

## Economic Analysis

### I. Introduction

1. The economic and financial feasibility of the GCF Project was determined using primarily “Cost-based valuation methods for cost-benefit analysis.” This methodology estimates the coastal protection benefit of the GCF intervention. While mitigation of the impacts from sea-level rise and storm surge events is one of the project's significant benefits, other benefits such as social and institutional benefits will be derived from gender sensitive design that depict different social groups not quantified. This analysis presents the economic appraisal based on the coastal protection benefit of the project.
2. Liberia's coastal zones are highly vulnerable to climate change. According to the NAPA (2008), West Point and Kru Town in Montserrado County are among the areas along the coast where erosion is most severe. In these areas, the population is poor, and all social indicators – e.g., access to health and education – are very low. Unemployment is high. A large proportion of the coastal community lives in temporary and poorly constructed housing with little protection from sea or storm surges. A large proportion of these people live on very low-lying land, often in unplanned settlements or illegal or extra-legal settlements. For this combination of reasons, the community's capacity to adapt to climate change is very low, and resilience is very limited. In the baseline, climate-change induced sea-level rise combined with increasing storms and sea-surges could have catastrophic impacts in terms of destroying livelihoods and lives. Already, key economic sectors of fishing, farming, and trade are at risk, and the displacement of people is increasing.
3. Liberia remains one of the poorest nations in the world as it recovers from decades of conflict and recovery from the decline in commodity prices and the major Ebola epidemic that hit West Africa in 2014. A recent IMF statement (2019) highlighted that Liberia's economic situation is challenging, and strong policy actions will be required to maintain as favorable an outlook as anticipated at this time last year. Macroeconomic stability has proved elusive despite improved revenue collection in the first half of FY2019, and the fiscal stance has loosened significantly. With accommodative monetary policy meeting fiscal needs, the exchange rate depreciated by 26 percent over the year, and inflation accelerated to 28 percent at end-December. This is detrimental to the living standards of the most vulnerable Liberians who earn and spend primarily in Liberian dollars and threatens the pro-poor agenda's success. Growth for 2018 is now estimated at 1.2 percent, while the forecast for 2019 on current policies has been revised down to 0.4 percent from 4.7 percent.<sup>1</sup>
4. Liberia's livelihood and economic assets have been devastated by sea-level rise and flooding. Flooding hit Monrovia and surrounding areas of Montserrado County on 18 July 2018. The National Disaster Management Agency (NDMA) said the flooding caused significant material damage and severe transport problems. Flooding also affected parts of neighboring Margibi County. As of 19 July, a total of 31,186 people was affected, including thousands of children. The flooding has damaged at least 187 homes.<sup>2</sup>
5. West Point is a slum area of about 10,872 inhabitants with about 1812 residential buildings. It has a high density of poor unemployed/inactive and vulnerable employed fishermen and women

<sup>1</sup> <https://www.imf.org/en/News/Articles/2019/03/08/pr1971-imf-staff-completes-2019-article-iv-mission-to-liberia>

<sup>2</sup> <http://floodlist.com/africa/liberia-flooding-montserrado-margibi-monrovia-july-2018>

who are market sellers. Assets vulnerable to climate threats include slum / informal dwellings, fishing sites, beach, road, marketplaces, LEC power substation.

6. An economic appraisal was carried out for the project. The investment comprises of three interventions that include: i) the protection of coastal communities and infrastructure at West Point against erosion caused by sea-level rise and increasingly frequent high-intensity storms; ii) institutional capacity building and policy support for the implementation of Integrated Coastal Zone Management (ICZM) across Liberia, and iii) protecting mangroves and strengthening gender- and climate-sensitive livelihoods to build local climate resilience in Monrovia. Note that economic analysis is a package of interventions to reduce the impact of extreme climate change in Liberia. Thus, this section presents the aggregated economic internal rate of return (EIRR) and economic net present value (NPV) for the three sub-projects shown above. The project is designed to generate benefits when these sub-projects are implemented under a single project framework. Note that while the costs associated with the strengthening of gender- and climate-sensitive livelihoods to increase local adaptive capacity are included in the analysis, the benefits are not captured in the project.
7. Along the significant part of the coastline, a revetment is proposed to fix the coastline position and protect the coastline against coastal retreat. The revetment should be stable enough to withstand extreme scenarios as specified in the design requirements and conditions. The beach will be kept as it is, as the excavated sand (for the revetment) will be placed at the beach location. However, in the future, the beach will retreat further and eventually disappear. This means that the depth in front of the revetment will increase until it reaches equilibrium.
8. The project's analysis was carried out in accordance with the Guidelines for the Economic Analysis of Projects of the United Nations Development Program (UNDP 2015). The economic desirability of the investments was determined by computing the EIRR and NPV and comparing the EIRR with the assumed 10% discount rate (as recommended in UNDP 2015). ***The discounted fund flows period is 50 years based on the lifespan of the investments.*** We assume that the benefits of the project become zero after 50 years. For benefits like income growth through alternative livelihoods, the stream of benefits of only fifteen years is used to be conservative.

## II. Estimation of Benefits

9. For all interventions, costs and benefits are estimated by comparing the with-project and without-project scenarios during 2020–2050 in constant 2019 prices. The without-project scenario represents a continuation of the existing situation considering population growth, while the with-project scenario represents the project investment scenario. This is presented in the feasibility report prepared in support of this proposal. Given the characteristics of the engineered solutions in the target locations designed for annual hazards, we use the AAL primarily for the economic analysis, and avoided losses and casualties represent the bulk of the estimated benefits of the sub-projects.
10. Not only direct costs and (financial) revenues are considered, but also all other possible positive and negative impacts on society are included in the impacts. For some impacts, it is not possible to express these in monetary values due to a lack of data, inherent complexity, or ethical reasons. In this study, this is the case for the intangible safety effects (accidents or life lost), biodiversity impacts, and recreational & cultural impacts of measures (such as safeguarding recreational

beach life by beach nourishment). These impacts could not be quantified due to inherent complexity and lack of data for Liberia. For these reasons, these impacts are assessed more qualitatively. The with or without benefits of the project estimated for this economic analysis include the avoided damages with the project and the increase in income as a result of alternative livelihood investment and protection of the community from coastal erosion and seas level rise.

11. Based on the above, we estimate avoided damages with or without the project. The feasibility report shows the impacts of the hazards on coastal retreat and additional storm erosion for the high climate change scenario (RCP 8.5), given the current shoreline and assets in Monrovia. It is expected that the most significant coastal retreat due to erosion is in 2050 for the coastal sections of New Kru Town and West Point. Different types of assets and critical infrastructure are vulnerable to hazards. In particular, residential buildings, informal economic activities (for instance, shops), fishing sites, roads, and power substations are exposed and vulnerable. Apart from this, the beaches – which have a significant recreational value for the inhabitants of Monrovia – will be lost by 2050 in the high climate change scenario.
12. To estimate the avoided damages, the impacts of the hazards on coastal retreat due to coastal retreat and storm erosion are used. The vulnerability analysis annex shows the impacts for the high climate change scenario (IPCC RCP 8.5), given the current map and assets in Monrovia for:
  - Coastline in the year 2020 (now) with an additional storm erosion due to a storm with a return period of 100 years (in 2020);
  - Expected coastline in the year 2050 due to coastal retreat;
  - Expected coastline in the year 2050 due to coastal retreat including additional storm erosion due to a storm with a return period of 100 years (in 2050);
13. Direct and indirect damage of assets that are vulnerable to climate threats accessed include:
  - Business & offices buildings (formal commercial assets);
  - Religious & cultural buildings;
  - Infrastructure (for example, port buildings and utility buildings);
  - Government & education buildings (for example, administration buildings, schools)
  - Residential buildings (formal & informal housing);
  - Fishery sites (landing sites for canoes);
  - Power stations.
14. The number of these assets in the project site is presented below:

Section	West Point
<b>Buildings</b>	
Business and Offices	186
Hotels and Restaurants	1
Infrastructure	14
Religion and Cultural Heritage	6
Residential	1812
Schools and Government	5
Power substations	1
Fishery sites	2
Open markets	2

Population	10872
Area in ha	136
Road length in km	7.80

15. The **direct tangible damage** is defined as the damage in terms of loss of (physical) assets (buildings, roads, other) due to the identified relevant hazards. For the coastal retreat, assets such as buildings and roads are lost once these assets are in the ocean. This damage occurs at the pace of the coastal retreat and therefore builds up over time. Storms surges (high waves and swells) come additional to the coastal retreat and will damage buildings closest to the ocean. For the storm erosion, Annual Expected Damage (AED) is estimated based upon the return period of the storms (see vulnerability analysis).
16. The losses caused by the hazards are estimated in USD by loss of asset values for each asset category. For each asset category, asset values (in USD) have been assumed based on available price or (reconstruction) costs information for Liberia. See the vulnerability analysis for details.<sup>3</sup>
17. The direct and indirect tangible damage is estimated for the years 2030, 2050, 2070, and 2100 in the do-nothing scenario (RCP 8.5, optimistic socio-economic scenario). The storm damage is additional damage to the coastal retreat damage (in case of a storm event). In West Point, the coastal retreat reaches such a distance by the year 2065 and no additional storm damage after that year.

*Table 1: Direct and indirect tangible damage in USD, 2030-2100 (do nothing scenario, RCP 8.5, optimistic socio-economic scenario)*

			2030	2050	2070	2100
Cumulative erosion damage			19,641,704	85,095,280	154,939,075	154,939,075
Expected damage	annual	storm	751,537	1,740,455	-	-

18. In addition to the above damages estimated, we also include an increase in income growth and the social benefit of the project through improved infrastructure.
19. Following the World Bank (2015) Project Appraisal Document (PAD) for a Youth Opportunities Project for Liberia's project, the economic analysis considers that the project is effective at improving the earnings growth of the youth by 2 percent per year over their lifetime. Conservatively, and based on World Bank (2015), the income growth is only for ten years of the project rather than the lifespan of the investments. Programs like this are effective at

<sup>3</sup> Data on real estate prices, land values are scarce and historical coastal retreat damages are absent in Monrovia. Nevertheless, some sources and studies have been found for real estate values such as for road (re)construction costs and for rental values (per room) and housing values. Moreover, based upon the damage literature also the % of inventory (content of buildings) have been estimated per category.

increasing earnings growth as well as bumping up earnings.<sup>4</sup> We converted the initial annual income of \$250 used in the analysis to the 2018 value (\$252) and assumed a 2% growth in income for the project beneficiaries. Other benefits include social benefits due to better access to education, health, commercial and administrative facilities currently abandoned in the area because of climate threats (assumed to be US\$2/person/year based on an analysis in other countries).<sup>5</sup>

### III. Estimated cost

20. The estimated capital cost of the project is presented in the table below, with its distribution over the first six years of project implementation.

Capital cost (USD)		1	2	3	4	5	6
Total	25,040,944	1,825,610	4,259,285	5,219,161	5,121,411	7,612,354	1,003,124

### IV. Economic appraisal: Net present value and sensitivity analysis.

21. Given the above estimates, the net present value of the project is \$18.41 million using a 10% discount rate, with an internal rate of return of 22%, confirming the economic viability of the proposed investments.
22. Three sensitivity test cases examined: (i) total cost increased by 15%; and (ii) total benefits decreased by 15%, and (iii) total cost increased by 15%, and total benefits simultaneously reduced by 15%. The project has IRR higher than the 10% discount rate in all cases. The sensitivity analysis is carried out to understand if the economic viability conclusion changes when benefits are over-valued or costs are under-estimated. The results are presented below.

*Table 2: Net present value (million USD)*

	Avoided Damages (NPV)	Avoided Damages (IRR)
<b>Base case</b>	\$18.41M	22%
<b>Cost +15%</b>	\$15.81M	19%
<b>Benefits - 15%</b>	\$13.05M	19%
<b>Cost +15% and benefit -15%</b>	\$10.45M	16%

<sup>4</sup> Based on a Randomized Control Trial (RCT) conducted on the Youth Opportunities Project in Northern Uganda in 2013, the YOP participants increased business assets by 57 percent, hours of work by 17 percent, and earnings by 38 percent compared to the control group four years after the intervention. The project did so with an average cash grant of US\$382 per participant, as well as facilitation to create a simple business plan (Blattman, Fiala, and Martinez. 2013. Generating Skilled Self-Employment in Developing Countries: Experimental evidence from Uganda). Through the provision of a cash grant of US\$150 and enterprise training, the Women's Income Generating Support (WINGS) program doubled the monthly cash earnings and tripled cash savings of participants as compared to the control group after one year, again as measured through an RCT. Blattman et al. 2013. Building Women's Economic and Social Empowerment through Enterprise: An experimental assessment of the Women's Income Generating Support Program in Uganda.

<sup>5</sup> World Bank appraisal document for Timor Leste.

23. The NPV and IRR indicate that using a different discount rate of say 5% – putting different weights on the future relative to the present for the investment makes the investments with a positive return for the future generation of Liberia. For an investment with 50 years lifespan, this lower discount rate can be an acceptable and reasonable justification for the project.
24. In addition to the discount factor, note other benefits (indirect benefits highlighted in the feasibility report) not fully estimated in this report. For example, Output 3 of the proposed project will put measures in place to reduce the anthropogenic pressure on mangrove ecosystems in the Mesurado Wetland. Preserving wetlands typically have positive ecosystem benefits that are larger than the cost of the investment. The implication of ignoring these additional benefits is that the estimates of the economic IRR and NPV will be the lower bound and provide conservative estimates of the value of the project.