators (KPIs) for measure 1

Net costs / benefits	USD	Calculated	**$5,127,757**
EIRR (15 yrs)	%	Calculated	**10%**
ENPV (15 yrs)	**USD**	Calculated	**$1,331,395**
Net costs / benefits per year	**USD / year**	Calculated	**$320,485**

The results show that all KPIs are positive in terms of the economic feasibility of the proposed measure.

Various scenarios were tested to establish the economic viability of Measure 1 based on either change in the costs of investment or changes in the level of benefits. The results are presented in the following table.

Table 4 Sensitivity analysis for Measure 1.

Investment costs	ENPV of the investment	EIRR of the investment
60%	$4,872,970	31%
80%	$3,102,182	17%
100%	$1,331,395	10%
120%	$(439,393)	5%
140%	$(2,210,180)	1%
Benefits	**ENPV of the investment**	**EIRR of the investment**
60%	$(2,742,738)	-3%
80%	$(705,672)	4%
100%	$1,331,395	10%
120%	$3,368,461	16%
140%	$5,405,528	22%

The results show a positive ENPV and EIRR in three out of five scenarios with alternating level of costs and benefits, respectively. Based on the assumptions described above, measure 1 can be justified on economic grounds.

M2: Installation of rainwater collectors, latrines, and waste incinerators health centres

The measure includes the installation of rainwater harvesters in health centres the project targeted area. The main benefits are related to providing clean water for sanitation and thus reducing climate sensitive diseases prevalence and the impacts of infections with anti-microbial resistant pathogens.

The main benefits from the intervention will be avoided health costs of infections with anti-microbial resistant pathogens.

Counterfactual

The counterfactual for this measure is based on the negative impacts in the absence of water for sanitation in health centres. In the absence of the project, investment would most likely not occur and so benefits per unit of investment are based on the comparison of the "climate change impact" situation and the "with project" situation.

Assumptions

The economic cost-benefit analysis, over a 15-year period was conducted for the implementation of healthcare centre climate resilience investments.

Table 5 Assumptions for Measure 2.

Parameter	Sources and assumptions elaboration	Unit	Value
Input data			
Discount rate	[The World Bank (2025) Central African Republic MPO]	%	5%
Total investment cost of per one health facility	Feasibility study/budget	USD	$35,000
Cost for waste management	Feasibility study/budget	USD	$20,000

# of health facilities to be retrofitted by the project	Project proposal	#	100
Total cost per one health facility	Calculated	USD	$55,000
Total WASH improvements costs - All facilities	Calculated	USD	$5,500,000
Number of health facilities in CAR	African Health Business. (2022). Central African Republic health sector profile. African Health Business	#	650
Population of CAR	WHO (2023)	#	5,152,421
# of beneficiaries per investment	Calculated	#	7,927
Lifetime of investment	Muhirirwe, S. C., Kisakye, V., & Van der Bruggen, B. (2022). Reliability and economic assessment of rainwater harvesting systems for dairy production. Resources, Conservation & Recycling Advances, 14, 200079.	Years	15
Opex costs - as percentage of investment	Assumption	%	5%
Opex costs for one health facility (annual)	**Calculated**	**USD/health facility**	**$2,750**
Investment costs per one healthcare facility	**Calculated**	**USD/per sub-project**	**$55,000**

Benefits calculations			
Improved healthcare delivery			
DALYs of infectious diseases in CAR	WHO (2023) Burden of Disease 2000-2019	#/100,000	1,754
Percentage of reduction of burden of disease	Assumption	%	25%
DALYs avoided per investment	Calculated	DALY	17

Monetary value of one DALY	Daroudi, R., Akbari Sari, A., Nahvijou, A., & Faramarzi, A. (2021). Cost per DALY averted in low, middle-and high-income countries: evidence from the global burden of disease study to estimate the cost-effectiveness thresholds. Cost Effectiveness and Resource Allocation, 19(1), 1-9.	USD/DALY	$1,000
Total benefits per one upgraded health facility	**Calculated**	**USD/per investment**	**$17,381**

Results

The benefits were calculated based on the development of an operational rainwater harvester at the supported health centres.

Table 6 KPIs for measure 2.

Net costs / benefits	**USD**	Calculated	**$6,110,715**
EIRR (15 yrs)	**%**	Calculated	**15%**
ENPV (15 yrs)	**USD**	Calculated	**$2,982,360**
Net costs / benefits per year	**USD / year**	Calculated	**$381,920**

The results show that all KPIs are positive in terms of the economic feasibility of the proposed project.

Various scenarios were tested to establish the economic viability of Measure 2 based on either change in the costs of investment or changes in the level of benefits. The results are presented in the following table.

Table 7 Sensitivity analysis for measure 2.

Investment costs	ENPV of the investment	EIRR of the investment
60%	$6,196,796	42%
80%	$4,589,578	24%
100%	$2,982,360	15%
120%	$1,375,142	9%
140%	$(232,076)	4%
Benefits	ENPV of the investment	EIRR of the investment
60%	$(1,425,020)	0%
80%	$778,670	8%
100%	$2,982,360	15%
120%	$5,186,050	22%
140%	$7,389,740	30%

The results show a positive ENPV and EIRR in all but one scenario with alternating level of costs and benefits, respectively. Based on the assumptions described above, measure 2 can be justified on economic grounds.

M3: Installation of rainwater collectors and latrines in schools

The measure includes the installation of rainwater harvesters in schools of the project targeted areas. The benefits are related to providing water for sanitation and thus reducing climate sensitive diseases prevalence. The main benefits from the intervention will be avoided costs to acquire water and health costs from diarrhoeal diseases.

Counterfactual

The counterfactual for this measure is based on the negative impacts in the absence of water for sanitation in schools. In the absence of the project, investment would most likely not occur and so benefits per unit of investment are based on the comparison of the "climate change impact" situation and the "with project" situation.

Assumptions

The economic cost-benefit analysis, over a 15-year period was conducted for the implementation of water harvesters in schools.

Table 8 Assumptions for measure 3.

Cost calculations on a per investment basis			
Parameter	**Sources and assumptions elaboration**	**Unit**	**Value**
Input data			
Discount rate	The World Bank (2025) Central African Republic MPO	%	5%
Investment cost per school	Feasibility study/budget	USD	$35,000
# of schools to be retrofitted by the project	Project proposal	#	100
# of pupils per school	Project proposal	#	30
Total cost or rainwater harvester installations - All facilities	Calculated	USD	$3,500,000
Number of total direct beneficiaries	Project proposal	#	3,000
Lifetime of investment	Muhirirwe, S. C., Kisakye, V., & Van der Bruggen, B. (2022). Reliability and economic assessment of rainwater harvesting systems for dairy production. Resources, Conservation & Recycling Advances, 14, 200079.	Years	15
Opex costs - as percentage of investment	Assumption	%	5%
Opex costs for one school (all investments included)	**Calculated**	**USD/health facility**	**$1,750**
Investment costs per school	**Calculated**	**USD/per sub-project**	**$35,000**

Benefits calculations on a per investment basis			
Average annual precipitation	Feasibility study	mm	1,150
Rainwater catchment area	Assumption	m^2	100
Annual water volume savings by rainwater - per harvesting system	Calculated	Litres per annum	115,000
Total annual saving all investments	Calculated	Litres per annum	11,500,000
Benefits			
Economic water related benefits			
Import price of water per litre	UNICEF (2025) Access to water brings hope to Bangui residents	USD/l	$0.002
Benefits resulting in access to water per investment	**Calculated**	**USD/year**	**$259**
Reduced diarrhoeal disease morbidity			
DALYs of diarrhoeal diseases, schistosomiasis, intestinal nematodes, and lymphatic filariasis in CAR	WHO (2023) Burden of Disease 2000-2019	#/100,000	274
Percentage of reduction of burden of disease	Wolf, Jennyfer, et al. "Effectiveness of interventions to improve drinking water, sanitation, and handwashing with soap on risk of diarrhoeal disease in children in low-income and middle-income settings: a systematic review and meta-analysis." The Lancet	%	52%
Number of avoided DALYs	Calculated	#	0.043
Monetary value of one DALY	Daroudi, R., Akbari Sari, A., Nahvijou, A., & Faramarzi, A. (2021). Cost per DALY averted in low, middle-and high-income countries: evidence from the global burden of disease study to estimate the cost-effectiveness thresholds. Cost Effectiveness and Resource Allocation, 19(1), 1-9.	USD/DALY	$1,000

Avoided health costs due to M3 per school - averaged on a yearly basis	**Calculated**	**USD/year**	**$43**
Reduced water access time			
Average time spent to bring water	Kamba, F., Sangija, F., & Wei, S. (2016). The Poor Sanitatino and Access to Clean Water in Rural Areas: Case of Bossangoa (Central African Republic). Advances in Social Sciences Research Journal, 3(6) 01-24.	mins	80
Size of jerrycan used to bring water	UNICEF (2025) Access to water brings hope to Bangui residents	Litres	10
Times needed to bring water per year per investment	Calculated	#	11,500
Maximum minimum wage	Conservative assumption based on ILOSTAT, Statistics on wages	USD/month	133
Minimum hourly wage	Calculated	USD/h	$0.4
Benefits from reduced time spent to bring water annually	Calculated	USD	5,887
Total annual benefits due to M3 per school	**Calculated**	**USD/per investment**	**$6,189**

Results

The benefits were calculated based on the development of an operational rainwater harvester at the supported schools.

Table 9 KPIs for Measure 3.

Net costs / benefits	USD	Calculated	**$2,622,815**
EIRR (15 yrs)	%	Calculated	**11%**
ENPV (15 yrs)	**USD**	Calculated	**$1,013,190**
Net costs / benefits per year	**USD / year**	Calculated	**$104,913**

The results show that all KPIs are positive in terms of the economic feasibility of the proposed project

Various scenarios were tested to establish the economic viability of Measure 3 based on either change in the costs of investment or changes in the level of benefits. The results are presented in the following table.

Table 10 Sensitivity analysis for measure 3.

Investment costs	ENPV of the investment	EIRR of the investment
60%	$2,806,886	34%
80%	$1,910,038	20%

100%	$1,013,190	11%
120%	$116,342	6%
140%	$(780,506)	1%
Benefits	ENPV of the investment	EIRR of the investment
60%	$(1,185,782)	-4%
80%	$(86,296)	4%
100%	$1,013,190	11%
120%	$2,112,676	18%
140%	$3,212,162	25%

The results show a positive ENPV and EIRR in all but one scenario with alternating level of costs and benefits, respectively. Based on the assumptions described above, Measure 3 can be justified on economic grounds.

M4 Large: Construction/rehabilitation of climate resilient network water systems

The benefits are related to providing safe water and thus reducing climate sensitive diseases prevalence. The main benefits from the intervention will be avoided health costs from diarrhoeal diseases and avoided time spent for water collection.

Counterfactual

The counterfactual for this measure is based on the negative impacts in the absence of water networks in communities.

An alternative scenario was assessed as a counterfactual, i.e. non climate resilient system with a diesel pump. The counterfactual was assessed for affordability.

The scenario would reduce the CAPEX costs but will increase OPEX costs due to fuel cost and other consumables

Counterfactual analysis			
Fuel consumption per day for 40m^3	Assumption based on system characteristics	Lt/day	9
Fuel in rural CAR	Assumption based on CAR prices	USD	3.3
Additional Fuel cost	Calculated	USD	$10,840.0
Additional costs (Oil, Filters,	Assumption	USD	636
Annual additional OPEX	Calculated	USD	$11,476.0
Daily tariff per beneficiary	Calculated	USD/day	$0.026
Check	Calculated	Y/N	NO

Based on the affordability analysis the cost would be marginally higher than the maximum affordable daily tariff per beneficiary. This would mean that communities would not be able to afford the system costs and rely on the hand pumps that are currently serving them.

Based on the above, the most probable counterfactual is that the investment would most likely not occur. Therefore, benefits per unit of investment are based on the comparison of the "climate change impact" situation and the "with project" situation.

Assumptions

The economic cost-benefit analysis, over a 15-year period was conducted for the construction/rehabilitation of climate resilient network water systems.

Table 11 Assumptions for measure 4.

Benefits calculations on a per investment basis			
Benefits			
Financial revenues			
System capacity	Feasibility study	m^3/day	40
Average cost of water	Feasibility study	XAF per lt	1.00
XAF to USD	Xe Conversion rate (2/3/2026)	USD/XAF	0.0018
Average number of days per month	_	days	30.44
Number of months of system at 80% capacity	Feasibility study	months	5
Yearly revenues per system	**Calculated**	**USD per system**	**$23,952**
Improved health benefits			
DALYs of diarrhoeal diseases, schistosomiasis, intestinal nematodes, and lymphatic filariasis in CAR	WHO (2023) Burden of Disease 2000-2019	#/100,000	274
Percentage of reduction of burden of disease	Wolf, Jennyfer, et al. "Effectiveness of interventions to improve drinking water, sanitation, and handwashing with soap on risk of diarrhoeal disease in children in low-income and middle-income settings: a systematic review and meta-analysis." The Lancet	%	52%
Number of avoided DALYs	Calculated	#	5

Monetary value of one DALY	Daroudi, R., Akbari Sari, A., Nahvijou, A., & Faramarzi, A. (2021). Cost per DALY averted in low, middle-and high-income countries: evidence from the global burden of disease study to estimate the cost-effectiveness thresholds. Cost Effectiveness and Resource Allocation, 19(1), 1-9.	USD/DALY	$1,000
Total annual health avoided costs due to water security	Calculated	USD/year	$4,626
Reduced water access time			
Percentage of HH spending less than 30 mins to access water	UNICEF. (2021). MICS6: Central African Republic	%	5%
Number of beneficiaries having access to safe drinking water in less than 30 mins	Logframe/Feasibility study	%	100%
Average time spent to bring water	Kamba, F., Sangija, F., & Wei, S. (2016). The Poor Sanitatino and Access to Clean Water in Rural Areas: Case of Bossangoa (Central African Republic). Advances in Social Sciences Research Journal, 3(6) 01-24.	mins	80
Times needed to bring water daily	Kamba, F., Sangija, F., & Wei, S. (2016). The Poor Sanitatino and Access to Clean Water in Rural Areas: Case of Bossangoa (Central African Republic). Advances in Social Sciences Research Journal, 3(6) 01-24.	#	1
Maximum minimum wage	Conservative assumption based on ILOSTAT, Statistics on wages	USD/month	133
Minimum hourly wage	Calculated	USD/h	$0.4

Average household size	UN HH size and composition	#	6
Benefits from reduced time spent to bring water annually	Calculated	USD	69,009
Total annual benefits due to M4	**Calculated**	**USD/per investment**	**$73,635**

Results

The benefits were calculated based on the development of an operational water network for the targeted communities. The results show that the OPEX would be affordable for the beneficiaries.

Affordability analysis			
Daily income for those under poverty line	Feasibility study	XAF	722
XAF to USD	Xe Conversion rate (2/3/2026)	USD/XAF	0.0018
Maximum percentage of HH available income for Sanitation and drainage	WHO/UNICEF (2021) The Measurement and Monitoring of Water Supply, Sanitation and Hygiene (WASH) Affordability	%	2%
Maximum affordable tariff per day	**Calculated**	**USD/day**	**$0.026**
Daily tariff per beneficiary	**Calculated**	**USD/day**	**$0.016**
Check	**Calculated**	Y/N	**YES**

Financial Analysis – Per investment

A financial analysis for Commercial, concessional loans and grants for the CAPEX was conducted to assess the possibility of alternative financial structure of the investment.

Commercial loans assumed tenor of 5yrs and an interest rate of 15% based on conservative assumptions from the AfDB.

The following table provides the financial KPIs for commercial loans

Table 12 Financial KPIs for commercial loan investment

Financial indicators	**NPV (15 years)**	**$(218,761.92)**
	IRR (15 years)	**-18%**

Concessional loans assumed tenor of 5yrs and an interest rate of 1% based on the GCF concessionally for CAR.

The following table provides the financial KPIs for concessional loans

Table 13 Financial KPIs for concessional loan investment

Financial indicators	**NPV (15 years)**	**$(138,221.57)**
	IRR (15 years)	**-15%**

Grants assumed no cost for CAPEX, but OPEX that would still be assumed by the Water User Association.

Table 14 Financial KPIs for grants investment

Financial indicators	**NPV (15 years)** **IRR (15 years)**	**$41,614.60** **N/A**

The analysis showcases that only grants are viable for the specific context of CAR.

Economic Analysis – All investments

Table 15 KPIs for measure 4- Large

Economic indicators	**NPV (15 years)** **IRR (15 years)**	**$36,662,988** **40%**

The results show that all KPIs are positive in terms of the economic feasibility of the proposed project

Various scenarios were tested to establish the economic viability of Measure 4 – Large based on either change in the costs of investment or changes in the level of benefits. The results are presented in the following table.

Table 16 Sensitivity analysis for measure 4 – Large.

Discount rate	NPV (15 years) - Grants	Change in net revenue / income	NPV (15 years) - GCF grants)	Change in water price	NPV (15 years) - GCF grants)
5%	$ 36,662,988.05	100%	$ 36,662,988.05	100%	$ 36,662,988.05
5%	$ 36,662,988.05	90%	$ 32,996,689.25	90%	$ 35,109,101.15
10%	$ 22,145,100.37	80%	$ 29,330,390.44	80%	$ 33,555,214.26
15%	$ 13,497,243.67	70%	$ 25,664,091.64	70%	$ 32,001,327.36
20%	$ 8,152,658.54	60%	$ 21,997,792.83	60%	$ 30,447,440.46

The results show a positive ENPV and EIRR in all scenarios with alternating level of costs and benefits, respectively. Based on the assumptions described above, measure 4 – large can be justified on economic grounds.

M4 Small: Construction/rehabilitation of climate resilient small water systems

The benefits are related to providing safe water and thus reducing climate sensitive diseases prevalence. The main benefits from the intervention will be avoided health costs from diarrhoeal diseases and avoided time spent for water collection.

Counterfactual

The counterfactual for this measure is based on the negative impacts in the absence of water networks in communities.

An alternative scenario was assessed as a counterfactual, i.e. non climate resilient system with a diesel pump. The counterfactual was assessed for affordability.

The scenario would reduce the CAPEX costs but will increase OPEX costs due to fuel cost and other consumables

Affordability analysis

Fuel consumption per day for 40m^3	Assumption based on system characteristics	Lt/day	9
Fuel in rural CAR	Assumption based on CAR prices	USD	3.3
Additional Fuel cost	Calculated	USD	$10,840.0
Additional costs (Oil, Filters,	Assumption	USD	636
Annual additional OPEX	Calculated	USD	$11,476.0
Daily tariff per beneficiary	Calculated	USD/day	$0.026
Check	Calculated	Y/N	**NO**

Based on the affordability analysis the cost would be marginally higher than the maximum affordable daily tariff per beneficiary. This would mean that communities would not be able to afford the system costs and rely on the hand pumps that are currently serving them.

Based on the above, the most probable counterfactual is that the investment would most likely not occur. Therefore, benefits per unit of investment are based on the comparison of the "climate change impact" situation and the "with project" situation.

Assumptions

The economic cost-benefit analysis, over a 15-year period was conducted for the implementation of climate resilient small water systems.

Table 17 Assumptions for measure 4 – Small water systems

Cost calculations on a per investment basis			
Parameter	**Sources and assumptions elaboration**	**Unit**	**Value**
Input data			
Discount rate	The World Bank (2025) Central African Republic MPO	%	5%
Constructions/rehabilitation of climate resilient network water systems	Project budget	USD	$52,000
Number of network water systems supported by the project	Project budget	#	120
Total Investment cost	Calculated	USD	$6,240,000
Number of direct beneficiaries per system	Project log frame/Feasibility study	#	500

Lifetime of water system	Xie, H., & Ringler, C. (2026). Impact of climate change on cost and cost efficiency of solar irrigation in Sub-Saharan Africa. Earth's Future, 14, e2025EF007410. https://doi.org/10.1029/ 2025EF007410	Years	15
Operational costs as percentage of the CAPEX	Assumption	%	8%
5yr maintenance cost	Feasibility study	USD	2,200
10yr maintenance cost	Feasibility study	USD	6,200
Opex costs	**Calculated**	**USD/entire measure**	**$5,200**
Total investment costs (all investments)	**Calculated**	**USD/entire measure**	**$6,240,000**

Benefits calculations on a per investment basis			
Benefits			
Financial revenues			
System capacity	Feasibility study	m^3/day	18
Cost per water	Affordability based	XAF per lt	0.60
XAF to USD	Xe Conversion rate (2/3/2026)	USD/XAF	0.0018
Average number of days per month	-	days	30.44
Number of months of system at 80% capacity	Feasibility study	months	5
Yearly revenues per system	**Calculated**	**USD per system**	**$6,467**
Improved health benefits			
DALYs of diarrhoeal diseases, schistosomiasis, intestinal nematodes, and lymphatic filariasis in CAR	WHO (2023) Burden of Disease 2000-2019	#/100,000	274

Percentage of reduction of burden of disease	Wolf, Jennyfer, et al. "Effectiveness of interventions to improve drinking water, sanitation, and handwashing with soap on risk of diarrhoeal disease in children in low-income and middle-income settings: a systematic review and meta-analysis." The Lancet	%	52%
Number of avoided DALYs	Calculated	#	1
Monetary value of one DALY	Daroudi, R., Akbari Sari, A., Nahvijou, A., & Faramarzi, A. (2021). Cost per DALY averted in low, middle-and high-income countries: evidence from the global burden of disease study to estimate the cost-effectiveness thresholds. Cost Effectiveness and Resource Allocation, 19(1), 1-9.	USD/DALY	$1,000
Total annual health avoided costs due to water security	Calculated	USD/year	$712
Reduced water access time			
Percentage of HH spending less than 30 mins to access water	UNICEF. (2021). MICS6: Central African Republic	%	5%
Number of beneficiaries having access to safe drinking water in less than 30 mins	Logframe/Feasibility study	%	100%
Average time spent to bring water	Kamba, F., Sangija, F., & Wei, S. (2016). The Poor Sanitatino and Access to Clean Water in Rural Areas: Case of Bossangoa (Central African Republic). Advances in Social Sciences Research Journal, 3(6) 01-24.	mins	80

Times needed to bring water daily	Kamba, F., Sangija, F., & Wei, S. (2016). The Poor Sanitatino and Access to Clean Water in Rural Areas: Case of Bossangoa (Central African Republic). Advances in Social Sciences Research Journal, 3(6) 01-24.	#	1
Maximum minimum wage	Conservative assumption based on ILOSTAT, Statistics on wages	USD/month	133
Minimum hourly wage	Conservative assumption based on ILOSTAT, Statistics on wages	USD/h	$0.4
Average household size	UN HH size and composition	#	6
Benefits from reduced time spent to bring water annually	Calculated	USD	10,617
Total annual benefits due to M4	**Calculated**	**USD/per investment**	**$11,328**

Results

The benefits were calculated based on the development of an operational water network the targeted communities. The results show that the OPEX would be affordable for the beneficiaries.

Affordability analysis			
Daily income for those under poverty line	Feasibility study	XAF	722
XAF to USD	Xe Conversion rate (2/3/2026)	USD/XAF	0.0018
Maximum percentage of HH available income for Sanitation and drainage	WHO/UNICEF (2021) The Measurement and Monitoring of Water Supply, Sanitation and Hygiene (WASH) Affordability	%	2%
Maximum affordable tariff per day	**Calculated**	**USD/day**	**$0.026**
Daily tariff per beneficiary	**Calculated**	**USD/day**	**$0.023**
Check	**Calculated**	Y/N	**YES**

Financial Analysis – per investment

A financial analysis for Commercial, concessional loans and grants for the CAPEX was conducted to assess the possibility of alternative financial structure of the investment.

Commercial loans assumed tenor of 5yrs and an interest rate of 15% based on conservative assumptions from the AfDB.

The following table provides the financial KPIs for commercial loans

Table 18 Financial KPIs for commercial loan investment

Financial indicators	**NPV (15 years)**	**$(52,102.63)**
	IRR (15 years)	**-14%**

Concessional loans assumed tenor of 5yrs and an interest rate of 1% based on the GCF concessionally for CAR.

The following table provides the financial KPIs for concessional loans

Table 19 Financial KPIs for concessional loan investment

Financial indicators	**NPV (15 years)**	**$(30,289.62)**
	IRR (15 years)	**-10%**

Grants assumed no cost for CAPEX, but OPEX that would still be assumed by the Water User Association.

Table 20 Financial KPIs for grants investment

Financial indicators	**NPV (15 years)**	**$18,416.01**
	IRR (15 years)	**N/A**

The analysis showcases that only grants are viable for the specific context of CAR.

Economic Analysis – All investments

Table 21 KPIs for measure 4- Small

Economic indicators	**NPV (15 years)**	**$ 7,119,646.91**
	IRR (15 years)	**24%**

The results show that all KPIs are positive in terms of the economic feasibility of the proposed project

Various scenarios were tested to establish the economic viability of Measure 4 – Small based on either change in the costs of investment or changes in the level of benefits. The results are presented in the following table.

Table 22 Sensitivity analysis for measure 4 – Small.

Discount rate	NPV(15 years) - Grants	Change in net revenue / income	NPV (15 years) - GCF grants)	Change in water price	NPV (15 years) - GCF grants)
5%	**$ 7,119,646.91**	**100%**	**$ 7,119,646.91**	**100%**	**$ 7,119,646.91**
5%	$ 7,119,646.91	90%	$ 6,407,682.22	90%	$ 6,490,322.72
10%	$ 3,711,745.59	80%	$ 5,695,717.53	80%	$ 5,860,998.52
15%	$ 1,732,736.21	70%	$ 4,983,752.84	70%	$ 5,231,674.33
20%	$ 549,620.93	60%	$ 4,271,788.15	60%	$ 4,602,350.14

The results show a positive ENPV and EIRR in all scenarios with alternating level of costs and benefits, respectively. Based on the assumptions described above, measure 4 – small can be justified on economic grounds.

M5: Certification of communities as Open Defecation Free

The benefits are related reduced contamination from open defecation and thus reducing climate sensitive diseases prevalence. The main benefits from the intervention will be avoided health costs from diarrhoeal diseases.

Counterfactual

The counterfactual for this measure is based on the negative impacts in the case of continued open defecation. In the absence of the project, investment would most likely not occur and so benefits per unit of investment are based on the comparison of the "climate change impact" situation and the "with project" situation.

Assumptions

The economic cost-benefit analysis, over a 15-year period was conducted for the implementation of open defecation free (ODF) interventions.

Table 23 Assumptions for measure 5.

Parameter	Sources and assumptions elaboration	Unit	Value
Input data			
Discount rate	The World Bank (2025) Central African Republic MPO	%	5%
Investment cost for open defecation free (ODF) interventions	Project budget	USD	$3,300
Number of communities supported	Project budget	#	500
Total cost of ODF interventions	Calculated	USD	$1,650,000
Number of people per community	Project logframe	#	500
Number of beneficiaries to be supported by ODF activities	Calculated	#	250,000
Number of mothers (households) to be supported by the project	Calculated	#	500
Total investment costs for M5	**Calculated**	**USD/entire measure**	**$1,650,000**

Benefits calculations on a per investment basis			
Benefits			
Improved Health benefits			

DALYs of diarrhoeal diseases, schistosomiasis, intestinal nematodes, and lymphatic filariasis in CAR	WHO (2023) Burden of Disease 2000-2019	#/100,000	274
Percentage of reduction of burden of disease	Njuguna, J. Effect of eliminating open defecation on diarrhoeal morbidity: an ecological study of Nyando and Nambale sub-counties, Kenya. BMC Public Health 16, 712 (2016). https://doi.org/10.1186/s12889-016-3421-2	%	37%
Number of avoided DALYs	Calculated	#	253
Monetary value of one DALY	Daroudi, R., Akbari Sari, A., Nahvijou, A., & Faramarzi, A. (2021). Cost per DALY averted in low, middle-and high-income countries: evidence from the global burden of disease study to estimate the cost-effectiveness thresholds. Cost Effectiveness and Resource Allocation, 19(1), 1-9.	USD/DALY	$1,000
Total annual health avoided costs due ODF status	Calculated	USD/year	$253,173
Total economic value	**Calculated**	**USD/year**	**$253,173**

Results

The benefits were calculated based on the absence of open defecation in the supported communities.

Table 24 KPIs for measure 5.

Net costs / benefits	USD	Calculated	**$1,767,829**
EIRR (15 yrs)	%	Calculated	**11%**
ENPV (15 yrs)	**USD**	Calculated	**$706,356**
Net costs / benefits per year	**USD / year**	Calculated	**$110,489**

The results show that all KPIs are borderline negative in terms of the economic feasibility of the proposed intervention. Nevertheless, this is because the assessment is only monetizing direct reduction in the burden of disease, without taking into consideration potential contamination of water sources.

Table 25 Sensitivity analysis for measure 5.

Investment costs	ENPV of the investment	EIRR of the investment
60%	$1,291,438	24%
80%	$998,897	16%
100%	$706,356	11%
120%	$413,815	8%
140%	$121,275	5%
Benefits	ENPV of the investment	EIRR of the investment
60%	$(161,268)	2%
80%	$272,544	7%
100%	$706,356	11%
120%	$1,140,169	15%
140%	$1,573,981	19%

The sensitivity analysis corroborates the above assumption.

Consolidated project level cost/benefit analysis

An economic analysis of the project as a whole has been performed to assess the incremental adaptation benefits to climate change. This analysis combines all five measures, scaled up to the envisaged level of investment designated per measure within the Annex 4 project budget. Additionally, the project-level analysis considers the entire proposed project budget including the costs of all the components (i.e. non-investment components as well) and project management costs and co-finance.

Since the analysis is conducted from the project perspective only project covered O&M costs are included in the analysis.

Results

The following table presents the project level cost-benefit analysis that consolidates all five previously elaborated adaptation measures and includes the non-investment part of the programme budget. The discount rate of 5% used was the same as throughout the entire analysis.

Table 26 Consolidated economic analysis – entire project

Costs - (OPEX costs – project support)			
M1 - CAPEX costs	USD	M1	$8,000,000
M1 - OPEX costs		M1	$-
M2 - CAPEX costs	USD	M2	$5,500,000
M2 - OPEX costs		M2	$-

M3 - CAPEX costs	USD	M3	$3,500,000
M3 - OPEX costs		M3	$-
M4 - CAPEX costs	USD	M4	$21,600,000
M4 - OPEX costs		M4	$2,046,939
M5 - CAPEX costs	USD	M5	$1,650,000
M5 - OPEX costs		M5	$-
Total	**USD**	**Calculated**	$42,296,939

Other project costs			
Total project budget	USD	Project proposal	$73,778,982
Total non-investment project costs	USD	Project proposal	$33,528,982
Total non-investment project costs	**USD**	**Calculated**	$33,528,982

Total investment costs	**USD**	**Calculated**	$40,250,000
Total project costs	**USD**	**Calculated**	$73,778,982
Total costs (with OPEX project support)	**USD**	**Calculated**	$75,581,987

Benefits			
M1 - benefits	USD	M1	$16,103,757
M2 - benefits	USD	M2	$15,295,715
M3 - benefits	USD	M3	$8,292,815
M4 - benefits	USD	M4	$124,279,607
M5 - benefits	USD	M5	$3,164,656
Total benefits	**USD**	**Calculated**	$167,136,551

Table 27 KPIs - Project level

Net costs / benefits	USD	Calculated	**$91,554,564**
EIRR (15 yrs)	%	Calculated	**14%**
ENPV (15 yrs)	**USD**	Calculated	**$34,266,643**
Net costs / benefits per year	**USD / year**	Calculated	**$5,722,160**

The results show a positive EIRR of 14%, and ENPV is positive USD $34,266,643 . The big difference between the high ENPV and EIRR of the measures compared to the overall project are the expected costs in order to ensure the project's adaptation investments are implemented within a supportive enabling environment, have sufficient technical support for effective implementation, and include sufficient institutional capacity building to ensure the benefits are sustainable in the longer term. Essentially, these investments are necessary to catalyse a paradigm shift in CAR. While the full project shows a positive economic return on investment, specific investments - with the exception of open defecation intervention - show a high rate of return on investment and the non-investment costs will ensure the project leaves a substantial legacy of capacity for sustainability and more effective allocation and utilisation of future flows of climate finance.

Findings

The report shows that all five of the adaptation measures analysed have either a very high or high economic internal rate of return and can be justified on economic grounds. The analysis shows that the selected measures will have a significantly positive economic impact for the targeted communities over the life of the project and beyond.

The report also undertook assessment of the incremental adaptation benefits of the five selected measures in the context of the overall project budget. This analysis showed the project has an EIRR of 14%. In conclusion, the analysis found that the project presents a strong investment for the GCF.

While the types of benefits these activities generate are often non-monetary and have the characteristics of public goods (which are often challenging to quantify for any credible economic analysis), without these activities the project's economically quantifiable adaptation investments would be significantly less impactful in the immediate term, would be less sustainable in the longer term and would fail to generate transformational change.

Conclusion

The results of the economic and financial analysis show that the project generates robust economic benefits from a societal perspective, contributes to the long-term sustainability of the WASH sector in CAR, and supports the GCF's goal on climate resilient development.