Annex 3b

Economic and Financial Analysis

to the GCF Funding Proposal

Building the resilience of Togo's national health system and vulnerable communities to climate-sensitive health outcomes

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Submitted by:
Deutsche Gesellschaft für internationale Zusammenarbeit (GIZ) GmbH

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Abbreviations and Acronyms

AMR	Anti - Microbial Resistant
ANAMET	*Agence Nationale de la Météorologie du Togo* (National Meteorological Agency of Togo)
ANPC	*Agence Nationale de la Protection Civile* (National Civil Protection Agency)
BCR	Benefit-Cost Ratio
BMZ	*Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung* (Federal Ministry for Economic Cooperation and Development)
CBA	Cost-Benefit Analysis
CCDR	Country Climate and Development Report
DALYs	Disability Adjusted Life Years
EFA	Economic and Financial Analysis
EIRR	Economic internal Rate of Return
ENPV	Economic Net Present Value
EUR	Euro
FS	Feasibility Study
GCF	Green Climate Fund
GDP	Gross Domestic Product
GIZ	*Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ) GmbH
GPEI	Global Philanthropy Environment Index
HEWARS	Health Early Warning system
HF	Health Facilities
IMF	International Monetary fund
INSEED	*Institut National de la Statistique et des Etudes Economiques et Démographiques* (National Institute of Statistics and Economic and Demographic Studies)
IRR	Internal Rate of Return
kWh	Kilowatt-hour
MPDC	*Ministère de la Planification du Développement et de la Coopération* (Ministry of Planning, Development and Cooperation)
MWh	Megawatt-hour
m^3	cubic meter
NVP	Net Present Value
PPP	Public and Private Partnerships
tCO_2e	Tonnes of Carbon Dioxide Equivalent
UNDP	United Nations Development Programme
USD	US Dollar
USP	*Unité de Soins Périphériques* (Peripheral Care Unit)
VSL	Value of Statistical Life
WAPP	West African Power Pool
WASH	Water, Sanitation, and Hygiene
WHO	World Health Organization
WOP	Without Project
WP	With Project

Executive Summary

The project "Building the resilience of Togo's national health system and vulnerable communities to climate-sensitive health outcomes" aims to strengthen essential public health and WASH services through climate-informed surveillance, climate-resilient primary care infrastructure, solar-powered cold chains, and community-based adaptation. These interventions address growing climate-related health risks and serve as public goods that reinforce service continuity for vulnerable populations in the Centrale, Kara, and Savanes regions.

A detailed mapping of potential financing options was carried out to assess their suitability considering Togo's fiscal constraints and the public-good nature of the interventions. Domestic budget allocations, commercial bank lending, Public and Private Partnerships (PPP) models, impact bonds, insurance mechanisms, philanthropic contributions, and concessional loans were all assessed as unsuitable due to limited fiscal space, the absence of revenue-generating activities, and affordability constraints. Grants remain the only instrument capable of financing system-wide climate-health adaptation without creating fiscal pressure or compromising access and equity in essential public services.

A short financial module is used to assess fiscal sustainability under a concessional loan and a full grant scenario. The results show that under a full grant scenario, the Government of Togo remains responsible for operation, maintenance, and major replacement costs of the assets after project completion. These costs reach about EUR 18.1 million over 20 years. Annual requirements increase from roughly EUR 800,000 to 1 million in the early years to about EUR 2 million as equipment approaches the end of its life cycle. These obligations remain manageable within domestic health budgets, particularly given government plans to increase the health sector allocation from 7.32 % of public expenditure in 2022 to 11 % by 2027 under the National Health Development Plan. Maintenance and replacement costs represent about 0.6% of projected government health expenditure

Under a scenario with concessional loan of EUR 44 million, annual debt service would reach about EUR 1.6 million after the grace period, with total repayments of about EUR 49–50 million. Combined with maintenance and replacement costs, total fiscal commitments would approach EUR 80 million. Given Togo's limited fiscal space, public debt near 70 % of GDP, and high risk of debt distress, additional borrowing for non-revenue generating investments would create significant fiscal pressure.

The Economic Analysis demonstrates that the project generates substantial climate and health benefits over a 20-year horizon. These include reductions in malaria, diarrhoeal diseases, heat-related maternal and infant health morbidity (calculated here through neonatal mortality) and antimicrobial resistance, avoided damage to health facilities during floods and extreme heat, improved continuity of essential services through reliable solar energy, reduced vaccine losses, and lower WASH-related morbidity. These benefits translate into strong economic performance, with an Economic Net Present Value (ENPV) of EUR 11.6 million, an Economic Internal Rate of Return (EIRR) of 10%, and a Benefit-Cost Ratio (BCR) of 1.3. Total economic benefits amount to EUR 110.4 million compared with total estimated costs (initial investments and O&M) of EUR 58.2 million.

Sensitivity testing confirms the robustness of the investment. The project maintains positive economic returns even under higher costs, lower benefits, or delayed benefit realization. These results reflect the structural nature of climate-health adaptation benefits, which accumulate progressively and support long-term resilience of the national health system.

Overall, the results of the economic and financial analysis confirm that the project generates strong socio-economic benefits and remains fiscally sustainable for the government of Togo under a full GCF grant financing scenario.

1. Introduction

This Annex presents the Economic and Financial Analysis (EFA) prepared for the Green Climate Fund (GCF) Funding Proposal "Building the resilience of Togo's national health system and vulnerable communities to climate-sensitive health outcomes". The EFA was conducted in the form of an integrated Cost Benefit Analysis (CBA) that assesses costs, revenue generation, and more importantly non-marketable benefits that are directly linked to the project's activities. This report provides an overview of the socio-economic context of the project, reviews potential financing options, outlines the scope and activities relevant for the EFA and the methodology applied to quantify and value the project's economic benefits. It then highlights the key results of the EFA and the sensitivity tests, before concluding with the justification for the use of GCF grant financing.

2. Socio economic context

Togo is a West African country located along the Gulf of Guinea and bordered by Ghana to the west, Benin to the east and Burkina Faso to the north. The country spans a narrow territory stretching from the coast to the Sahelian zone, with diverse ecological landscapes ranging from the humid coastal plains in the south to the drier savannahs in the north. According to the latest census, Togo's population reached about 8.1 million in 2022 and continues to grow rapidly, with an annual demographic growth rate of 2.4% (INSEED, 2022). The population remains predominantly rural, with around 57% living outside urban centres and relying on land, natural resources and informal activities for their livelihood.

The country's Gross Domestic Product (GDP) per capita is estimated at USD 1,043 in 2024, with an average economic growth rate of 5.3% (World Bank, 2025a). The economy is dominated by the tertiary sector centred around trade and financial activities, contributed 57% of the GDP followed by the primary sector (20% of the GDP in 2024) which relies mainly on agriculture as a major livelihood source for the majority of households while the secondary sector, based on the manufacturing of food products, construction and the production and distribution of water, electricity, and gas, accounted for 23% of GDP (Direction Générale du Trésor, 2024).

Human development challenges remain significant. Poverty levels are twice as high in rural areas as in urban settings (58.2% versus 24.6% in urban areas in 2021) (MPDC, 2024), and access to education, electricity, water and sanitation remains uneven across regions. The Human Capital Index stands at 0.43, meaning that a child born in Togo today will reach only 43% of his potential in health, education, and nutrition as an adult (World Bank, 2025a).

Togo is among the most climate-vulnerable countries in West Africa (ND-GAIN ranking 127/185 in 2023) (University of Notre Dame, 2023). Rising temperatures, shifting rainfall patterns, and more frequent extreme events such as floods and droughts are driving the spread of climate-sensitive health outcomes, including malaria, diarrhoeal diseases, and other vector- and water-borne infections, inducing an additional burden on an already fragile health system. These illnesses are known to be associated with adverse outcomes for both mothers and newborns, negatively impacting their human capital (Mubashir et al., 2020).

According to the world bank climate and development report (CCDR), damages from climate change could result over the next 25 years in a loss of average income per capita ranging between 6.1 % and 12.2 % depending on climate scenarios for Togo (World Bank, 2025b). In these scenarios, the poverty headcount could rise by between 1.8 and 3.1 % age points as a direct result of climate shocks, pushing between one-quarter to half a million people into poverty every year due to climate shocks.

2.1 Centrale region

The Centrale region, with around 796,000 inhabitants of which 50.1% are women, and 62.7% predominantly rural and characterized by high poverty and multidimensional deprivation (INSEED, 2023b). Livelihoods depend heavily on rain-fed agriculture and small trade, exposing households to climate variability and income instability. Poverty affects more than half of households (50.3% of households in 2021), and 43.4% of households suffer from multiple deprivations, particularly in terms of access to education, electricity, health services, housing, drinking water, and sanitation (INSEED, 2024). The health system is stretched, with 281 primary units serving dispersed communities and many facilities lacking reliable water, sanitation and energy services. Although maternal health indicators have improved, persistent gaps in infrastructure, emergency care capacity, and WASH limit the quality and continuity of services, particularly during climate shocks such as floods and heat waves.

2.2 Kara region

The Kara region has a population of 985,512, or 12.2% of the national population. Of the total population, 50.5% are women, while 71.1% reside in rural areas. The population is young and active, with the working-age group (15-59 years) representing more than half of the population, while children aged 0-14 represent about a third. Poverty remains widespread: close to 70 % driven by limited economic diversification, land degradation and high exposure to climate variability. Seasonal food insecurity and underemployment compound household vulnerability. The health system faces structural challenges despite a relatively large network of facilities: shortages of skilled personnel, gaps in obstetric and neonatal care, and insufficient WASH and energy access undermine service quality. Frequent power outages and limited cold-chain reliability affect vaccine storage and infection prevention. Poor water and sanitation coverage especially in rural prefectures drives high incidence of diarrhoeal diseases and limits resilience to climate-sensitive health outcomes.

2.3 Savanes region

RGPH-5 data shows that the Savanes region represents 13.8% of the national population with 1,142,138 inhabitants, 51.5% of whom are women. Most of the population lives in rural areas (83.4%), while only 16.6% live in urban areas, mainly in Dapaong, the regional capital. The population is predominantly young: those under 15 represent 44.6% of the total population, and the working-age group (15-59 years) represents approximately half of the total population. High fertility (approximately 6 children per woman) and limited access to reproductive health services led to rapid population growth and high dependency rates. Population density remains low but uneven, concentrated along major transport routes and near urban centres. Poverty affects more than 65% of the households (INSEED, 2024), food insecurity exceeds 40%, and households depend on climate-sensitive subsistence agriculture in an area increasingly affected by droughts, irregular rainfall and land degradation.
High fertility and limited access to education and reproductive health services intensify demographic pressure on social services. Savanes has the weakest health service density nationally with one facility per 8,500 inhabitants and many primary units operate without reliable electricity, safe water or adequate sanitation. Access to hygiene is particularly low: 8.6% of households have a handwashing facility with soap and water, and 84.6% have none (INSEED, 2019). These gaps significantly increase the burden of malaria, diarrhoeal diseases, and other climate-sensitive health outcomes. Infrastructure fragility, staff shortages and climate exposures constrain emergency response capacity and disrupt service continuity, making the region a priority for resilient health infrastructure, strengthened supply chains and expanded WASH access.

This socio-economic profile highlights the need to invest in health system resilience, the country's economic constraints, the livelihood and poverty conditions of the targeted populations. It gives a clear view of the country's limited ability to finance the project from domestic resources and the affordability constraints faced by beneficiaries. The following section therefore assesses the financing landscape and the suitability of different financing options for the project.

3. Mapping of potential sources of funding for the project

This section outlines the mapping of potential financing sources for the project, assessing their suitability to the country's macro-fiscal situation, health-financing constraints beneficiaries' affordability, and alignment with the project's climate-resilience and public-goods provision objectives.

- **Domestic budget reallocation:** Togo's health budget already operates within tight fiscal space since the Covid-19 shock in 2020, with public debt around 68% of GDP in 2023, a high fiscal deficit and persistent spending pressures linked to security incident and measures to contain the impact of high inflation (IMF, 2024). Government health expenditure already represents 7-9% of the national budget allocation (7.1% and 8.8% in 2022 and 2023 respectively) (MSHP, 2024). Reallocating budget towards this project would require reducing essential expenditures such as salaries, medicines, and facility. Domestic allocations remain important for co-financing and sustainability, but they cannot shoulder the upfront, system-scale investment. Hence, domestic budget is not suitable as the primary source.

- **Commercial bank loans / Public–Private Partnerships (PPP):** Primary and rural health facilities operate in high poverty context with low user fees by design to protect equitable access. These fees do not cover operational expenditures and cannot service commercial debt. Evidence from Sub-Saharan Africa shows that PPP operators typically require availability payments or minimum revenue guarantees, creating the same fiscal burden as sovereign borrowing. Given the project's limited user-fee revenue generation and low financial return profile, neither commercial debt nor PPPs are suitable as main financing routes.

- **Social impact bonds / blended repayable instruments:** Repayable blended finance instruments require a solvent public payer capable of reimbursing investors based on outcomes. In countries with tight fiscal constraints, the low financial return of these investments makes these mechanisms fiscally risky. They would shift affordability pressures into future outcome payments. These instruments cannot replace a primary grant for system-wide capital investments and are therefore not suitable as core finance.

- **Insurance / contingency funds:** Risk-transfer tools are valuable for shocks (e.g. extreme weather events) but cannot finance upfront investments in surveillance systems, resilient facilities, solarised cold chains equipment, and WASH infrastructure. They can be layered to protect assets after installation, yet they cannot fund the initial build-out. They are thus complementary but not substitutes for concessional climate finance.

- **Philanthropy funding:** Philanthropic flows are typically smaller, short-tenor, and project-specific and can help in the context of Togo to catalyse other public or private sector large scale funds. Murisa, (2025) also showed that the philanthropic environment showed modest improvement in sub–Saharan African countries with a drop of Global Philanthropy Environment Index (GPEI) due to global inflation pressure. They are excellent for pilots, innovation, or last-mile community work, but insufficient to finance a multi-year, government-owned, system-scale program across regions. Philanthropy is insufficient as a primary source.

- **Sovereign concessional loans (multilateral/bilateral):** Even concessional loans must be repaid from domestic revenues. Given the low revenue-generating profile of the project's activities and Togo's already constrained debt indicators, additional borrowing would increase fiscal risk. This contradicts debt-sustainability principles for social infrastructure with good public benefits. Such loans are not suitable as a core instrument for the project.

- **Grants** provide the level of concessionality required to fund the project's CAPEX without increasing fiscal pressure. They are fully aligned with the project's public-good nature and its focus on reducing vulnerability to climate-sensitive health outcomes, strengthening early warning systems, upgrading health infrastructure, and improving WASH.

4. Project scope and relevant activities for the EFA

The full scope of the project and its activities is detailed in the Feasibility Study and in the activity sheets included as Annex 2 of the Funding Proposal. For the Economic Analysis, a screening was undertaken to identify the interventions generating direct and quantifiable socio-economic benefits. Based on this assessment, the analysis focuses on activities under Components 1, 3 and 4, while Component 2 is considered an enabling intervention whose effects are captured indirectly through the strengthened performance of the other components.

Component 1

The activities under this component aim to strengthen the surveillance system for climate-sensitive infectious diseases through the integration of meteorological and health data, the expansion of hydrometeorological observation networks, the enhancement of National Meteorological Agency of Togo (*Agence Nationale de la Météorologie du Togo*, ANAMET)'s operational capacities, the development of predictive disease models, and the establishment of a functional Early Warning System. These interventions directly benefit a total of 1,841,389 people, including 903,503 men and 937,886 women, who gain access to climate-informed alerts and improved outbreak preparedness. The economic benefits of this component are captured through decreased burden of diseases attributable to climate change due to an operational Health Early Warning system (HEWARS).

Component 2

The Component 2 focuses on building an enabling environment for climate-health governance by strengthening institutional leadership, technical capacities and intersectoral coordination. Although essential for long-term systemic resilience, the activities under the component do not directly generate monetizable economic benefits and are therefore not modelled independently. Their impact is reflected indirectly through the Components 1, 3 and 4.

Component 3

This component addresses the physical vulnerability of health facilities in project area by upgrading infrastructure, improving WASH services, enhancing thermal comfort, securing maternity and neonatal units, establishing a maintenance system, and strengthening supply chains through solar-powered cold chains and digital monitoring tools. These interventions benefit 282,144 people, including 134,488 users of upgraded health facilities, 50,316 beneficiaries of strengthened cold chain systems and 147,656 individuals served by sentinel surveillance sites. The socio-economic benefits generate under this component include avoided climate-related damage to health infrastructure, reduced vaccine losses, avoided economic burdens of infections with anti-microbial resistant pathogens and lower electricity consumption and emissions in rural health facilities.

Component 4

Component 4 enhances community resilience through improved Water, Sanitation and Hygiene (WASH) infrastructure, vector control measures and climate-health communication and behaviour change activities. A total of 1,249,903 people benefit from community-level interventions, including climate-resilient water systems, sanitation facilities, environmental management activities and communication campaigns. In the EFA, the benefits are captured through the reduction of water-borne and vector-borne disease burden, improved access to clean water and sanitation services for vulnerable households.

The Economic Analysis covers those interventions that are most likely to generate direct socio-economic gains over a 20-years horizon. Components 1, 3 and 4 are therefore included, while Component 2 is excluded from direct quantification due to its indirect and systemic nature. Geographically, the scope of the analysis comprises the regions of Centrale, Kara and Savanes, which experience the highest burden of climate-sensitive health outcomes and the greatest vulnerability of health and WASH infrastructure. The target population includes rural communities, women, children, health facility users, community health workers and all groups receiving climate-health alerts or community-level support under the project.

5. Financial Analysis

The project finances interventions that fall entirely within the public health and climate-resilience domain and are delivered through public institutions. All investments supported by the GCF and co-financing partners target essential health services, climate-resilient health infrastructure, health early warning systems, WASH improvements, and community-level adaptation measures. These interventions provide public services that are non-rival and non-excludable and therefore meet the classical definition of public goods.

Given the nature of these activities, revenue-generating mechanisms do not yield sufficient cash flow that could be used to assess financial viability or to service debt, a short financial sustainability module has been developed to assess the fiscal implications of the project under a full grant versus a concessional loan scenario.

The results presented in the *"Fiscal sustainability"* sheet showed that under a full grant, the Government of Togo and the Ministry of Health would remain responsible for financing maintenance, and major replacement costs of the assets over their lifetime, estimated at approximately EUR 18.1 million over 20 years, with annual needs increasing from about EUR 1 million in the early years to around EUR 2 million toward the end of the period as key equipment reaches end of life. These obligations define the level of domestic budget commitment needed to ensure sustainability without creating additional sovereign debt. With the government planning to increase its budget allocation to health from 7.32% in 2022 to 11% in 2027 (National health development plan 2023-2027), we assume that these maintenance costs are manageable within domestic health budgets (~0.6% of govt health expenditure). In addition, the budget process relies on the submission of needs from local units to the central level, this paradigm shift created by the project will lead the central government to progressively include financing for resilience in health sector in its planning.

By contrast, under a concessional loan of EUR 44 million at 0.25 % interest, with a 10-year grace the government would pay roughly EUR 211,200 annually in interest during the grace period, followed by about EUR 1.64 million per year in debt service from Year 11 to Year 40, leading to total repayments of approximately EUR 49–50million representing additional 0.5% of GDP over the loan term. This debt service would come in addition to the EUR 28.1 million required for O&M and replacements, bringing total long-term fiscal commitments close to EUR 80 million. Given Togo's GDP of approximately EUR 9.2 billion, a public debt ratio near 70 % of GDP, and its classification by the IMF as high risk of overall debt distress in 2024, the additional long-term debt burden under a loan scenario would represent a significant fiscal constraint relative to limited public resources and low health sector spending levels, while the grant modality preserves fiscal space and strengthens long-term sustainability.

6. Economic analysis

6.1 Methodology

The economic analysis assesses the overall societal value of the project using a cost benefit analysis (CBA) approach. It captures both market and non-market benefits, including improved public health services, reduced economic losses from climate-sensitive health outcomes, and enhanced community access to water and sanitation. In this section, we present the overall methodological approach

6.1.1 Assumptions and data sources

The primary data for the economic model including initial investment costs, project lifespan, and the number of beneficiaries or population size impacted are drawn from the Feasibility Study (FS) estimates. (see the "Inputs data" sheets of the Excel file Annex 3_b for details on the assumptions and references). Where data was unavailable, assumptions were developed in consultation with key stakeholders such as Ministry of Health, ANAMET, and National Civil Protection Agency (Agence Nationale de la Protection Civile, ANPC) and will be refined to align with FS estimates.

Health economic data, including disability adjusted life years (DALYs) avoided through project interventions, are sourced from scientific literature and World Health Organisation (WHO) databases. Socio-economic indicators, health expenses data and macroeconomic data are either obtained from national statistical sources (National Institute of Statistics and Economic and Demographic Studies (*Institut Nationale de la Statistique et des Etudes Economiques et Démographiques*, INSEED), Ministry statistical yearbook, Health account) or from the World Bank's/ International Monetary Fund (IMF) database. Disease incidence data for malaria and diarrheal diseases are taken from the Feasibility Study.

Table 1: General assumption and parameters for economic estimation

Parameter and assumption	Value	Unit	Sources and References
General Assumptions			
Social discount rate	6%	percentage	(Haacker et al., 2020). On discount rates for economic evaluations in global health. Health Policy and Planning, 35(1), 107-114
Project lifespan	20	Years	Feasibility study
Number of USP in the 3 regions (Centrale, Kara, Savanes)	419	Units	Calculation based on MSHP 2023 statistical Yearbook
Total number of HF in the 3 regions	473	Units	calculation based on MSHP 2023 statistical Yearbook
Value of one DALY	1,000	USD	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 | Full Text (Daroudi et al., 2021)
GDP per capita, PPP (current international $) in 1990	1,110.17	USD	World Development Indicators last updated 07/10/2025 https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD?locations=TG
GDP per capita, PPP (current international $) in 2024	3,239.09	USD	World Development Indicators last updated 07/10/2026 https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD?locations=TG
GDP per capita, PPP annual growth rate	3%	%	Own calculation from World Development Indicators
Population Growth rate	2%	%	(INSEED, 2023a). RGPH5 Results

Parameter and assumption	Value	Unit	Sources and References
Inflation forecast (Average value)	3.42%	%	https://fr.theglobaleconomy.com/Togo/inflation_outlook_imf/
Total population in the 3 regions (Centrale, Kara, Savanes)	2,924,561	People	(INSEED, 2023a). RGPH5 Results
Exchange rate Dollars to EUR	0.86	EUR	IMF yearly average from 1990 to 2023
Exchange rate CFA to EUR	0.0015	EUR	IMF yearly average from 1990 to 2023
Share of USP Type I & II among all health facilities in the three regions.	89%	percentage	Calculation based on MSHP 2023 statistical Yearbook
Share of the USP targeted by the project in the total number of USP in the three regions	7%	percentage	Calculation based on MSHP 2023 statistical Yearbook
Indicative cost for component 1	7,622,272	EUR	Annex 4
Indicative cost for component 2 (without the in-kind) of government	7,902,120	EUR	Annex 4
Indicative cost for component 3	19,515,830	EUR	Annex 4
Indicative cost for component 4	8,959,778	EUR	Annex 4
Total project indicative cost	44,000,000	EUR	Annex 4

(Source: Own elaboration, 2025)

Table 2: Data inputs and assumptions for Component 1 economic estimates

Parameter and assumption	Value	Unit	Sources and References
Total indicative cost for Component 1	7,622,272	EUR	Annex 4
O&M (Annual recurrent After full operationalisation From Y6 -Y20)	124,000	EUR	See Estimates Inputs_Opex sheet in Annex_3a
Climate change attributable DALYs per 100'000 capita in low and middle-income countries in the African Region	278	DALYs per 100 000 hbts	WHO (2013) The Global Health Observatory
Effectiveness factor (central scenario)	30%	percentage	Percentage of reduction of burden of climate-sensitive infectious due to Early warning systems
Number of total beneficiaries of component 1	1,841,389	People	Beneficiaries' calculation

(Source: Own elaboration, 2025)

Table 3: Data inputs and assumptions for Component 3 economic estimates

Parameter and assumption	Value	Unit	Sources and References
Total indicative cost for component 3	19,515,830	EUR	Annex 4 information
O&M (Annual recurrent After full operationalisation From Y6 -Y20)	627,300	EUR	See Estimates Inputs_Opex sheet in Annex_3a

Parameter and assumption	Value	Unit	Sources and References
Value of health asset exposed to climate risks	4.62	Millions USD	Togo | Disaster Risk Platform
Total Value of exposed asset to climate risks	21.4	Millions USD	Togo | Disaster Risk Platform
Share of health asset in total exposed asset	21.59%	percentage	Own calculation
Expenditure provided by the contingency plan to manage climate related damage in the Centrale region	701,281,000	FCFA	ANPC (2024) Plan de régional de contingence multirisques
Expenditure of the expenditure provided by the contingency plan to manage climate related damage in the Kara region	279,282,500	FCFA	ANPC (2024) Plan de régional de contingence multirisques
Expenditure provided for by the contingency plan to manage climate related damage in the Savanes region	439,615,000	FCFA	ANPC (2024) Plan de régional de contingence multirisques
Number of estimated flood event in 15 years (proxy of frequency of climate extreme event in the region)	13	times	Author assumption based on (World Bank, 2025c). Country Climate risk profile available at https://climateknowledgeportal.worldbank.org/sites/default/files/country-profiles/17282-WB_Togo%20Country%20Profile%20WEB.pdf
Share of total health expenditures allocated to USP type 1 and 2 facilities	15%		Assumption based on calculation of District health expenditure
Water need per day per person attending the Health Facility	1.5	liters	Assumption
District and regional health facility attendance statistics, 2023 (Centrale, Kara, Savanes)	2,027,739	people	(MSHPCSUA, 2024) Annuaire statistique de la santé 2023 available at https://sante.gouv.tg/wp-content/uploads/2025/01/Togo_Annuaire_Statistique_2023_Final_signee.pdf
Water price for (0,25L)	25	FCFA	Field information
Annual Growth rate in HF frequentation	0.5%	Assumption	Conservative assumption
Mortality rate attributed to unsafe WASH	42.4	per 100000hbts	Word bank indicators https://data.worldbank.org/indicator/SH.STA.WASH.P5?name_desc=true
Neonatal sepsis and infection death rate in infants	311.4	per 100,000 infants	IHME, Global Burden of Disease (2024).https://ourworldindata.org/grapher/neonatal-sepsis-and-infection-death-rate-in-infants?mapSelect=~TGO
Value of statistical life (VSL) in Low-income countries (mean estimation)	78,624	USD	(Redfern et al., 2024) Redfern A, Li S, Gould M, Acero F, Stein D. Lessons from Applying Value of Statistical Life and Alternate Methods to Benefit–Cost Analysis to Inform Development Spending. Journal of Benefit-Cost Analysis. 2024;15(S1):127-154. doi:10.1017/bca.2024.10
percentageof neonatal sepsis avoided due improved WASH services	27%	percentage	(Kanyangarara et al., 2021) Access to water, sanitation and hygiene services in health facilities in sub-Saharan Africa 2013–2018: Results of health facility surveys and implications for COVID-19 transmission. Available at https://pmc.ncbi.nlm.nih.gov/articles/PMC8231746/
Number of health Facilities considerd	15	Unit	Feasability study
Total Births in the regions	95,738	infants	(MSHPCSUA, 2024) Annuaire statistique de la santé 2023 available at https://sante.gouv.tg/wp-content/uploads/2025/01/Togo_Annuaire_Statistique_2023_Final_signee.pdf
Disability-adjusted life-years (DALYs) associated to and associated with bacterial AMR in Sub-Saharan Africa	6,105.3	per 100000hbts	(Murray et al., 2022) Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis https://pmc.ncbi.nlm.nih.gov/articles/PMC8841637/
Effectiveness factor of Hands hygiene and environmental hygiene in health care facilities	10%	percentage	Author assumption
Electricity demand for one health centre per year	7,300	Kwh	"Technical guide on the electrification of healthcare facilities in rural areas" and assumptions from

Parameter and assumption	Value	Unit	Sources and References
			UNDP 2019. "Power for Health" Masterplan for Malawi - Energy Load Assessment," Efficiency (20Kwh/per day)
Electricity price per KWh	102	FCFA	(RTG, 2025) https://www.republiquetogolaise.com/energies/1905-10686-electricite-nouveaux-tarifs-depuis-le-15-mai
percentageof electricity consumption reduction due to Solar panel equipement	25%	percentage	Author Assumption
Grid emission factors for the electricity system of the Grid emission factor for the West African Power Pool	0.578	TCO2/Mwh	(UNFCCC, 2021) https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20210325112041972/ASB0034-2021.pdf
Social price of carbon	35	USD/tCO2e	Minimal value from World bank https://documents1.worldbank.org/curated/en/099553203142424068/pdf/IDU1c94753bb1819e14c781831215580060675b1.pdf
National Health Vaccination expenses	4,735.9	Millions Fcfa	(MSHP, 2021) https://sante.gouv.tg/wp-content/uploads/2024/04/Rapport-CS-2020-2021-ok.pdf
Share of District Health Facility expenditure in total current health expenditure	3%	percentage	(MSHP, 2021) https://sante.gouv.tg/wp-content/uploads/2024/04/Rapport-CS-2020-2021-ok.pdf
Percentage lost of vaccins due to cold chain supply (baseline)	15%	percentage	Assumption based on national data on vaccination
Percentage lost of vaccins due to cold chain supply with the project	8%	percentage	Assumption
DALYs due to prevalence of Malaria in Togo	3,384.17	per 100000hbts	(WHO, 2021) https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/global-health-estimates-leading-causes-of-dalys
Malaria prevalence (mean for the three regions)	20,850	per 100000hbts	Author calculation based on FS
Effectiveness factor of Reduction of Malaria burden case due to timely diagnostic and treatment	5%	percentage	Assumption and consultation with PNLP expert
Number of direct beneficiaries of component 3	282,144	people	Beneficiaries' calculation

(Source: Own elaboration, 2025)

Table 4: Data inputs and assumptions for Component 4 economic estimates

Parameter and assumption	Value	Unit	Sources and References
Total indicative cost for component 4	8,959,778	EUR	Annex 4 information's
O&M (Annual recurrent After full operationalisation From Y6 -Y20)	47,000	EUR	Author assumption
DALYs of diarrhoeal diseases in TOGO	2928.7	per 100000hbts	(WHO, 2021) https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/global-health-estimates-leading-causes-of-dalys
Increase level of adoption of Hygiene measure among the beneficiaries due to the component 4 activities implementation including communication campaign that include Wash practices	25%	Percentage	(Briceño et al., 2017). Evidence from "Are there synergies from combining hygiene and sanitation promotion campaigns: Evidence from a large-scale cluster-randomized trial in rural Tanzania"https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0186228 and Effectiveness of a large-scale handwashing promotion intervention on handwashing behaviour in Dhaka, Bangladesh

Number of drinking water supply systems in Schools	15	Units	Feasibility study
Number of Effective School Days in a year	186	Days	Official portal of the Togolese Republic : https://www.republiquetogolaise.com/education/1809-11070-annee-scolaire-2025-2026-le-decoupage & https://www.republicoftogo.com/toutes-les-rubriques/education/un-calendrier-bien-rythme#:~:text=En%20plus%20des%20cong%C3%A9s%20traditionnels%20de%20No%C3%ABl,:%20du%2013%20au%2022%20f%C3%A9vrier%202026.
Estimated Volume of Water Consumption in Schools	10	Litres/days	(WHO, 2009). Water Water, Sanitation and Hygiene Standards for Schools in Low-cost Settings https://iris.who.int/server/api/core/bitstreams/7dfb2a38-2fea-45b6-a76e-315ad5480931/content
Average number of students per school + Staffs Members (20)	223	people	Feasibility study
Annual water need per beneficiaries in schools	31,108,500	Litres	Calculated
Water price	265	CFA/m3	(pS-Eau, 2019) https://www.pseau.org/outils/lettre/article.php?lett_article_lettre_id=1523
Prevalence of diarrhoea	18.7	per 10000hbts	Feasability study
Central scenario of Effectiveness factor of component 4 interventions to improve diarrhoeal diseases burden	22%		(Wolf et al., 2022). 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 https://www.thelancet.com/action/showPdf?pii=S0140-6736%2822%2900937-0
Annual cost of volume of water supplied	12,366	EUR	Calculated
DALYs of diarrhoeal diseases Averted due to component 4 implementation	2,008.4	EUR	Calculated
Calculated economic burdens of diarrheoal diseases avoided due to implementation of component 4	1,720,194	EUR	Calculated

(Source: Own elaboration, 2025)

6.1.2 Methodology of economic benefits estimates

The economic analysis compares two scenarios: with project (WP) and without project (WOP).

- In the WOP case, we assume that the investments will not occur, and communities continue to bear the health and economic costs of climate-sensitive health outcomes such as heat-related diseases, malaria and diarrhoea.
- In the WP case, project interventions reduce these impacts and benefits are measured as incremental avoided costs compared to WOP case, capturing the economic value of reduced disease burden and improved resilience

In the model, we consider incremental costs and benefits in the WP scenario compared to the WOP case. Costs are derived from budget information, while benefits are estimated using revealed-preference methods [1].
The following table presents the mains benefits with their valuation techniques

Table 5: Main project economic benefits estimated and valuation techniques

Components	Economic benefits	Valuation techniques
Component 1	Disability adjusted life years (DALYs) averted by climate sensitive infectious diseases surveillance system operationalisation.	Avoided Cost of DALYs estimated.
Component 3	Avoided costs of climate-related damage to health infrastructure.	Avoided cost and using available data from ANPC as proxy of infrastructure damage cost.
	Economic value of avoided maternal/or neonatal mortality due to resilient maternity and improved access to WASH facilities in maternity.	Avoided cost using Value of Statistical life technique (VSL).
	Reduced economic burdens of Malaria due to improved surveillance, timely diagnostic treatment.	Avoided Cost of DALYs estimated.
	Avoided electricity fees using solar equipment.	Avoided Cost.
	Avoided Greenhouse Gas Emissions use of solar cold chain equipment.	Avoided Cost.
	Avoided health costs of infections with anti-microbial resistant pathogens.	Avoided Cost of DALYs estimated.
	Reduction of losses of vaccines and sensitive medical products.	Avoided Cost.
Component 4	Improved Access to clean water and sanitation services for communities.	Avoided Cost.
	Reduced economic burdens of Diarrhoea due to improved access to WASH Services .	Averted DALYs.

(Source: Own elaboration, 2025)

In the following section, we present the methodological framework to assess the annual flows of benefits and costs of the three components

Component 1: Strengthening the surveillance system for climate-sensitive health outcomes

The main economic benefits of this component arise from the reduction of climate-sensitive health outcomes attributable to the operationalization of the surveillance system. The assessment will follow three steps: (i) estimation of avoided DALYs averted, (ii) economic valuation, and (iii) projection of annual benefit flows over the project lifecycle.

- Avoided DALYs represent the reduction in climate sensitive disease burden among the target population, owing to earlier detection, improved preparedness.

Avoided DALYs for year follow:

$$AD_t = DALYs_t * E * \frac{pp}{100{,}000}$$

- AD_t: represents the estimated number avoided DALYs in year *t*
- $DALYs_t$: DALYs attributable to climate sensitive infectious diseases

[1] Revealed preference methods estimate the value of non-market outcomes based on the prices paid for related market goods. (GCF, 2022). Annex VI. Economic and financial analysis (EFA) guidance.

- E: expected effectiveness factor of the climate-sensitive infectious diseases surveillance system
- pp: target population covered by project activities

Effectiveness values remain uncertain due to the limited availability of empirical country-specific data. Scenario analysis is applied to reflect this uncertainty, based on international evidence (Hunt et al., 2017; Rao et al., 2025).

Table 6: Assumption on the Effectiveness of surveillance system for climate-sensitive infectious diseases

Effectiveness of surveillance system for climate-sensitive infectious diseases	Value
Conservative	8%
Central	30%
Optimistic	40%

(Source: Own elaboration, 2025)

i) Economic valuation of avoided DALYs: Avoided DALYs are monetized to reflect the economic gain associated with improved health and productivity among beneficiaries. The valuation uses a cost-per-DALY value of USD 1,000 consistent with (Daroudi et al., 2021) for low-income country contexts.
ii) Projection of Benefit flows: The value of avoided DALYs is adjusted each year based on real GDP per capita growth, capturing improvements in productivity:

The total benefits over the project lifetime:

$$TB = \sum_{t} AD_t * VDALY_1 * (1 + g_{gdp})$$

Where $VDALY_1$ is the monetary value of DALY averted at the start of implementation and g_{gdp} is the projected real growth rate of GDP per capita in PPP terms.

Costs streams include:

- For Years 1 to 5 component budgeted expenditures
- For Years 6 to 20, OPEX is calculated, using asset-level cost estimates see new Sheet “Details_opex_Y6-Y20” provided

Component 3: Climate-resilient and low-carbon infrastructures, technologies, and supply chain

i) Avoided climate-related damage to health infrastructure. Climate-proofing investments are expected to reduce the vulnerability of health facilities to extreme weather events, affecting the Centrale, Kara, and Savanes regions. The methodology estimates the economic value of damages that would occur in a without-project situation and considers the proportion of those damages that the project is expected to prevent through enhanced structural resilience. Baseline climate-related damage costs are derived from expenditures planned under regional contingency frameworks led by the National Civil Protection Agency (ANPC), which detail resource requirements to address infrastructure losses associated with flooding and other hazards. Since these contingency plans cover multiple sectors, a proportional allocation approach is applied to determine the share attributable to the health sector, based on the valuation of exposed health assets relative to total exposed assets at national level. The analysis then isolates the subset of health infrastructure relevant for this project, that is primary rural health units (USP type 1 and type 2) located in high-exposure areas in the three target regions. The number of extreme events (flood) projected over 20 years is taken from the World Bank Climate Risk Profile for Togo. This provides an annualised baseline cost trajectory that represents a proxy of the magnitude of climate-induced costs on health infrastructure in the project area in absence of intervention.

ii) **Avoided DALYs due to reduced malaria burden and antimicrobial-resistant infections.** Avoided DALYs from malaria and antimicrobial-resistant infections are estimated using the same methodology applied for Component 1. Baseline DALY rates for malaria and Anti - Microbial Resistance (AMR) are applied to the project beneficiary population, then multiplied by the expected effectiveness of the intervention.

iii) **Reduced maternal and neonatal mortality.** The economic benefits of reduced maternal and neonatal mortality come from the improvement of WASH conditions in health centres and maternities. The benefits estimation follows the same structure as DALYs avoided methodology: (i) determine baseline disease burden, (ii) apply an effectiveness parameter, and (iii) monetise avoided health losses. Baseline mortality reflects the neonatal sepsis and infection death rate of 311.4 per 100,000 births (MSHPCSUA, 2024), applied to 95,738 annual births in the targeted regions. Effectiveness of 27% is used to reflect the reduction in neonatal sepsis attributable to improved hygiene and sanitation interventions in health facilities (Kanyangarara et al., 2021). This results in an estimated 80 avoided neonatal deaths per year. Unlike the DALY methodology, monetization uses the Value of a Statistical Life (VSL), valued at USD 78,624 based on evidence for low-income countries (Redfern et al., 2024). Annual economic benefits correspond to the number of avoided neonatal deaths multiplied by the VSL, indexed over time to real income growth.

iv) **Reduction of electricity bills due to solar panel equipment:** Solar installations in health facilities are expected to reduce electricity consumption by 25%, based on expert assumptions and WHO/United Nations Development Programme (UNDP) technical guidance. The analysis uses annual facility demand of 7,300 kWh, multiplied by the electricity tariff of 102 FCFA/kWh, to calculate avoided costs each year. These reductions reflect both lower operating costs and improved reliability of energy supply in peripheral facilities

v) **Avoided Greenhouse Gas Emissions due to use of solar cold chain equipment:** Solar-powered cold chain systems reduce reliance on grid electricity and diesel-powered refrigeration. Emissions avoided are calculated using the West African Power Pool (WAPP) grid emission factor of 0.578 tCO_2/MWh, applied to the share of electricity displaced by solar systems. Monetization uses the World Bank social cost of carbon of USD 35 per tCO_2e, producing a yearly stream of avoided climate damages.

Avoided water purchase expenses for patient due to Improved Access to clean water and sanitation services for Health Facilities (HF): Improved WASH infrastructure reduces the need for patients and health facilities to purchase water externally. The analysis uses a daily need of 1.5 litres per person, combined with annual facility attendance of 2,027,739 beneficiaries in the three regions, and a unit water price of 25 FCFA per 0.25 litres.

vi) **Reduced losses of vaccines and other temperature-sensitive medical products** are valued using an avoided replacement cost approach. Strengthened cold-chain infrastructure through solar refrigeration, continuous temperature monitoring, and improved logistics management is expected to significantly reduce wastage. The economic benefit is estimated as the difference between baseline and with-project wastage rates, multiplied by baseline vaccination expenditure, adjusted for the district health-facility share (3%). National vaccination expenditure data from the Ministry of Health's 2020–2021 health accounts Report serve as the reference baseline.

vii) **Avoided economic burdens of infections with anti-microbial resistant (AMR) pathogens:** AMR-related benefits are based on the DALY burden attributable to antimicrobial resistance, estimated at 6,105.3 DALYs per 100,000 inhabitants according to global burden of AMR assessments. Project interventions are assumed to reduce AMR-related DALYs by 10%, a conservative estimate consistent with WHO and peer-reviewed literature. Monetization uses the DALY value adopted for the EFA.

Component 4: Enhancing community adaptation and engagement

i) **Avoided diarrhoeal disease burden through improved access to safe water and sanitation:** The primary source of economic benefits under Component 4 is the reduction of diarrhoeal diseases among beneficiaries of the community WASH interventions including awareness campaign to encourage behaviour change. Baseline disease burden is derived from national DALY estimates for diarrhoeal diseases (2,928.7 DALYs per 100,000 inhabitants, WHO Global Health Estimates). This burden is applied to an estimated proportion of the target population benefiting from improved adoption of WASH good practices compared to the baseline (increase of 25% of adoption of WASH measures among the beneficiaries due to the component 4 activities) (Briceño et al., 2017). Effectiveness of the intervention in reducing diarrhoeal disease risk is estimated at 22%, based on the analysis by (Wolf et al., 2022), which reports the impact of combined WASH interventions on diarrhoeal morbidity in low- and middle-income settings. Avoided DALYs are then monetized using the DALY valuation. In the model, this yields 2,008.4 DALYs averted annually, corresponding to EUR 1,7 Million in avoided economic losses.

ii) **Avoided costs of water supply due to improved community infrastructure:** The project invests in 15 climate-resilient drinking water systems in schools. The analysis quantifies the economic value of the water supplied by these systems based on:

- ✓ a daily water need of roughly 10 litres/day per person (Basic water requirements estimated at 5 l/day/person for students and staff, plus additional 3 l/day/person for pour-flush toilet use (WHO, 2009)),
- ✓ an annual volume of 31,108 m³, and
- ✓ a unit water price of 265 FCFA per m³, sourced from national water tariff documentation.

The annual cost of the water supplied under the with-project scenario is EUR 12,366 representing the economic value of improved access to reliable safe water and the avoided expenses that households and schools would otherwise incur to obtain equivalent water through alternative sources.

6.2 Results of the economic analysis

The following analysis draws on the calculations performed in the Excel file *“Annex 3b_Economic_analysis_Togo_health_climate*”, primarily within the Sheets “*Overall_Project*”, “*EWS for health*”, “*Health Infrastructure*”, “*Community resilience*”, and “*Inputs_Data*”. The economic analysis covers the entire project. All results are expressed in economic terms, applying a 20-year project horizon consistent with the expected lifetime of the infrastructure upgrades, early warning systems, WASH improvements and public health benefits generated by the project.

The model compares a with-project scenario to a without-project (BAU) scenario, capturing avoided disease burden, avoided climate-related infrastructure damage, improved health outcomes, and strengthened WASH and cold-chain systems. Economic performance metrics including Economic Net Present Value (ENPV), Economic Internal Rate of Return (EIRR) and Benefit Cost Ratios (BCR) are based on a 6% social discount rate. The results are summarized in table 7.

Table 7: Economic Results of the project over 20-year lifespan, by component

Indicators	UNIT	Overall Project	Component 1	Component 2	Component 3	Component 4
Break even	Year	13	10	-	12	10
ENPV (6% Social discount rate)	EUR	11,629,145	5,624,511	-	6,311,466	6,118,134
EIRR	%	10%	15.8%	-	10.8%	16.3%
Total costs over 20 years	EUR	58,184,500	9,982,272	7,902,120	30,035,330	10,264,778
Total benefits over 20 years	EUR	110,373,643	26,773,920	-	35,673,582	19,081,692
B/C Ratio	Ratio	1.3	1.8	-	1.3	1.8

(Source: Own elaboration, 2025)

The project demonstrates strong overall economic viability, with an Economic Net Present Value (ENPV) of EUR 11.6 million at a 6% social discount rate and an Economic Internal Rate of Return (EIRR) of 10.%. The benefit-cost ratio (BCR) of 1.3 indicates that every euro invested is expected to generate EUR 0.3 in socio-economic value. The project breaks even around year 13, which is consistent with investments in climate-resilient health systems where benefits accumulate progressively where benefits materialise progressively over time. These results confirm a robust economic case under conservative benefits estimations assumptions.

At the component level, the component 1 shows strong economic performance, with an EIRR of 15.8%, an ENPV of EUR 5.6 million, and a BCR of 1.8. The earlier break-even point at year 10 reflects the rapid realisation of benefits associated with improved climate information, early warning, and decision-making systems, which reduce health risks and improve system efficiency.

The Component 3 also delivers substantial economic returns, with an EIRR of 10.8%, an ENPV of EUR 6.3 million, and a BCR of 1.3. Given its large share of total project costs (over 50% of total lifecycle costs), its positive performance is critical to overall project viability. Benefits are driven by avoided damage to health infrastructure, reduced mortality and morbidity (including neonatal and malaria-related outcomes), improved cold chain performance, and operational savings from resilient and energy-efficient systems. The break-even point at year 12 reflects the long-lived nature of infrastructure and the gradual accumulation of health gains. Given its large share of total project costs (almost 50% of all expenditures), Component 3's positive performance is critical for overall project viability.

Component 4 shows strongest economic performance, with an EIRR of 16.3%, an ENPV of EUR 6.1 million, and a BCR of 1.8, with break-even reached around year 10. The results reflect the relatively low cost and high effectiveness of WASH and behaviour change interventions in reducing disease burden. Benefits are driven by reduced incidence of diarrhoeal diseases, improved hygiene practices, and increased access to safe water, which translate into both health gains and productivity improvements.

Component 2 does not have quantifiable economic indicators because it focuses on institutional strengthening, governance, training, and capacity-building. These generate enabling environment that make the other components function effectively but do not produce directly monetizable returns.

6.3 Sensitivity analysis

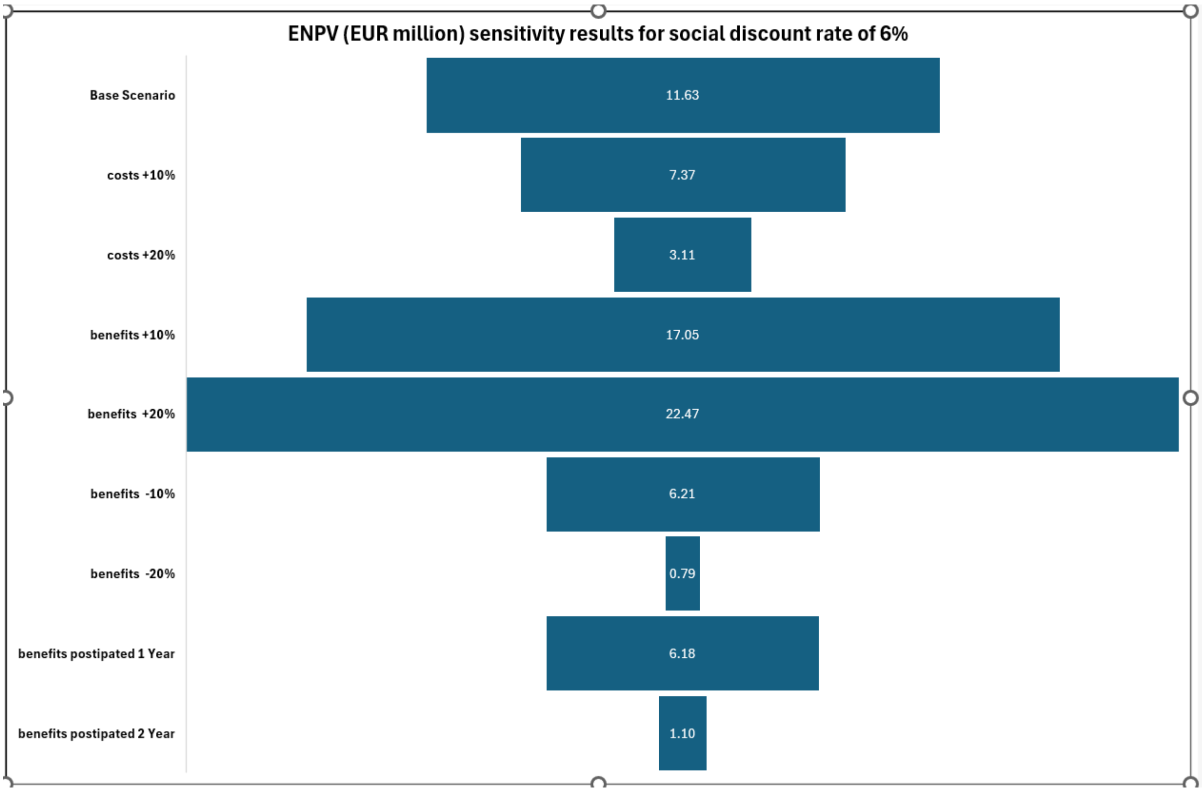
The sensitivity analysis shows that the project remains economically viable under a wide range of parameter variations, but performance weakens significantly when benefits are reduced or postponed.

Table 8: Sensitivity analysis results

Social discount rate	Key Performance Indicators for Different Discount Rates (DR)						EIRR
	2%	4%	6%	8%	10%	12%	
	ENPV (Millions of Euros)						%
Base Scenario	34	21	11.6	5	0	-3	10%
costs +10%	29	16	7.4	1	-4	-7	8.4%
costs +20%	24	12	3.1	-3	-7	-10	7%
benefits +10%	43	28	17.1	9	4	0	11.7%
benefits +20%	51	35	22.5	14	7	3	13.4%
benefits -10%	25	14	6.2	1	-4	-6	8.2%
benefits -20%	17	7	0.8	-4	-7	-9	6.3%
benefits postipated 1 Year	27	15	6.2	0	-4	-7	8.0%
benefits postipated 2 Year	20	9	1.1	-4	-8	-11	6.3%

(Source: Own elaboration, 2025)

Figure 1: Sensitivity analysis of ENPV



(Source: Own elaboration, 2025)

- **Sensitivity to Higher Costs:** increasing total project costs by 10% reduces the ENPV from 11.6 million to EUR 7.4 million, and the EIRR declines from 10% to 8.4%. A 20% cost increase lowers the ENPV to EUR 3.1 million and reduces the EIRR to 7%. Despite this reduction, the project maintains positive economic value with substantial benefits that outweigh cost escalation. The sensitivity analysis shows that the project delivers strong economic results even under risks related to procurement cost increases and inflation in construction and equipment markets.

- **Sensitivity to Lower Benefits:** reductions in benefits have a stronger effect on economic performance than cost variations. A 10% decrease in benefits reduces the ENPV to EUR 6.2 million and lowers the EIRR to 8.2%. A 20% reduction in benefits decreases the ENPV to EUR 0.8 million and the EIRR to 6.3%. These results reflect the benefits' reliance on avoided losses, including reduced mortality, disease burden, avoided infrastructure damages, and improved WASH services. These outcomes depend heavily on sustained operational performance of health facilities, cold chains, community WASH systems, and the climate–health early warning system. Maintaining intervention quality over time is therefore central to preserving economic value.

- **Sensitivity to Benefit Delays:** postponing benefits by one year reduces ENPV from EUR 11.6 million to EUR 6.2 million. A two-year delay lowers the ENPV to approximatively EUR 1.1 million and reduces the EIRR to 6.**3**%. These results show the importance of timely commissioning of resilient infrastructure, full deployment and operationalization of surveillance systems, to ensure expected benefits materialise as planned.

- **Sensitivity to the Social Discount Rate:** the ENPV declines as the social discount rate increases, from 34 million at 2% to a negative value of EUR -3 million at 12%. This trend reflects the long-term nature of project benefits and is fully expected for climate-resilient health investments. The EIRR of 12.0% exceeds commonly applied social discount rates (6 –10%), meaning the project remains economically justified under standard adaptation investment benchmarks.

7. Conclusion

The analysis demonstrates that the project delivers substantial economic benefits, even though it does not generate any repayable revenue streams. The interventions supported climate-informed surveillance, resilient health infrastructure, solar-powered cold chains, and community WASH systems are typical public goods.

Economically, the project offers strong value for money. Over a 20-year horizon, the overall ENPV is EUR 11.6 million at a 6% social discount rate, with an EIRR of 10% and a benefit-cost ratio of 1.3. Total benefits amount to EUR 110.4 million compared to total costs of EUR 58.2 million. Benefits are driven by avoided climate-related damage to health facilities, avoided disease burden (malaria, diarrhoea, neonatal mortality, AMR), reduced vaccine losses, and improved continuity of essential services. Component-level returns reinforce this pattern: component 1 provides strong economic case (EIRR of 15.8% and a BCR of 1.8); component 3 generates significant avoided losses and health gains (EIRR = 10.8%), and component 4 provides positive returns from reduced diarrhoeal disease burdens and improved access to clean water system and sanitation (EIRR = 16.3%). These results confirm that the project is economically compelling.

Sensitivity testing further validates the robustness of the investment. Even with a 20% increase in costs, ENPV remains positive (EUR 3.1 million at a 6% discount rate) and the EIRR (7%) stays above the social discount rate. Reduced benefits have a stronger effect, as is expected for adaptation projects where gains accrue gradually. But the project maintains economic viability even with a 20% reduction in benefits. Delaying benefits by one- or two-years lowers returns significantly, confirming the importance of timely implementation. Across all discount rates, the project remains economically justified under standard adaptation investment benchmarks.

Beyond quantified benefits, the project delivers critical non-monetised climate resilience outcomes: stronger national surveillance capacity, improved emergency preparedness, reduced health services disruptions, and increased community resilience. These benefits accrue primarily to rural populations, women, and children's groups with the lowest adaptive capacity and the highest exposure to climatic risks. The solarisation of health services and strengthened cold chains also reduce emissions, improve reliability, and protect essential medicines and vaccines from temperature shocks.

In summary, the project presents a clear case for GCF grant financing. Only a grant aligns with the public-good nature of the interventions, preserves limited fiscal space, and enables the Government of Togo to strengthen climate resilience in its health sector without compromising access or equity. GCF is uniquely positioned to support this investment, given its mandate in climate adaptation, its experience with health resilience programming, and its ability to crowd-in co-financing from BMZ and other partners. The project delivers high economic returns, strong pro-poor benefits, and long-term climate resilience outcomes, demonstrating excellent value for money and clear alignment with GCF objectives.

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