

ANNEX 10
ECONOMIC AND FINANCIAL ASSESSMENT

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"ONE BLOCK AT A TIME"

**BUILDING RESILIENT AND HEALTHY COOK ISLANDS
COMMUNITIES**

I. Overview and economic viability

The project cost for the implementation of priority climate resilience activities is USD12.47 million. USD0.73 million is expected to fund project management and measurement and evaluation activities. The total project budget is USD13.20 million (with GCF grant funding USD12.08 million of the budget).

The health burden cost due to climate change impact average USD3.69 million annually during the project lifespan. This comprises of morbidity and mortality costs (see II for discussion and references):

1. Morbidity
 - a. DALY¹ (disability-adjusted life year) morbidity (direct) – minimum conservative estimate, indirect is unaccounted
 - b. DALY cost for high income country = USD23,782
 - c. # of DALYs from climate change: 189.6 DALYs directly attributable to CC per 100,000 population
2. Mortality
 - a. Deaths per annum Western Pacific region = 4,100
 - b. VSL (Value of Statistical Life) = USD6.4m
 - c. Mortality due to climate change in the Cook Islands is pro-rated to the current population.

Considering project costs and the benefit from reduction on climate change-induced health burden costs, cost benefit analysis (CBA) shows the project delivers positive net present value (NPV) of USD 4.80 million at 3% discount rate over 20 years (Table 1). As a minimum (break-even or NPV = 0) for economic viability, the project needs to reduce total morbidity and mortality burden due to CC by 38%.

The CBA assumptions include:

- a. Investment useful life = 20 years (2024-2044)
- b. Projection of the Cook Islands population out to 2044 from the 15,040 population (as of December 2021) = based on the UNDESA² medium scenario forecast data
- c. % reduction CC mortality and morbidity = 50%
- d. Discount rate global health economics = 3% for high income countries³
- e. Sensitivity = breakeven analysis for % reduction.

¹ One DALY represents the loss of the equivalent of one year of full health. DALYs for a disease or health condition are the sum of the years of life lost to due to premature mortality (YLLs) and the years lived with a disability (YLDs) due to prevalent cases of the disease or health condition in a population. <https://www.who.int/data/gho/indicator-metadata-registry/imr-details/158>

² United Nations, Department of Economic and Social Affairs, Population Division (2022). World Population Prospects 2022, Online Edition

³ Markus Haacker, Timothy B Hallett, Rifat Atun, On discount rates for economic evaluations in global health, Health Policy and Planning, Volume 35, Issue 1, February 2020, Pages 107–114, <https://doi.org/10.1093/heapol/czz127>

Table 1: Cost-benefit analysis of the project⁴

Economic Analysis TMO proposal to GCF																					
USD millions	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Year	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044
Costs																					
Investment costs																					
GCF	-2.55	-4.22	-2.29	-2.02	-1.00	-															
GoCI	-0.36	-0.53	-0.08	-0.08	-0.07																
O&M costs																					
Total costs	-2.91	-4.75	-2.37	-2.10	-1.08	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26
Benefits																					
CC morbidity (USD/m)	-	-	-	-	-	0.74	0.74	0.74	0.76	0.77	0.78	0.78	0.79	0.79	0.80	0.81	0.81	0.82	0.82	0.83	0.83
DALYs # per 100k population	189.60	189.60	189.60	189.60	189.60	189.60	189.60	189.60	189.60	189.60	189.60	189.60	189.60	189.60	189.60	189.60	189.60	189.60	189.60	189.60	189.60
CI population	15,620	15,790	16,020	16,210	16,400	16,520	16,670	16,900	17,040	17,210	17,340	17,470	17,580	17,740	17,900	18,010	18,130	18,230	18,340	18,430	18,430
Population increase	170	230	190	190	120	150	230	140	170	130	130	110	160	160	110	120	100	100	110	90	130
DALYs # CI	29.62	29.94	30.37	30.73	31.09	31.32	31.61	32.04	32.31	32.63	32.88	33.12	33.33	33.64	33.94	34.15	34.37	34.56	34.77	34.94	34.94
DALYs cost (USD/m)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
CC mortality (USD/m)						2.72	2.74	2.77	2.81	2.83	2.86	2.88	2.90	2.92	2.95	2.97	2.99	3.01	3.03	3.05	3.06
VSL # Western Pacific	4,258	4,304	4,367	4,419	4,471	4,503	4,544	4,607	4,645	4,692	4,727	4,762	4,792	4,836	4,880	4,910	4,942	4,970	5,000	5,024	5,024
Total region population (m)	164	166	168	170	172	174	175	178	179	181	182	182	184	185	186	188	189	190	192	193	194
CI VSL due CC	0.41	0.41	0.42	0.42	0.43	0.43	0.43	0.44	0.44	0.44	0.45	0.45	0.45	0.46	0.46	0.46	0.47	0.47	0.47	0.48	0.48
CI VSL value (USD/m)	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40
% attributable to project	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Total benefits (USD/m)	-	-	-	-	-	1.73	1.74	1.76	1.78	1.80	1.82	1.83	1.84	1.86	1.87	1.89	1.90	1.91	1.92	1.94	1.95
Net benefit (USD/m)	-2.91	-4.75	-2.37	-2.10	-1.08	1.47	1.48	1.50	1.52	1.54	1.55	1.57	1.58	1.59	1.61	1.63	1.64	1.65	1.66	1.67	1.68
Discount rate	3%																				
NPV(USD/m)																					4.80
Break-even attribution rate																					
Break-even attribution rate	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%	38%
Total benefits breakeven	-	-	-	-	-	1.31	1.32	1.34	1.35	1.37	1.38	1.39	1.40	1.41	1.42	1.43	1.44	1.45	1.46	1.47	1.48
Net benefit B/E	-2.91	-4.75	-2.37	-2.10	-1.08	1.05	1.06	1.07	1.09	1.10	1.12	1.13	1.14	1.15	1.16	1.17	1.18	1.19	1.20	1.21	1.21
NPV																					-0.00

⁴ This table is included in the funding proposal package in spreadsheet format as Annex 23.

II. Discussion

A. Morbidity

One possible means of estimating benefits of DALY-averting health interventions is outlined in Daroudi 2021⁵. This method utilises average costs per DALY averted stratified by national income status (low, medium, high and very high). For high-income countries like the Cook Islands, the estimated cost per DALY averted is USD23,782. The most recent assessment of mortality and burden of disease attributable to climate change was performed by WHO in 2013⁶.

In this estimate, countries in the Western Pacific region with the same income as the Cook Islands at the time of assessment suffered 189.6 DALYs directly attributable to climate change per 100,000 population. With an official census population of 15,040 at the end of 2021, the Cook Islands would be expected to suffer 28.5 DALYs that year. Using this estimate of DALYs directly attributable to climate change, each year the Cook Islands loses nearly USD700,000 ($28.5 * \text{USD}23,782 = \text{USD}677,787$), or nearly USD12.6 million over the project period. Because the data forming the basis of this estimate are only by region (in the case of DALYs) and averaged across all countries with the same income status, it is probable that these figures are conservative.

Furthermore, there are reasons to believe that the Cook Islands has higher-than-average vulnerability to climate change⁷, which further suggests that these are likely underestimates. Additionally, the WHO-provided estimates only endeavour to estimate DALYs that are directly attributable to climate change. There is good reason to believe⁸ that the indirect health consequences of climate change have their own contribution to DALYs, but they are not accounted for in the WHO figures; again, the estimated budgetary figures *supra* are almost certainly lower than the actual costs that will be borne by the Cook Islands in reality.

B. Mortality

Relatedly, WHO has produced estimates of mortality directly attributable to climate change, and attributes 4,100 deaths per annum to climate change in the Western Pacific region⁹. The proportional share of directly climate change-attributable deaths in the Cook Islands is nearly 0.4 mortality per annum ($(15,040/158 \text{ million}) * 4,100 = 0.39$)¹⁰.

For context, the Cook Islands experiences about 130 all-cause mortalities per annum¹¹, based on the most recent year for which data are available (2018). Using Value of Statistical Life (VSL) figures by

⁵ Daroudi, R., Akbari Sari, A., Nahvijou, A. *et al.* 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 Eff Resour Alloc* **19**, 7 (2021). <https://doi.org/10.1186/s12962-021-00260-0>

⁶ World Health Organization (WHO). Climate Change Attributable DALYs ('000) – Low-and-middle-income countries of the Western Pacific Region (2013). [https://www.who.int/data/gho/data/indicators/indicator-details/GHO/climate-change-attributable-dalys-\(000\)](https://www.who.int/data/gho/data/indicators/indicator-details/GHO/climate-change-attributable-dalys-(000)).

⁷ <https://www.who.int/publications-detail-redirect/9789290617303>

⁸ [https://www.thelancet.com/article/S0140-6736\(19\)31762-3/fulltext](https://www.thelancet.com/article/S0140-6736(19)31762-3/fulltext)

⁹ <https://www.who.int/data/gho/data/indicators/indicator-details/GHO/climate-change-attributable-deaths>

¹⁰ <https://www.who.int/westernpacific/about/where-we-work>

¹¹ <https://www.health.gov.ck/wp-content/uploads/2021/09/2018-bulletin-7-September2021-update.pdf>

country income status, one crude estimate of the cost of mortalities is USD6.4 million/life¹² (N.B. these are not age-standardized rates, the pure cost of mortality is only approximated by VSL figures, there is a high degree of uncertainty generated by multiplying income category-level estimates, while the full complement of caveats about the underlying WHO estimates from above apply equally here).

C. Total morbidity and mortality costs

Using these figures for both morbidity and mortality, it can be estimated that there is an annual cost of almost USD3.2 million due to climate change in the Cook Islands ultimo 2021. These costs are projected to increase with an increasing population. As argued above, these estimates are conservatively calculated. Additionally, the expected increase in the severity of the impacts of climate change (increasing severity of tropical cyclones, increasing mental health problems due to loss of homes and livelihoods due to sea level rise, etc – see Section 5 of Pre-Feasibility Study) are not considered here (DALYs are kept constant, VSL is calculated by pro-rating the Cook Islands population forecast over the 4,100 deaths attributable to climate change for the Western Pacific region in 2013), making the estimates more conservative yet.

¹² Viscusi, W., & Masterman, C. (2017). Income Elasticities and Global Values of a Statistical Life. *Journal of Benefit-Cost Analysis*, 8(2), 226-250. doi:10.1017/bca.2017.12