Republic of Liberia

Technology Action Plan

for the Adoption & Diffusion of Climate Change Coastal Adaptation Technologies

May 14, 2021

Prepared by:
E.Tenesee WILSON
National Coastal Erosion Expert Consultant
TNA - EPA Liberia
e.teneseew@gmail.com

Foreword

In September 2015, Liberia, as a signatory to the UN Climate Change Convention, submitted the Nationally Determined Contribution (INDC) in advance of the new climate change agreement reached at the UN Climate Conference in Paris in December. Liberia's INDC was designed as a platform to integrate its Low Carbon Development Strategy into the country's long-term sustainable development Vision by 2030 (Agenda for Transformation). Liberia ratified the Paris Agreement in August 2018 and is working hard to revise its NDC for submission.

Regardless of the many contributions to climate change, Liberia, like many other developing countries, is especially vulnerable to its impacts. The country is at this moment susceptible to the adverse effects of climate change such as Shifting cultivation in the agriculture sector, unsustainable logging practices, unregulated coastal mining, high level of biomass consumption in the form of charcoal and fire wood for local energy use, and decreasing river flow due to high level of evaporation. The agricultural sector, which ensures the livelihoods of around 70% of the population remains vulnerable to flooding, erosion with changing rainfall patterns putting lives at risk in a country where nearly 8 out of 10 people do not have secure access to food. Current climate change vulnerability in Liberia include; increase in extreme events (e.g., exacerbated floods, extreme drought), sea level rise, flooding and coastal erosion being experienced on an annual basis that eats up the coast as observed in Monrovia, Buchanan and Greenville.

I would like to add that Liberia has an overall lack of energy. In most rural areas in Liberia, less than 5% of the population has access to electricity while most homes run mini generators. The current energy situation in Liberia is characterized by a dominance of traditional biomass consumption, low access to poor quality and relatively expensive modern energy services. It is estimated that over 95% of the population rely on firewood, charcoal, and palm oil for their energy needs.

The EPA of Liberia is overly happy with the level of the assessment done by the Technology Needs Assessment Team (TNA) through a national stakeholder's participatory process emulating from the identification and prioritization of environmentally sound technologies to the diffusion of these technologies to mitigate and adapt to climate change. We would like to recognize the United Nations Environment Programme (UNEP), DTU Partnership and Global Environment Facility (GEF).Your contributions have resulted in this rich source of information and we hope that this report will spur Parties into seeking out partnerships for the purpose of accelerating climate action and increasing ambition in Liberia.

Professor Wilson K. Tarpeh
EXECUTIVE DIRECTOR/CEO

Disclaimer

Table of Contents

List of Acronyms and Abbreviations

BA&EF	Barrier Analysis and Enabling Framework
CAGs	Community Action Groups
CBOs	Community Based Organizations
EPA	Environmental Protection Agency
FWS	Flood early Warning System
GCF	Green Climate Funds
GEF	Global Environment Facility
GOL	Government of Liberia
ICZM	Integrated Coastal Zone Management
ICZMU	Integrated Coastal Zone Management Unite
IPCC	Intergovernmental Panel on Climate Chang
LLA	Liberia Land Authority
MCA	Multi-Criteria Analysis
MME	Ministry of Mines and Energy
MPW	Ministry of Public Works
NDMA	National Disaster Management Agency
NAP	National Adaptation Programme
NAPA	National Adaptation Programme of Action
NGOs	Non-Governmental Organizations
PIs	Project Ideas
SWGs	Sectoral Working Groups
TAP	Technology Action Plan
TNA	Technology Needs Assessment
UDP	United Nations Environment Programme Technical University of Denmark Partnership
UL	University of Liberia
UNEP	United Nations Environment Programme
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development

List of Tables

Acknowledgements

This coastal zone's Technology Needs Assessment (TNA) on the Technology Action Plan (TAP) for the adoption and diffusion of climate change adaptation technologies in Liberia has been achieved through a tremendous collaborative effort by many institutions, affected and vulnerable coastal communities through stakeholder engagements, site visits, documents and interviews with residents of coastal communities facilitated by the Environmental Protection Agency of Liberia (EPA) and the TNA. The institutions, communities and individuals mentioned in this report are duly acknowledged for their valuable contributions that successfully resulted to this report.

We would like to express our sincere appreciation to the national TNA team headed by its national coordinator Mr. Christopher B. Kabah and also in particular, Mr. Jefferson F. Nyandibo and Mr. Benjamin S. Karmorh of the Environmental Protection Agency of Liberia (EPA) climate change department and specifically the Executive Director / CEO of the EPA, Prof. Wilson Tarpeh for their support and commitment to this process. Our heartfelt gratitude goes to the coastal zone technical working group (Annex I) for their tireless efforts and contributions to this report.

The development of this document was made possible largely due to the generous financial support received from the Global Environmental Facility (GEF) through the United Nations Environment Programme (UNEP) and the Technical University of Denmark (DTU), UNEP DTU partnership that provided technical and methodological support in conducting the TNA's TAP process. Their support to this project that has produced the first, second and this third report, has built the necessary momentum for a national paradigm shift in our understanding of the current threats of coastal risks and vulnerabilities along the nation's coastline that urgently require the adoption, transfer and diffusion of the identified and prioritized coastal zone's adaptation technologies through their proposed Project Ideas (PIs) stipulated herein this TAP report.

Report III
Technology Action Plan

Executive Summary

This Technology Action Plan (TAP) report represents Liberia's third coastal zone report for the Technology Needs Assessment (TNA) project. The TNA's Coastal Zone first report identified and prioritized three coastal adaptation technologies (*Integrated Coastal Zone Management (ICZM), Flood early Warning System (FWS), and Rock Revetments*) to address the impacts of climate change within the sector. The second report *Barrier Analysis and Enabling Framework* (BA&EF) assessed the potential barriers that could impede the adoption and diffusion of the three technologies and as well provided an enabling framework or possible measures to overcome the identified barriers for adoption.

This report presents the Action Plan of the prioritized three technologies based on the second report. It is built upon the measures identified for overcoming the barriers that could impede the implementation of the retained technologies. The measures identified in *Report II* are turned into actions in this TAP. As such, this report consists of two major sections, the Technology Action Plan (TAP) and Project Ideas (PIs) for each of the prioritized technologies for climate change adaptation in the coastal zone of Liberia.

The Action Plan for each technology in this report is a ten (10) year plan (2021- 2031) which indicates the technology's ambition/ target and outlined the specific Actions and Activities to be considered/ implemented for the achievement of said target. In so doing, the timeframe for planning and implementation of each activity is specified and the responsible body or institutions to carry out the activities are as well identified. The estimated resources needed and their associated costs of realization are stipulated; including potential sources of funding. These details for each technology are summarized in the *TAP overview tables* inserted at the end of this summary.

The second section of this report focuses on Project Ideas; and as such, a *Project Idea* was developed for each of the three prioritized technologies. This is aimed at setting the stage for the development of concept notes to be submitted to the identified funding entities for financial support of their implementation to address the impacts of climate change in coastal areas. In this regard, the following Project Ideas (PIs) presented herein for the coastal zone sector were identified and retained due to their potential socio-economic, environmental management and climate change adaptation or mitigation benefits they stand to provide while protecting lives and properties in vulnerable coastal areas. The three PIs are well detailed/ developed in *tables 26, 27and 28* of this report. Listed below are the three (3) recommended Project Ideas in accordance with the retained technologies.

1) *Formulation of an Integrated Coastal Zone Management (ICZM) policy framework/ plan for Liberia's ICZM Unit.*
2) *Construction/ Installation of Flood early Warning System (FWS) within the Bushrod Island area, near Monrovia".*
3) *Construction of Rocks' Revetment along the beach side of Mississippi Street in Sinoe County to protect the highly vulnerable and "at risk" lives and properties therein from the impacts of Climate Change coastal erosion and flooding.*

The Technology Action Plans and Project Ideas developed in this report were carefully designed by the coastal zone technical working group with specific Actions and Activities that are interrelated and if applied as indicated, will together contribute to the successful adoption, implementation and diffusion of the proposed technologies through their Project Ideas. However, there were some major cross-cutting barriers identified against the successful achievement of the above; and as such, they were categorized as *Economic & Financial, Technical, Legal & Regulatory, and Information & Awareness.* Nevertheless, the identified enabling measures to overcome these potential barriers are stipulated in *table 29* of this report.

At this end, the Action Plan and Project Ideas presented herein were developed through a participatory process in reference to Chambers (2005) and Rocheleau (1995). Therefore, the stakeholder engagement was one of the key aspects of the process; hence, the names, contacts and institutions of the coastal zone Technical Working Group (TWG) are presented in *table 30; Anne -I* of this report. The Liberia's TNA workshop for Technology Action Plan and Project Idea brief was conducted on January 22, 2021 in Monrovia through a cross-sectorial stakeholder consultation working group, expert knowledge, available literature and other investigations for the coastal zone. After the general workshop, there were series of technical working sessions carried out for a comprehensive process.

As such, the tables below present the TAP overview for the Action Plan of the technologies .

Sector: COASTAL ZONE								
Technology: Integrated Coastal Zone Management (ICZM)								
Ambition	Promote sustainable use/ management of coastal resources and to protect lives and properties within vulnerable coastal environment							
Benefits	Social: well managed and improved public use of coastal areas; Economic: job creation & sustainable use of coastal resources for all; Environmental: protected coastal ecosystems.							
Action	**Activities to be implemented**	**Sources of funding**	**Responsible body & focal point**	**Time frame**	**Risks**	**Success criteria**	**Indicators for Monitoring of implementation**	**Budget per activity ($US)**
Action: 1 **Develop a legal framework or policy plan for ICZM in Liberia.**	1.1. Conduct workshop/ training of ICZM functions, role and principles to the identified responsible actors, institutions that are directly or indirectly involved with the management of coastal areas;	GCF; GEF; CTCN; World Bank; African Development Bank; UNFCCC/UNEP/EU/USAID; GOL	MME; EPA	1- 2 years	Involvement of non-relevant coastal actors, technicians, stakeholders and vulnerable / affected communities leaders	Quantity of personnel trained in each vulnerable coastal city or community	Scale of Initiatives taken by vulnerable coastal residents to adapt to coastal erosion risks and impacts	$500,000.00
	1.2. Prepare a list of the most important laws (framework, policies…) affecting the management of coastal resources;	GCF; GEF; CTCN; World Bank; UNFCCC/UNEP/CI / UNDP/ EU/ USAID; GOL	MME; EPA	1 year	Limited institutional collaborate / cooperation	Amount of relevant required laws, frameworks / policies identified & compiled	Draft report submitted and validated	$50,000.00
	1.3. Conduct gap analysis and needs assessment of the laws and framework, policies etc. and establish ICZM steering committee;	GCF; GEF; CTCN; World Bank; UNFCCC/UNEP/EU/ USAID; GOL	EPA, MME	1 year	Limited or inadequate technical expertise	Identification of the actual existing gaps	ICZM steering committee established and approved by the relevant authorities	200,000.00
	1.4. Create/implement/enforce laws, policies, strategies, framework…. If necessary. This should involve stakeholder's participation from institutional to local community groups.	GCF; GEF; CTCN; World Bank; UNFCCC/UNEP/CI / UNDP/ EU/ USAID; GOL	EPA, MME	1-10 years	Limited sectoral collaboration & support; resistance to accept coastal regulatory laws by the residents	Involvement and participation of local community leaders and vulnerable groups	Coastal regulations are created, adopted & diffused across all coastal counties along with an agent an agent;	2,500000.00
Action 2: **Secure national and**	2.1. Secure ICZM annual national budgetary allotment;	Government of Liberia (GOL);	MME, EPA	2-3 years	Limited / inadequate political will/ support	Allotment of ICZM national budget	First annual budget approved & provided	50,000.00

or international funding for the establishment, functioning and sustainability of ICZM in Liberia. And purchase/ invest in coastal monitoring equipment.	2.2. Establish / enhance partnerships with appropriate international donors or development partners that support climate change adaptation projects;	GCF; GEF; World Bank; EU, USAID; GOL	MME, EPA	2 years	Not knowing the suitable institutions and the way forward	Most relevant & effective climate change development partners Identified	Approval of climate change support agreements	75,000.00
	2.3. Regularly develop funding proposals for sustainable community based adaptation projects that meet climate change funding requirements for support;	GCF; GEF; CTCN; World Bank; UNFCCC/UNEP/ UNDP/ EU/ USAID; GOL	EPA, MME	10 years	Lack or limited technical expertise to develop the required proposal	Development of at least 1 proposal per year	Numbers of proposals developed, submitted and approved for funding	1,000000.00
	2.4. Invest in equipment and software to monitor, map and model coastal dynamics including waves, currents, tides and sand transport.	GCF; GEF; CTCN; World Bank; EU/ USAID; GOL	MME, EPA	3-10 years	Lack of proper coastal equipment and software in country	Identification of the needed equipment and software internationally	25% of the equipment and monitoring software purchased and imported;	8,750000.00
Action: 3 **Provide regular technical training / capacity building for ICZM personnel.**	3.1. Provide regular technical hands-on training / capacity building at all levels for personnel involved with the establishment, transfer and diffusion of the ICZM technology across the vulnerable coastal areas.	GCF; GEF; CTCN; World Bank; UNFCCC/UNEP/CI / UNDP/ EU/ USAID; GOL	MME, EPA	1-10 years	Lack/ limited national experts to provide / conduct the training	15 ICZM personnel trained within 2 years;	Number of personnel from different institutions and sectors already trained & deployed in the counties;	2,510000.00
	3.2. Conduct short term training for coastal communities with gender inclusion;	GCF; GEF; CTCN; World Bank; UNFCCC/UNEP/CI / UNDP/ EU/ USAID; GOL	EPA, MME	1-5 years	Little or limited initial coastal knowledge by personnel	Short & long term trainings provided to 15 ICZM personnel with gender consideration/	Coastal management Laws and regulations are being enforced by the initial trained personnel	155,000.00
	3.3. Hire 5 qualified coastal experts (national and international), research institutions/ groups to conduct training;	GCF; GEF; CTCN; World Bank; UNFCCC/UNEP/ UNDP/ EU/ USAID; GOL	EPA, MME	1-5 years	Limited financial support to conduct training	50% of the total amount needed is generated to carryout initial training for year 1 & 2	First round of ICZM training conducted and trainers salaries are available;	350,000.00

	3.4. Develop and implement a protocol for monitoring, mapping, modeling and reporting on coastal dynamics including coastal wetlands, dunes, waves, tides, sand movement, with a special focus on vulnerable coastal communities.	CTCN; World Bank; UNFCCC/UNEP/ UNDP/ EU/ USAID; GOL	EPA, MME	1-2 years	Limited or delay in reporting	Protocol for monitoring coastal activities and research is developed	2 activities already monitored, reported and accounted for within year 1;	35,000.00
Action: 4 **Provide, encourage and facilitate ICZM cross-sectoral cooperation and coordination**	4.1. Create and support ICZM cross-sectorial working group meetings to facilitate coordination;	GOL, UNDP/ EU/ USAID;	EPA, MME	1 year	Unwillingness to collaborate	Technical working groups established across sectors involved with coastal issues	Quarter 1 sectoral working session held and report submitted	17,000.00
	4.2. Create and sustain ICZM platforms for information and data sharing among institutions and the public to facilitate and enhance decision making;	GCF; GEF; CTCN; World Bank; UNFCCC/UNEP/ UNDP/ EU/ USAID; GOL	EPA, MME	10 years	Limited support for maintenance/ up-keeping and limited data or information to be published	One or two ICZM platforms already developed, established and functional	Regularly active and up to date information available	587,000.00
	4.3. Draft and sign Data Sharing Agreements to build meaningful and official linkages (MOU, etc.) with other local and international organizations engaged in coastal monitoring and mapping;	GCF; GEF; CTCN; World Bank; UNFCCC/UNEP/ UNDP/ EU/ USAID; GOL	EPA, MME	1-6 years	Unwillingness/ Limited data and information sharing between institutions	Amount of MOU and data sharing agreements signed with local and or international organizations	Numbers of activities or projects undertaken / achieved under the agreement with specific reports	50,000.00
	4.4. Establish and support a national coastal research scientific team/committee to conduct research and facilitate dialogue and exchange	GCF; GEF; CTCN; World Bank; UNFCCC/UNEP/ UNDP/ EU/ USAID; GOL	EPA MME	10 years	Limited technical coastal experts to be involved	National coastal research committee properly established	2-5 coastal research project/ activities successfully initiated, facilitated and support by the committee	1,110000.00

Sector: COASTAL ZONE								
Technology: Flood early Warning System								
Ambition	Detecting threatening events in advance to protect lives and properties in vulnerable coastal areas from flood and storm surge in Liberia							
Benefits	Reduce the level of casualty/ negative impact that could affect the coastal population							
Action	**Activities to be implemented**	**Sources of funding**	**Responsible body & focal point**	**Time frame**	**Risks**	**Success criteria**	**Indicators for Monitoring of implementation**	**Budget per activity ($US)**
Action: 1 **Prepare or identify laws/ legal policies or framework, actors, institutions and strategies to uphold FWS.**	***Activity 1.1*** Conduct a desk review of existing framework/ policies/ strategies of flood early warning system to incorporate the coastal zone.	GCF; CTCN; World Bank; Bank; UNFCCC/UNEP/USAID; GOL	EPA	1 year	No available existing framework/ strategies for FWS	Availability of experts & technicians to review the existing strategy or develop a new one	FWS policy plan or strategy developed, accepted and instituted nationally	40,000.00
	Activity 1.2 If necessary, improve or upgrade the existing flood early warning system to an international standard & incorporate coastal monitoring.	GCF; GeF; CTCN; World Bank; UNFCCC/UNEP/ EU/ USAID; GOL	EPA, MME NDMA,	1-5 years	Limited funding for standardize equipment and operations	Potential available funding from climate change partners	Quantity of modern FWS equipment purchase and available in country	810,000.00
	Activity 1.3 Create and support local community groups in vulnerable coastal areas to uphold the FWS regulations. It is highly important that these groups consider gender inclusion.	GCF; GeF; CTCN; World Bank; UNFCCC/UNEP/ EU/ USAID; GOL	EPA, NDMA	10 years	Limited funding to support and sustain the groups	Willingness and availability of the vulnerable communities to participate	Establishment of 15 vulnerable coastal community groups with gender inclusion in flood vulnerable communities	1,500000.00
	Activity 1.4 Solicit the support of local vulnerable coastal community leaders to facilitate the adoption, transfer and diffusion of the FWS technology in vulnerable coastal communities across Liberia.	GCF; GeF; CTCN; World Bank; UNFCCC/UNEP/ EU/ USAID; GOL	EPA	1-2 years	Difficulties in bringing local stakeholders together for coordination.	Information dissemination and awareness conducted to have the local leaders understand and support the FWS technology	Full participation and collaboration of local vulnerable community leaders in the process;	500,000.00
Action: 2 **Secure or establish a regular annual**	***Activity 2.1*** Secure FWS funding or financial support from local and international partners that support climate change	GCF; GeF; CTCN; World Bank; UNFCCC/U	EPA	1-10 years	Difficulties to secure national funding from government due to	FWS funding proposals are being developed for international support	Initial FWS funding/ projects proposals developed and accepted for funding and first	850,000.00

national budgetary allotment or international financial support to uphold the operations of the FWS technology.	projects/ activities.	NEP/ EU/ USAID; GOL			limited available funds		international partnership established	
	Activity 2.2 Invest in/ purchase high standard and quality FWS software and equipment to monitor, map and model coastal floods, inundations to safe guide livelihood activities.	GCF; GeF; CTCN; World Bank; UNFCCC/U NEP/ EU/ USAID; GOL	EPA, NDMA, MME	1-8 years	Non availability of quality FWS monitoring software and equipment in country	Standardize FWS software and equipment are available and identified internationally	Initial funds secured, and procurement of initial 20% of the equipment is achieved	4,565000.00
	Activity 2.3 Regularly create/ develop climate change adaptation / mitigation funding proposals for the FWS and submit them for support to the reputable climate change partners or funders.	GCF; GeF; CTCN; World Bank; UNFCCC/U NEP/ EU/ USAID; GOL	EPA	1-10 years	Limited / inadequate national experience to prepare international climate change funding proposals	Availability of experienced international experts to be hired	2 International experts / consultants hired and first proposal is developed and ready for submission to climate change donors for acceptance	1,650000.00
Action 3: **Provide regular technical training / capacity building for FWS personnel at all levels (institution to local community).**	***Activity 3.1*** Provide both long and short terms technical trainings, internships for FWS personnel at institutional level.	GCF; GeF; CTCN; UNFCCC/U NEP/ EU/ USAID; GOL	EPA, NDMA,	8 years	Limited specialized national institutions and experts to conduct the training	Amount of secured funding opportunities & international partnership training institutions	6 FWS personnel trained between year 1 and 2 and are available to be deployed	1,520000.00
	Activity 3.2 Conduct capacity building training in all local vulnerable coastal communities where the FWS technology will be installed.	GCF; GeF; CTCN; UNFCCC/U NEP/ EU/ USAID; GOL	EPA	5 years	Difficulties to fund & support the training activities	Number of training activities planned and targeted communities	12 vulnerable coastal communities trained in year 1	475,000.00
	Activity 3.3 Provide, support and increase FWS research projects/ activities to enable data collection.	GCF; GeF; UNFCCC/ EU/ USAID; GOL	EPA & FWS national committee	1- 8 years	Difficulties in securing funding to support research activities	Number of FWS research projects/ activities developed for funding	4 research projects / activities undertaken in year 1	700,000.00
	Activity 3.4 Establish a national FWS research/ scientific group /committee to facilitate the operations of the technology.	GCF; GeF; World Bank; UNFCCC/U NEP/ USAID; GOL	EPA, NDMA	1-2 year	Limited national experts or technicians	6 available national experts identified	FWS national scientific research team established	350,000.00

Action 4: **Develop, regulate and improve coordination and collaboration among FWS institutions and the concerned stakeholders.**	***Activity 4.1*** Establish a regular quarterly cross-sectorial regulatory meetings and technical working sessions to ensure a proper collaboration and information sharing among FWS institutions and local community leaders.	GCF; GeF; CTCN; World Bank; UNFCCC/UNEP/ EU/ USAID; GOL	EPA	1-10 years	Difficulties in getting stakeholders together	Cross-sectoral collaboration & coordination strategy established	Successful implementation of first quarter meeting/ working session in year one	100,000.00
	Activity 4.2 Develop/ establish partnerships with overseas universities and research institutions engaged in coastal floods / risks related data collections, mapping, monitoring and modeling.	GCF; GeF; CTCN; World Bank; UNFCCC/UNEP/ EU/ USAID; GOL	EPA, NDMA	1-5 years	Difficulties in identifying reputable research institutions & limited expertise to conduct FWS research.	Initial research institutions identified and first group of technicians trained for FWS research works	First partnership established and a research project has been approved and funding secured.	210,000.00
Action 5: **Provide and improve timely/ quick information sharing / awareness among the relevant institutions, stakeholders and the population at risk.**	***Activity 5.1*** Provide & support quick and timely information sharing to population at risk by direct text messages or by radio awareness for timely precaution.	GCF; GeF; CTCN; UNFCCC/UNEP/ EU/ USAID; GOL	EPA	10 years	Very poor communication services (network, internet) in rural areas	Funding secured to improve communication services in rural coastal areas	Network and communication services improved in all coastal vulnerable communities to adopt the FWS	102,000.00
	Activity 5.2 Create/ develop and support/ sustain FWS information platform or website.	GCF; GeF; CTCN; UNFCCC/ USAID; GOL	EPA	10 years	Limited funding access to maintain the platforms for a 10 year service	Availability of funding to develop the FWS information sharing platforms	FWS information sharing platform and networks services established	210,000.00
	Activity 5.3 Map and regularly update coastal flood risk areas and publish the results on the FWS platform.	GCF; CTCN; UNFCCC/UNEP/ EU/ USAID; GOL	EPA, NDMA	9 years	Irregular mapping activities and inadequate up to date service	Amount of active mapping projects/ activities	Number activities results published on the FWS website/ platform regularly	200,000.00
	Activity 5.4 Produce annual report for stakeholders and decision-makers on the state of the coast highlighting on-going research, key activities, changes and challenges.	GCF; GeF; CTCN; World Bank; UNFCCC/UNEP/ EU/ USAID; GOL	EPA, NDMA	10 years	Irregularity in reporting	Mechanism established to support annual report	Successful regular quarterly reports submitted in year 1	100,000.00

Sector: COASTAL ZONE								
Technology: Revetment								
Ambition	To adopt revetments in highly vulnerable coastal areas to protect lives, properties & the shoreline from coastal erosion and flooding impacts.							
Benefits	Protection of lives, properties and coastal environments. Creation of jobs; Serve as breeding place for many coastal organisms/ species;							
Action	**Activities to be implemented**	**Sources of funding**	**Responsible body and focal point**	**Time frame**	**Risks**	**Success criteria**	**Indicators for Monitoring of implementation**	**Budget per activity ($US)**
Action 1: **Strengthen and enforce the existing zoning laws and building codes in coastal areas (along the beaches);**	***Activity 1.1:*** Conduct a desk review of the existing zoning laws and building codes; if applicable, strengthen to avoid the construction of private / residential building along and very close to the beach.	GCF; GeF; CTCN; UNFCCC/UNEP; Government of Liberia (GoL)	MME	1 year	Limited collaboration & delay in completing the review;	Experts / consultants hired; technical review team/ committee established;	First draft report submitted for inputs/ comments and etc.	40,000.00
	Activity 1.2: Indicate/ give a specific demarcation / limit in length from the shore (beach sand) where all residential construction must stop.	GCF; GeF; CTCN; GOL	MPW; MME	1 year	There are many private structures already constructed along the beaches;	Demarcation defined and excepted;	First information and awareness campaign on construction limit conducted in five vulnerable coastal areas	15,000.00
Action 2: **Secure or establish a regular annual national budgetary allotment or international financial support to facilitate the construction, transfer and diffusion of revetments nationally;**	***Activity 2.1:*** Regularly develop project/ funding proposals that meet international climate change adaptation funding requirements to have access to such funding for the construction and maintenance of rocks' revetments;	GCF; GeF; CTCN; World Bank; UNFCCC/UNEP/ EU/ USAID; GOL	EPA; MME	1-10 years	Inadequate data to justify climate change impacts; inadequate expertise to develop proposals	Two revetments funding/ project proposals developed & submitted for international support;	One project proposal accepted to construct 250 meters revetment; an international partnership established for support and capacity building;	600,000.00
	Activity 2.2: Invest in/ purchase revetments specialized construction equipment and materials;	GCF; GeF; CTCN; UNFCCC/UNEP/ EU/ USAID; GOL	MME; MPW	1-3 years	Non specialize revetment construction equipment in country;	Standardize revetment equipment identified and available internationally;	Procurement of initial long reach excavators and five thousand meters long geotextiles completed;	3,143900.00
	Activity 2.3: Create / enhance partnership with climate change adaptation and mitigation supports to minimize the high cost of revetment construction;	GCF; GeF; CTCN; UNFCCC/UNEP/ EU/ GOL	MME; EPA	1-10 years	Difficulties in establishing partnership with international agencies;	First partnership treaty discussion/ meeting held;	First draft report completed on the first discussion;	64,000.00

Action 3: **Provide regular technical training / capacity building at both institutional and individual level to increase and improve the expertise of rocks' revetments / coastal defence construction;**	***Activity 3.1:*** Train engineers and technicians on how to conduct feasibility studies, revetment design & construction	GCF; GeF; UNFCCC/UNEP/ EU/ USAID; GOL	MME	5 years	Limited national experts and institutions to conduct training;	External /international institution identified to train initial 10 personnel;	Funding secured and agreement (MOU) signed for the personnel to travel;	800,000.00
	Activity 3.2: Establish or enhance partnerships with overseas coastal and marine universities / institutions to provide long & short term technical trainings for personnel.	GCF; GeF; CTCN; UNFCCC/UNEP/ EU/ USAID; GOL	MME; EPA	1- 8 years	Difficulties to fund & support the training and research activities;	A partnership established and a funding proposal developed for training of personnel;	Agreement (MOU) signed, and two personnel awarded research training for one year abroad;	300,000.00
	Activity 3.3: Conduct capacity building training on the safe guide, management and sustainability activities in all local vulnerable communities where revetments will be constructed;	GCF; GeF; CTCN; World Bank; UNFCCC/UNEP/ EU/ USAID; GOL	MME	1-2 year	Limited national funding to support the trainings;	A national funding proposal developed and submitted;	Training plan and activities developed; and the first community to be trained is identified;	150,000.00
	Activity 3.4: Provide, support and increase revetment research projects/ activities for data collection.	GCF; GeF; UNFCCC/UNEP/ EU/ USAID; GOL	MME; EPA	2 year	Limited funds and inadequate national expertise;	Two national experts identified;	A national coastal research team established;	825,000.00
Action 4: **Promote the awareness and acceptance of the technology by the end-users;**	***Activity: 4.1:*** Provide and improve knowledge, awareness and information sharing about the rocks' revetment to the end-users through a detailed community involvement process.	GCF; GeF; UNFCCC/UNEP/ EU/ USAID; GOL	MME; EPA	1 year	Difficulties in getting the end-users together for discussions;	Coordination strategy established by incentivising the discussion meetings with the local end-users;	First information, awareness and knowledge sharing session on revetments benefits conducted with the end-users;	32,000.00
	Activity 4.2: Create, support and sustain community-based action groups and promote the acceptance of the technology by relevant group leaders and end-users while considering gender inclusion.	GCF; GeF; CTCN; World Bank; UNFCCC/UNEP/ EU/ USAID; GOL	EPA	1 year	Limited financial support to sustain/ uphold the community action groups;	Overwarming willingness of vulnerable community residents to form part of the action group;	Two meetings held and the 10 members needed for the establishment of 2 community action groups vetted and selected;	30,000.00

Chapter 1: Technology Action Plan and Project Ideas for Liberia's Coastal Zone Sector

1.1. Technology Action Plan (TAP) for Liberia's Coastal Zone Sector

1.1.1. Sector overview

Liberia is a developing country with a small population, with the vast majority of its population living in poverty. In Liberia, the coastal zone sector is a major economic asset. It provides a means of livelihoods for the majority of the people through fishery, tourism, recreational activities and etc. Liberia has a coastal area of about 580km long (DAI 2008), within which more than 70% of its population lives.

Sadly, various global climate models project a sea-level rise in Liberia of 0.13 to 0.56 m by the 2090s relative to the sea level from 1980-1999 (McSweeney et al. 2010). Liberia has a low infrastructure capacity for basic social services, making the country highly vulnerable to climate change. DAI (2008) reported current beach erosion rates are as high as 3 m/yr. with ongoing structural damage and loss. According to USAID (2013), the underlying rates of erosion are likely primarily related to natural conditions (e.g., geology, longshore currents, wave action). In 2005, it was projected that a rise in sea level by 1 m, would cause a loss of about 95 km^2 of the estimated 580 km long coastline (due to inundation); and 50% of the area inundated (48km^2) will be areas with settlement such as parts of the capital city of Monrovia, River Cess, Buchanan, and Robert Sport, which are less than 1 m above mean sea level (Wiles, 2005). This was projected to result in a loss in infrastructure and land of around $250 million apart from the social and psychological stress to the population, with women and children being particularly vulnerable (Tumbey, 2015). In so doing, the direct impacts of coastal erosion, floods and related sea level rise impacts such as seawater /saline intrusion into fresh drinking water have become some of the alarming climate change impacts currently affecting coastal communities. These impacts are disrupting livelihoods and leaving many residents homeless due to the lack of sustainable approach to mitigate or adapt to the direct threats presented to the communities. Therefore, protecting these areas from climate change direct threats is vital to the nation's economic and developmental agenda.

In order to protect Liberia's coastal sector from the above climate change related threats for the TNA's project, three (3) technology options for adaptation in the coastal zone were identified and prioritized from others, using the TNA's "Multi Criteria Analysis (MCA)" through stakeholder engagement, experts' knowledge and cross-sectoral technical working group. Below are the identified and prioritized three coastal technologies and their targets:

1. *Integrated Coastal Zone Management (ICZM):*

The ICZM is considered as an "*Other non-market goods*" technology. It is a dynamic, multidisciplinary and iterative process to promote sustainable management of coastal zones. The

ICZM seeks over the long-term to balance environment, socio-economic, cultural and recreational objectives all within the limits set by natural dynamics. It covers the full cycle of information collection, planning, decision making, management and monitoring of implementation in the coastal zone. As such, the target set in the TNA is to successfully adopt, transfer and diffuse the ICZM technology across the nine (9) coastal counties of Liberia.

2. *Flood early Warning System (FWS):*

In general, the FWS which is considered as *"other non-market goods"* aims to reduce the degree of casualty that could be caused by coastal floods through alerting the public in advance to take appropriate actions (precaution). The TNA project targets to adopt, transfer and diffuse the FWS to help protect vulnerable lives and properties within frequently flooded and vulnerable coastal areas by means of detecting threatening events in advance and therefore alerting the "at risk" population once an event exceeds a given threshold.

3. *Rocks Revetment:*

The Rocks revetment is considered as a "*publicly provided goods*" which is a sloped seaward structure of hard engineering option of coastal defence that protects against erosion caused by wave action, storm surge and tidal effects. It is often built with boulders (rocks), concrete or other durable materials to protect a scarp, shoreline, embankment or sand dune against erosion (UNFCCC, 1999). It also minimizes the destructive and hazardous risks to coastal ecosystem, vegetation, sand dunes and important infrastructures. Revetments are frequently used in locations where further shore erosion will result in excessive damage; e.g. when roads and buildings are about to fall into the sea.

The visible impacts of coastal erosion in many cities have initiated some efforts towards climate change adaptation initiatives such as coastal protection projects, the formulation of some policies and laws to sustainably manage the coastal zone. Summarized in *table 1,* are some related documents that include the coastal zone.

Table 1*:* Some related coastal policies and adaptation documents for climate change on Liberia

Documents & year	**Main contents**	**Lead agency**	**Status**
National Policy and Response Strategy on Climate Change (NPRSCC) of 2018	The climate change policy and strategy document is prepared in order to ensure that climate change adaptation and mitigation issues are mainstreamed at policy level and in key sectorial and cross-sectorial development efforts. The NPRSCC includes concrete policy and measures in specific areas on climate change adaption and mitigation, action and resource mobilization plans and monitoring and evaluation framework.	Environmental Protection Agency (EPA) of Liberia	Ongoing; it has facilitated the mainstreaming of climate change adaptation and mitigation at policy level in key sectorial development efforts.
National Disaster Management Policy of Liberia (NDMP), 2012	The NDMP provides an overall framework for disaster management in Liberia. It particularly aims at integrating risk reduction as appropriate into development policies and planning at all levels of government; including the environment, land, agriculture & forestry sectors, coastal areas and etc.	National Disaster Management Agency (NDMA) Liberia	It has been implemented and continues to be observed and considered at many important national policy planning.

Intended Nationally Determined Contributions (INDC) of Liberia, 2015	The INDC (2015) shows that Liberia recognizes the current and future threats of climate change. The document provides some efforts and initiatives that have been undertaking by Liberia towards addressing climate change threats. The INDC includes one component on mitigation and one on adaptation.	Environmental Protection Agency (EPA) of Liberia	The INDC has been implemented and is currently under review to be revised / updated considering current issues.
Coastal Add-On project (CAP)	Government of Liberia obtained funding from the Global Environmental Facility (GEF) through the UNDP to Enhance Resilience of Liberia's Montserrado County Vulnerable Coastal Areas to Climate Change Risks. The CAP constructed a 1200 (One Thousand, Two Hundred) linear metres coastal defense "Revetment" in the D-Twe, Kru-Town area to reduce the vulnerability of the community's population and natural coastal environment to climate change risks, and enhance the capacity of the community to recover from coastal erosion impacts. This project protected the only public high school and hospital in the area from being damaged by the impacts of coastal erosion.	Ministry of Mines and Energy (MME) of Liberia	The project was successfully implemented and ended. It protected the only public high school and hospital in the area from being damaged by the impacts of coastal erosion.

1.1.2. Action Plan for Technology 1: Integrated Coastal Zone Management (ICZM)

1.1.2.1. Introduction

The ICZM technology was the most ranked and prioritized of the three retained technologies from the *TNA Report-I*. The ICZM covers the full cycle of information collection, planning, decision making, management and monitoring of implementation in the coastal zone to promote sustainable management (French, 2005). The prioritization of the ICZM by stakeholders was done using the TNA "Multi Criteria Analysis (MCA)".

Some benefits of ICZM are:

- ICZM reduces ecosystem degradation; and also conserves and maintains existing ecosystems from potential climate change impacts through policies, laws and regulations;
- It manages / protects coastal resources in a sustainable way;
- ICZM seeks over the long-term, to balance environment, socioeconomic, cultural and recreational objectives; *Liberia's' TNA coastal Report I (2019).*

1.1.2.2. Ambition for the TAP

The objective and target for the deployment and diffusion of the ICZM in Liberia is to promote sustainable usage, planning and management of coastal resources and ecosystems so as to protect vulnerable lives and properties therein from present and future related climate change impacts.

1.1.2.3. Actions and Activities selected for inclusion in the TAP for ICZM

a) Summary of barriers and measures to overcome barriers

Below in *Table: 2* is a summary of the identified barriers and measures to meet the specified ambition for the deployment/ transfer and diffusion of the ICZM technology.

Table 2: Summary of barriers and measures for the deployment and diffusion of ICZM

Categories of Barrier	Measures to overcome barriers
Economic and Financial	• To address the high capital cost for equipment, it is highly recommended that an annual national budgetary allotment be secured to specifically address the operations and high cost for the start-up equipment of ICZM. The available funds can be used to train technicians, conduct research, monitor and support deployment activities of the technology. • To address the issue of inadequate access to public, external and other private funding, it was analyzed and recommended to create a partnership with other available international donors that support climate change adaptation projects. • It is also important to develop sustainable community based projects and prepare funding proposals that meet climate change funding requirements to implement and diffuse the ICZM projects across all coastal counties of Liberia.
Social, Gender and Behavioral	• These involve the participation of local community leaders and concerned stakeholders, as well as vulnerable groups that are directly affected by the impacts of coastal erosion and flood in the transfer and diffusion of ICZM. • Community Action Groups (CAG) could be created to enforce the established regulations of the technology at local levels. The involvement of local groups will promote the technology at the community level and also increase the sensitization of ICZM policies and regulations. This will also promote behavioral change against beach sand mining and other destructive activities in the coastal zone.
Information and Awareness	• To overcome the barrier of limited understanding of ICZM functions and fundamental principles, capacity building through training workshops for sensitization should be provided for all relevant stakeholders and also affected local community residents. In so doing, you will increase the public understanding of the technology and the objective for its adoption. • In order to overcome the limited dissemination of information about the ICZM sustainable management regulations, it was recommended to increase awareness and provide adequate information dissemination through the media, radio and television announcements or dramas, community and high school environmental groups, workshops and etc.. These measures are recommended to be repeated regularly to increase sensitisation.
Technical	To therefore overcome the limited technical expertise in the different sectors or disciplines of ICZM, it was analysed and recommended to provide regular technical training for personnel involved with the establishment and diffusion of the technology at all levels. Because the ICZM is a multidisciplinary coastal technology and it requires knowledgeable people, technicians and experts in each of its sectors or disciplines to properly achieve its objective. It is important to involve both local and international experts / institutions to conduct the recommended trainings.
Environmental	• In order to overcome the barrier of limited access to some coastal environment for the transfer and diffusion of ICZM, it was recommended to utilize the local residents in such area for the technology transfer, adoption and upholding. • For those areas that are naturally highly risky, and cannot easily allow the technology, it was recommended that the step-back / retreat method of coastal zone management be applied in such areas for the safety of lives.
Legal & Regulatory	• It was recommended to develop an act and policy to govern the ICZM in order to overcome the lack of legal act for the establishment, jurisdiction, transfer and diffusion of the technology. The development of said act will facilitate budgetary allotment and attract political will to support the proper functioning of the technology. • It is also important to review the existence of an Integrated Coastal Zone Management Unit (ICZMU) at the ministry of mines and energy; if applicable, create a proper legal regulatory framework and a functional office, and to hire initial qualified personnel and experts to initiate the proper establishment in respect to the fundamental principles and objectives of ICZM.
Institutional arrangement & Organization	It was recommended to create, develop and support cross-sectorial working groups' meetings to ensure a proper coordination among institutions in order to overcome the barrier of limited and inadequate coordination among institutions, personnel, stakeholders and local communities. This will help to regulate the functional understanding of individual institutions as some institutions share similar functions in Liberia.

b) Actions selected for inclusion in the TAP for *ICZM*

This section provides a list of narrative descriptions and reasonable arguments for each of the measures selected as actions to be included in the TAP for the ICZM. The measures considered to be used as actions are based on the economic and financial potentials identified from Liberia's coastal zone BAEF report while considering the problem/objective trees therein.

i. Develop/ formulate a proper legal act, framework /policy plan and identify the responsible actors and institutions involved with the management of coastal resources, ecosystems and environments; and form an ICZM steering committee.

The coastal zone technical working group recommended the establishment of an ICZM policy plan or legal act for its adoption and governance in Liberia as a measure to overcome the identified legal, regulatory and financial barriers for the ICZM.

ii. Allocate ICZM annual national budgetary allotment and establish partnerships with available international donors/ development partners that support climate change adaptation projects. With the secured ICZM funding, purchase or invest in coastal monitoring equipment. Develop funding proposals for sustainable community based adaptation projects that meet climate change funding requirements.

These actions to be included in the TAP aim at addressing the challenges presented by the economic and financial barriers that could possibly hinder the establishment, transfer and diffusion of the ICZM across the vulnerable coastal areas of Liberia.

iii. Provide regular technical training / capacity building at all levels for personnel involved with the establishment, transfer and diffusion of the ICZM technology.

The training of personnel at all level of the ICZM (institutional, sectoral and local community) will address the technical barriers of limited or lack of technical expertise and capacity.

iv. Create, develop and support cross-sectorial working group meetings.

This action is aimed at ensuring a proper coordination and information / data sharing among institutions to address the existing limited and inadequate coordination there. Meanwhile, *table 3* below summarizes the actions selected for inclusion in the TAP.

Table 3: Actions selected for inclusion in the TAP

Barrier category	**Action selected for TAP**
Legal and Regulatory	-MME in collaboration with the EPA should develop or establish a proper legal act /law, framework and or policy plan for the establishment of ICZM in Liberia. -Identify responsible actors, institutions that are involved with the management of coastal resources, ecosystems and environments for inclusion; and form a steering committee.
Economic and Financial	MME & EPA to secure national and or international funding for the establishment, functioning and sustainability of ICZM in Liberia & purchase / invest in coastal monitoring equipment.
Technical	MME to provide regular technical training / capacity building at all levels (institution to local community) for personnel involved with the establishment, transfer and diffusion of the ICZM technology across the vulnerable coastal areas.
Institutional & Organizational arrangement	MME to provide, create, encourage and support ICZM cross-sectorial working group meetings to facilitate coordination and cooperation;

c) Activities identified for implementation of selected actions

This section aims to expand the identified Actions into more specific "Activities." *Table 4* presents a list of Activities which need to be implanted to achieve each identified Action.

Table 4: Activities identified for implementation of ICZM Actions

Action	Activity
1. Develop or establish a proper legal act /law, framework and or policy plan for the establishment of ICZM in Liberia.	1.1. MME & EPA to conduct workshop/training of ICZM functions/ role and principles to the list of identified responsible actors, institutions that are directly or indirectly involved with the management of coastal areas; 1.2. EPA to prepare a list of the most important laws (framework, policies…) affecting the management of coastal resources; 1.3. EPA & MME to conduct gap analysis and needs assessment of the laws and framework, policies etc. and establish ICZM steering committee; 1.4. EPA to create/implement/enforce laws, policies, strategies, framework if needed. This should involve stakeholder's participation from institutional to local community based group level.
2. Secure national or international funding for the establishment, functioning and sustainability of ICZM in Liberia. And purchase coastal monitoring equipment.	2.1. MME to secure ICZM annual national budgetary allotment; 2.2. EPA & MME to establish partnerships with available international donors or development partners that support climate change adaptation projects; 2.3. MME & EPA to regularly develop funding proposals for sustainable community based adaptation projects that meet climate change funding requirements for support; 2.4. MME to invest in equipment and software to monitor, map and model coastal dynamics including waves, currents, tides and sand transport.
3. Provide regular technical training / capacity building for ICZM personnel.	3.1. MME, provide regular technical hands-on training / capacity building at all levels for personnel involved with the establishment, transfer and diffusion of the ICZM technology across the vulnerable coastal areas. 3.2. The training should include ICZM personnel from the institutional level down to the local community based group; the training opportunities should be both short and long term; 3.3. The training should be conducted by qualified national and international coastal experts, research institutions and groups; 3.4. MME to develop and implement a protocol for monitoring, mapping, modeling and reporting on coastal dynamics including coastal wetlands, dunes, waves, tides, sand movement, with a special focus on vulnerable coastal communities.
4. Provide, encourage and facilitate ICZM cross-sectoral cooperation and coordination.	4.1. MME to create and support ICZM cross-sectorial working group meetings to facilitate coordination; 4.2. Use the EPA's EKMS platform for ICZM information and data sharing among institutions to facilitate and enhance decision making; 4.3. MME & EPA, draft and sign Data Sharing Agreements to build meaningful and official linkages (MOU, etc) with other local and international organizations engaged in coastal monitoring and mapping; 4.4. MME to establish a national coastal research committee to facilitate dialogue and exchange.

d) Actions to be implemented as Project Ideas (PIs)

The above Actions selected to be turned into Project Ideas for the realization of the TAP were carefully and technically considered by the coastal zone technical working group. Those four (4) selected Actions are measures that are directly aim at creating an enabling environment for the ICZM as they complement each other. They are targeted to address four barrier's categories "*Economic & financial, Technical, Legal & regulatory, and Institutional & organizational arrangement"*. Therefore, they all have to be considered to avoid additional barriers. In connection to the *Actions* for the ICZM Project Idea, the *Activities* identified and designed for the implementation of the Actions are significant to achieve the Project Idea.

1.1.2.4. Stakeholders and Timeline for implementation of TAP for ICZM

a) Overview of Stakeholders for the implementation of the TAP

This section describes the main stakeholders identified and their roles as required for each of the actions to be implemented. As such, presented in *Table 5* are the identified key stakeholders with their associated roles.

Table 5: Key Stakeholders and their roles for the implementation of ICZM TAP

Key Stakeholder	Role
Ministry of Mines & Energy (MME)	▪ Lead ministry/ focal point for ICZM implementation; ▪ In collaboration with the EPA, hire a legal consultant with a considerable experience in environmental policy formulation to develop or establish a proper legal act /law, framework and or policy plan for the establishment of ICZM in Liberia. ▪ Identify the responsible actors, institutions that are directly or indirectly involved with the management of coastal resources, ecosystems and environments for inclusion in the ICZM; ▪ Coordinate coastal research and provide internships for students and vulnerable community groups; ▪ In collaboration with the University of Liberia, purchase/ invest in equipment and software to monitor, map and model coastal dynamics including waves, currents, tides and sand transport; ▪ Create/implement/enforce laws, policies, strategies, framework if needed. This should involve stakeholder's participation from institutional to local community based group level; ▪ Regularly develop funding proposals for sustainable community based adaptation projects that meet climate change funding requirements for support; ▪ Provide/ facilitate technical training / capacity building for ICZM personnel; ▪ Provide, encourage and facilitate ICZM cross-sectoral cooperation and coordination.
Ministry of Finance, Development and Planning (MFDP)	▪ Secure annual national budgetary allotment and or international funding for the establishment and sustainability of ICZM in Liberia. ▪ Monitor project implementation and accountability of funds.
Environmental Protection Agency (EPA)	Create/implement/enforce laws, policies, strategies, framework for coastal environment protection. This should involve stakeholder's participation from institutional to local community based group level;
University of Liberia (UL); Department of Environmental Sciences /Climate Change	▪ Establish a national coastal research/scientific committee or team, and develop partnerships with other research institutions nationally and internationally; ▪ Develop and implement a protocol for monitoring, mapping, modeling and reporting on coastal dynamics including coastal wetlands, dunes, waves, tides, sand movement, with a special focus on vulnerable coastal communities; ▪ Regularly develop coastal research funding proposals for sustainable climate change based adaptation/ mitigation projects that meet climate change funding or development partners requirements for support ▪ Provide regular technical training / capacity building for ICZM personnel.

b) Scheduling and Sequencing of specific Activities

Table 6 below aims at describing the scheduling and sequencing of specific activities to be undertaken to achieve the actions identified for the ICZM. In so doing, this TAP is planned to be implemented for a period of ten years (2021- 2031). After said duration, it is highly recommended to be reviewed and updated as per the current/ prevailing future situation following a needs assessment and gap analysis. As such, the four *actions* envisioned under this TAP for the ICZM sequencing would be approximately as listed below:

Table 6: Scheduling and Sequencing of specific Activities for ICZM TAP

Action	**Activity**	**Timeframe (Planning & implementation)**										**Responsible body**
		Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	
Develop or establish a proper legal act / policy plan or framework for the operations and sustainability of the ICZM	Conduct workshops, trainings on ICZM functions/ role and principles for coastal actors or managers											MME, EPA
	Listing of the most important laws (framework, policies) affecting the management of coastal resources;											MME, EPA
	Gap analysis and needs assessment of laws and framework, policies etc. and establish ICZM steering committee;											EPA, MME
	Create/implement/enforce laws, policies, strategies, framework if applicable											EPA, MME
Secure national and or international funding for the functioning, operations and sustainability of ICZM in Liberia. And purchase/ invest in coastal monitoring equipment.	Secure ICZM annual national budgetary allotment;											MME, EPA
	Establish partnerships with international donors or development partners that support climate change adaptation projects;											MME, EPA
	Regularly develop funding proposals for sustainable community based adaptation projects ;											EPA, MME
	Invest in equipment and software for coastal monitoring;											MME, EPA
Provide regular technical training / capacity building for ICZM personnel	Provide regular technical hands-on training / capacity building at all levels of ICZM personnel											MME, EPA
	Conduct short term training for coastal communities with gender inclusion;											EPA, MME
	Hiring of national and international coastal experts and institutions to conduct ICZM trainings;											EPA, MME
	Develop and implement a protocol for monitoring, mapping, modeling and reporting on the coastal zone;											EPA, MME
Provide, encourage and facilitate ICZM cross-sectoral cooperation and coordination.	Create and support ICZM cross-sectorial working groups to facilitate coordination;											EPA, MME
	Create a platform for ICZM information and data sharing ;											EPA, MME
	Draft and sign Data Sharing Agreements to build meaningful and official linkages (MOU, etc.) with other local and international organizations;											EPA, MME
	Establish and support a national coastal research scientific team /committee to facilitate dialogue and exchange;											EPA, MME

1.1.2.5. Estimation of Resources Needed for Action and Activities

a) Estimation of capacity building needs

The ICZM is a dynamic, multidisciplinary and iterative process to promote sustainable management of coastal zones. As such, its successful implementation highly depends on the capacity of the implementers. Therefore, there is a high and urgent need to strengthen the capacity of relevant stakeholders, institutions, technicians, vulnerable coastal communities through hands-on training in issues, tools and equipment related to coastal zone management.

b) Estimations of costs of actions and activities

Table 7 below presents an estimated 10 years budget for implementation and sustainability.

Table 7: Estimation of cost and resources needed for ICZM Action and Activities

Activity	**Estimated Costs ($ USD)**	**Source of funds**	**Justification**
Conduct workshops, training on ICZM functions/ role and principles for coastal actors or managers	500,000.00	GCF; UNEP UNFCCC/GoL	Capacity building and awareness on the benefits and objective of ICZM adoption
Listing of the most important laws (framework, policies) affecting the management of coastal resources;	50,000.00	GEF; CTCN; UNFCCC/ CI /UNEP/ GOL	Barrier assessment of sustainable management and implementation of ICZM
Gap analysis and needs assessment of laws and framework, policies etc. and establish ICZM steering committee;	200,000.00	GEF; CTCN; UNFCCC/ /UNEP/ GOL	Assessment of gap analysis and needs
Create/implement/enforce laws, policies, strategies, framework if applicable	2,500000.00	UNFCCC/ /UNEP/ GOL	To Legally uphold and regulate ICZM
Secure ICZM annual national budgetary allotment;	50,000.00	GOL	To support ICZM operations and activities
Establish partnerships with international donors or development partners that support climate change adaptation projects;	75,000.00	GCF; UNEP World Bank; UNFCCC/GeF	To increase knowledge sharing, partnership and capacity
Regularly develop funding proposals for sustainable community based adaptation projects ;	1,000000.00	GEF; UNEP/ UNFCCC/GoL	For the support of vulnerable coastal community based adaptation projects
Invest in equipment and software for coastal monitoring;	8,750000.00	GCF/EU/ GoL UNFCCC/	For technical implementation of coastal projects and research
Provide regular technical hands-on training / capacity building at all levels for personnel involved with the establishment, transfer and diffusion of the ICZM;	2,510000.00	GCF; GEF; UNFCCC/UNEP/CI /UNDP/ USAID; GOL	To improve technical capacity building of personnel
Conduct short term training for coastal communities with gender inclusion;	155,000.00	UNFCCC/ EU /UNEP/ GOL	Strengthening the resilience of vulnerable and affected coastal communities
Hiring of national and international coastal experts and institutions to conduct ICZM training;	350,000.00	GCF; UNEP UNFCCC/GeF	To support the implementation of local capacity building
Develop and implement a protocol for monitoring, mapping, modeling and reporting on the coastal zone;	35,000.00	UNFCCC/ EU /UNEP/ GOL/ CI/ CTCN	For a standardized coastal management and vulnerability research methodology
Create and support ICZM cross-sectorial working groups to facilitate coordination;	17,000.00	GOL/ UNDP	To facility and encourage cross-sectorial coordination
Create a platform for ICZM information and data sharing ;	587,000.00	UNFCCC/ UNDP/GoL	To promote ICZM information, awareness and knowledge sharing
Draft and sign Data Sharing Agreements to build meaningful and official linkages (MOU, etc.) with other local and international coastal organizations;	50,000.00	GoL/ UNDP/ UNEP/ UNFCCC	To facility data collection

Establish and support a national coastal research scientific team /committee to facilitate dialogue and exchange;	1,110000.00	GCF/UNEP/ UNFCCC/GeF / GoL	To manage the operations of ICZM
Total	**17,939,000.00**		

1.1.2.6. Management Planning

a) *Risks and Contingency Planning*

The below *table 8* provides an overview of the main identified risks and the contingency plan for the successful implementation of the Integrated Coastal Zone Management TAP.

Table 8*:* Risks and contingency plan for the implementation of ICZM TAP

Risks	Level	Contingency plan
No legal framework or policy to govern the ICZM	Low	Hire a legal consultant with an acceptable amount of experience in environmental/ climate change related policy to develop ICZM legal framework / policies.
No government funding to sustain the ICZM	High	Secure an annual budgetary allotment from nation government to sustain the ICZM.
High costs of implementation (equipment, software, training & etc.)	High	Secure funding from international partners that support climate change related project.
Limited local technical skills / capacity in ICZM	Medium	Plan and conduct regular capacity building, hands-on training for ICZM personnel; it can be done through long and short training opportunities, internships, and partnerships with research institutions.
Unacceptability of ICZM laws and regulations	Medium	Increase ICZM awareness and its importance to the increasing climate change related risks and vulnerability to coastal communities. Also, enforce the ICZM laws and regulations.
Inadequate stakeholders and institutional cooperation and data sharing	High	Promote, encourage and develop local or national networks, platforms or websites for climate change data sharing specifically for ICZM.
Unwillingness to decentralize the ICZM from the capital Monrovia	Low	Establish ICZM sub-offices in each vulnerable coastal city across the country to specifically address or coordinate climate change impacts affecting lives and properties form the community based level.

b) Next steps

The following identified immediate and critical requirements are important to achieve or move forward with the adoption and diffusion of ICZM across Liberia's vulnerable coastal areas:

Immediate requirements to proceed:

- The EPA including its national TNA coordinator should arrangement and conduct a sectoral meeting with (MME, UNDP and others) relevant stakeholders involved with coastal management to discuss the outcome and recommendations of the TNA's TAP to find a suitable way forward for the realization of identified technology's project therein.
- Coordinate and develop a clear understanding of the project among the stakeholders.
- Constitute a technical project committee to implement the TAP's recommendations.

Critical steps:

- The project committee should engage or solicit funding from the identified recommended climate change related funding sources with the refined project ideas in the TAP.
- Secure a funding support nationally and internationally.
- Ensure regular capacity building for personnel.

1.1.2.7. TAP overview table for Integrated Coastal Zone Management (ICZM)

The overview of the Technology Action Plan (TAP) for the ICZM is given in *table 9* below:

Table 9: TAP overview table for Integrated Coastal Zone Management

Sector: COASTAL ZONE								
Technology: Integrated Coastal Zone Management (ICZM)								
Ambition	Promote sustainable use/ management of coastal resources and to protect lives and properties within vulnerable coastal environment							
Benefits	Social: well managed and improved public use of coastal areas; Economic: job creation & sustainable use of coastal resources for all; Environmental: protected coastal ecosystems.							
Action	**Activities to be implemented**	**Sources of funding**	**Responsible body & focal point**	**Time frame**	**Risks**	**Success criteria**	**Indicators for Monitoring of implementation**	**Budget per activity ($USD)**
Action: 1 **Develop a legal framework or policy plan for ICZM in Liberia.**	1.1. Conduct workshop/ training of ICZM functions, role and principles to the identified responsible actors, institutions that are directly or indirectly involved with the management of coastal areas;	GCF; GEF; CTCN; World Bank; African Development Bank; UNFCCC/UNEP/EU/USAID; GOL	MME; EPA	1- 2 years	Involvement of non-relevant coastal actors, technicians, stakeholders and vulnerable / affected communities leaders	Quantity of personnel trained in each vulnerable coastal city or community	Scale of Initiatives taken by vulnerable coastal residents to adapt to coastal erosion risks and impacts	500,000.00
	1.2. Prepare a list of the most important laws (framework, policies…) affecting the management of coastal resources;	GCF; GEF; CTCN; World Bank; UNFCCC/UNEP/CI / UNDP/ EU/ USAID; GOL	MME; EPA	1 year	Limited institutional collaborate / cooperation	Amount of relevant required laws, frameworks / policies identified & compiled	Draft report submitted and validated	50,000.00
	1.3. Conduct gap analysis and needs assessment of the laws and framework, policies etc. and establish ICZM steering committee;	GCF; GEF; CTCN; World Bank; UNFCCC/UNEP/EU/ USAID; GOL	EPA, MME	1 year	Limited or inadequate technical expertise	Identification of the actual existing gaps	ICZM steering committee established and approved by the relevant authorities	200,000.00
	1.4. Create/implement/enforce laws, policies, strategies, framework…. If necessary. This should involve stakeholder's participation from institutional to local community groups.	GCF; GEF; CTCN; World Bank; UNFCCC/UNEP/CI / UNDP/ EU/ USAID; GOL	EPA, MME	1-10 years	Limited sectoral collaboration & support; resistance to accept coastal regulatory laws by the residents	Involvement and participation of local community leaders and vulnerable groups	Coastal regulations are created, adopted & diffused across all coastal counties along with an agent an agent;	2,500000.00

Action 2: **Secure national and or international funding for the establishment, functioning and sustainability of ICZM in Liberia. And purchase/ invest in coastal monitoring equipment.**	2.1. Secure ICZM annual national budgetary allotment;	Government of Liberia (GOL);	MME, EPA	2-3 years	Limited / inadequate political will/ support	Allotment of ICZM national budget	First annual budget approved & provided	50,000.00
	2.2. Establish / enhance partnerships with appropriate international donors or development partners that support climate change adaptation projects;	GCF; GEF; World Bank; EU, USAID; GOL	MME, EPA	2 years	Not knowing the suitable institutions and the way forward	Most relevant & effective climate change development partners Identified	Approval of climate change support agreements	75,000.00
	2.3. Regularly develop funding proposals for sustainable community based adaptation projects that meet climate change funding requirements for support;	GCF; GEF; CTCN; World Bank; UNFCCC/UNEP/ UNDP/ EU/ USAID; GOL	EPA, MME	10 years	Lack or limited technical expertise to develop the required proposal	Development of at least 1 proposal per year	Numbers of proposals developed, submitted and approved for funding	1,000000.00
	2.4. Invest in equipment and software to monitor, map and model coastal dynamics including waves, currents, tides and sand transport.	GCF; GEF; CTCN; World Bank; EU/ USAID; GOL	MME, EPA	3-10 years	Lack of proper coastal equipment and software in country	Identification of the needed equipment and software internationally	25% of the equipment and monitoring software purchased and imported;	8,750000.00
Action: 3 **Provide regular technical training / capacity building for ICZM personnel.**	3.1. Provide regular technical hands-on training / capacity building at all levels for personnel involved with the establishment, transfer and diffusion of the ICZM technology across the vulnerable coastal areas.	GCF; GEF; CTCN; World Bank; UNFCCC/UNEP/CI / UNDP/ EU/ USAID; GOL	MME, EPA	1-10 years	Lack/ limited national experts to provide / conduct the training	15 ICZM personnel trained within 2 years;	Number of personnel from different institutions and sectors already trained & deployed in the counties;	2,510000.00
	3.2. Conduct short term training for coastal communities with gender inclusion;	GCF; GEF; CTCN; World Bank; UNFCCC/UNEP/CI / UNDP/ EU/ USAID; GOL	EPA, MME	1-5 years	Little or limited initial coastal knowledge by personnel	Short & long term trainings provided to 15 ICZM personnel with gender consideration/	Coastal management Laws and regulations are being enforced by the initial trained personnel	155,000.00
	3.3. Hire 5 qualified coastal experts (national and international), research institutions/ groups to conduct training;	GCF; GEF; CTCN; World Bank; UNFCCC/UNEP/ UNDP/ EU/ USAID; GOL	EPA, MME	1-5 years	Limited financial support to conduct training	50% of the total amount needed is generated to carryout initial training for year 1 & 2	First round of ICZM training conducted and trainers salaries are available;	350,000.00

	3.4. Develop and implement a protocol for monitoring, mapping, modeling and reporting on coastal dynamics including coastal wetlands, dunes, waves, tides, sand movement, with a special focus on vulnerable coastal communities.	CTCN; World Bank; UNFCCC/UNEP/ UNDP/ EU/ USAID; GOL	EPA, MME	1-2 years	Limited or delay in reporting	Protocol for monitoring coastal activities and research is developed	2 activities already monitored, reported and accounted for within year 1;	35,000.00
Action: 4 **Provide, encourage and facilitate ICZM cross-sectoral cooperation and coordination**	4.1. Create and support ICZM cross-sectorial working group meetings to facilitate coordination;	GOL, UNDP/ EU/ USAID;	EPA, MME	1 year	Unwillingness to collaborate	Technical working groups established across sectors involved with coastal issues	Quarter 1 sectoral working session held and report submitted	17,000.00
	4.2. Create and sustain ICZM platforms for information and data sharing among institutions and the public to facilitate and enhance decision making;	GCF; GEF; CTCN; World Bank; UNFCCC/UNEP/ UNDP/ EU/ USAID; GOL	EPA, MME	10 years	Limited support for maintenance/ up-keeping and limited data or information to be published	One or two ICZM platforms already developed, established and functional	Regularly active and up to date information available	587,000.00
	4.3. Draft and sign Data Sharing Agreements to build meaningful and official linkages (MOU, etc.) with other local and international organizations engaged in coastal monitoring and mapping;	GCF; GEF; CTCN; World Bank; UNFCCC/UNEP/ UNDP/ EU/ USAID; GOL	EPA, MME	1-6 years	Unwillingness/ Limited data and information sharing between institutions	Amount of MOU and data sharing agreements signed with local and or international organizations	Numbers of activities or projects undertaken / achieved under the agreement with specific reports	50,000.00
	4.4. Establish and support a national coastal research scientific team/committee to conduct research and facilitate dialogue and exchange	GCF; GEF; CTCN; World Bank; UNFCCC/UNEP/ UNDP/ EU/ USAID; GOL	EPA MME	10 years	Limited technical coastal experts to be involved	National coastal research committee properly established	2-5 coastal research project/ activities successfully initiated, facilitated and support by the committee	1,110000.00

1.1.3. Action plan for technology 2: Flood early Warning System (FWS)

1.1.3.1. Introduction

In recent years, climate change related coastal flooding has become a national concern in Liberia. In an effort to address the direct impacts of coastal flooding in vulnerable coastal communities in Liberia, the FWS was the second highest ranked technology retained by stakeholders in the *TNA Report II* to be adopted and diffused in flood vulnerable coastal areas as a measure to address the problem. The FWS functions in a way by which it alerts the public in advance to take appropriate actions (precaution) whenever a threatening event exceeds a given threshold.

Some benefits of the FWS:

- It reduces the level of casualty/ negative impact that could affect the coastal population;
- It provides job opportunities;
- It promotes decision making; for example, a frequent high risk flood occurrence environment could be used or reserved for different purpose rather than residential.

1.1.3.2. Ambition for the TAP on Flood early Warning System (FWS)

The ambition for the TAP as it relates to the FWS technology aims to have the flood early warning system adopted, transferred and diffused as a climate change adaptation technology across all highly vulnerable flood areas in the coastal zone of Liberia.

1.1.3.3. Actions and Activities selected for inclusion in the TAP for the FWS

This section provides the specific actions and activities for the FWS which were identified by stakeholders and technicians in the coastal technical working sessions of *Report II* (BA&EF).

a) Summary of barriers and measures to overcome barriers

Table 10 below summarizes the identified barriers and measures to meet the ambition set for the deployment/ transfer and diffusion of the FWS technology.

Table 10: Summary of the identified barriers and measures to overcome the barriers: *FWS*

Barrier categories	Measures to overcome barriers
Economic and Financial	To overcome the high capital cost for FWS installation and operations, a regular annual national budgetary support/ allotment should be secured or established for the proper functioning and sustainability of the technology To overcome the Inadequate / limited access to funding, it is recommended to develop comprehensive funding / project proposals that meet international climate change adaptation funding requirements in order to have access to such funding. Partnerships should also be created with external organizations that support climate change adaptation projects through funding, technical training and etc.
Social, Gender and Behavioral	To overcome the barrier of non-gender inclusion for the FWS, create and provide mitigation and adaptation measures that will have direct positive impact or result on vulnerable women, children, youth and disable groups. As such, a timely emergency response team should be instituted to evacuate / prioritize people within such category in times of potential risk of flooding.
Information and Awareness	Provide, increase and support coastal flooding research projects / activities to generate data for onward / future improvement of the system or technology. Provide and improve quick information sharing between institution, stakeholders and the population at risk through direct text messages to individual phones or by radio awareness programmes.

Technical	To also overcome the barrier of limited technicians and experts to fully and properly operate the technology, it was agreed that providing adequate capacity building training for personnel should address the problem. The training should be done by institutions and experts that have successfully operated the FWS in other areas. These training should be both short and long term.
Environmental	To overcome the barrier of limited scientific understanding of a specific coastal environment for the instillation of the technology, conduct proper environmental impact assessments to understand the environmental and technical feasibility of the technology.
Legal & Regulatory	In order to overcome the legal and regulatory barrier to the transfer and diffusion of the FWS, create and adopt a legal framework / policy plan and ensure straight acceptance to local and international standards.
Institutional arrangement & Organization	To overcome the problem of inadequate coordination between institutions, it is highly important and recommended to develop, regulate and improve coordination through regular cross-sectorial regulatory meetings and working groups to ensure a proper coordination among institutions and also at individual level.
Others	To overcome some of the other barriers that may exist, it is therefore highly important and recommended to solicit political support and the involvement of politicians to understand the significance for the implementation and diffusion of the FWS which is to protect lives and properties from the risk of coastal flooding.

Source: Modified from Liberia's TNA Coastal Report II (BA&EF)

b) Actions selected for inclusion in the TAP for Flood early Warning System

This section provides a list of narrative descriptions and considerable arguments for each of the measures selected as actions to be included in the TAP for the FWS technology. The selected measures below were considered as actions and took into consideration the economic and financial benefits/ potentials which have been identified from *Report II, BA&EF*.

i. Prepare or identify laws/ legal policies or framework, actors, institutions and strategies to uphold the adoption and implementation, operations and sustainability of the flood early warning system technology in all flood vulnerable coastal communities across the coastal areas of Liberia. If said action is taken as recommend, the FWS could legally and professionally be adopted, transferred and diffused successfully with national political will/ support.

ii. Secure or establish a regular annual national budgetary allotment or international financial support to uphold the proper technical operations of the FWS so as to overcome the high capital cost for technology's installation and maintenance.

In so doing, it is highly recommended to develop a comprehensive funding proposal that meets international climate change adaptation funding requirements in order to have access to such funding. If said action is implemented as recommended, it would potentially reduce the overemphasized limited access to funding. As such, these actions aim at addressing the major challenges presented by the economic and financial barriers for the diffusion of the FWS.

iii. Provide and support regular adequate capacity building training for personnel to address the existing problem of limited technicians and experts to fully and properly operate the technology. In so doing, support and increase funding for FWS research projects and activities to enable and improve data collections so as to address the barrier of limited available data. To realize this action, the training should be done by experienced institutions and experts.

iv. Develop, regulate and improve coordination and collaboration among institutions and the concerned/ relevant stakeholders through regular quarterly cross-sectorial regulatory meetings and technical working group sessions to ensure a proper

collaboration and information sharing among institutions and local community leaders.

v. Provide and improve timely/ quick information sharing among the relevant institutions, stakeholders and the population at risk through direct text messages to individual phones or by radio awareness programmes. Said action shall enhance quick and urgent information dissemination directly to the needed and targeted population so as to take immediate precaution in order to save lives and properties and reduce the level of casualty that could have occurred.

In this light, *table 11* below summarizes the critical actions selected for inclusion in the TAP.

Table 11: Actions selected for inclusion in the TAP for the FWS technology

Barrier category	**Action selected for TAP**
Legal and Regulatory	Prepare or identify laws/ legal policies or framework, actors, institutions and strategies to uphold the adoption and implementation, operations and sustainability of the flood early warning system technology in all flood vulnerable coastal communities across the coastal areas of Liberia.
Economic and Financial	Secure or establish a regular annual national budgetary support/ allotment; prepare funding proposals and create partnerships with climate change funding partners for the technical functioning / operational support of the technology so as to address the high capital cost for FWS installation and maintenance.
Technical	Provide regular technical training / capacity building for FWS personnel at all levels (institution to local community) to address the issue of limited technicians and experts. And in so doing, provide, support and increase funding for FWS research projects and activities to enable data collection so as to address the barrier of limited available data
Institutional & Organizational arrangement	Develop, regulate and improve coordination and collaboration among FWS institutions and the concerned stakeholders through regular cross-sectorial regulatory meetings and technical working sessions to ensure a proper collaboration and information sharing among institutions and local community leaders.
Information and Awareness	Provide and improve timely/ quick information sharing among the relevant institutions, stakeholders and the population at risk through direct text messages to individual phones or by radio awareness programmes.

Source: Compiled from Liberia's *TNA Coastal Report II (BA&EF)*

c) <u>Activities identified for implementation of selected actions</u>

Table 12 below presents a detailed list of Activities that are needed to be implanted in order to make each of the identified Actions work. Therefore, the above identified Actions are expended into more specific Activities for implementation.

Table 12*:* Activities identify for the realization of FWS selected actions

Actions identified	**Activities to make the actions work**
Action 1: Prepare or identify laws/ legal policies or framework, actors, institutions and strategies to uphold FWS.	1.1. EPA to conduct desk review of existing framework/ policies/ strategies of flood early warning system to incorporate the coastal zone. 1.2. If necessary, GoL should improve or upgrade the existing flood early warning system to an international standard & incorporate coastal monitoring. 1.3. NDMA, create and support local community groups in vulnerable coastal areas to uphold the FWS regulations. It is highly important that these groups consider gender inclusion. 1.4. EPA & NDMA to solicit the support of local vulnerable coastal community leaders to facilitate the adoption, transfer and diffusion of the FWS technology in vulnerable coastal communities across Liberia.
Action 2: Secure or establish a regular annual national budgetary allotment or	2.1. EPA & NDMA to secure FWS funding or financial support from local and international partners that support climate change projects/ activities. 2.2. EPA to invest in/ purchase high standard and quality FWS software and equipment to

international financial support to uphold the operations of the FWS technology.	monitor, map and model coastal floods, inundations to safe guide livelihood activities. 2.3. EPA, the lead entity should regularly develop adaptation / mitigation funding proposals for the FWS and submit them for support to the GCF, Gef/ UNFCCC for support.
Action 3: Provide regular technical training / capacity building for FWS personnel at all levels (institution to local community).	3.1. EPA & NDMA to provide both long and short terms technical training, internships for FWS personnel at institutional level. 3.2. NDMA, conduct capacity building training in all local vulnerable coastal communities where the FWS technology will be installed. 3.3. EPA & NDMA to provide, support and increase FWS research projects/ activities to enable data collection. 3.4. NDMA & EPA to establish a national FWS research/ scientific group /committee to facilitate the operations of the technology.
Action 4: Develop, regulate and improve coordination and collaboration among FWS institutions and the concerned stakeholders.	4.1. NDMA to establish regular cross-sectorial regulatory meetings and technical working sessions to ensure a proper collaboration and information sharing among FWS institutions and local community leaders. 4.2. EPA & NDMA to develop/ establish partnerships with overseas universities and research institutions engaged in coastal floods / risks related data collections, mapping, monitoring and modeling.
Action 5: Provide and improve timely/ quick information sharing / awareness among the relevant institutions, stakeholders and the population at risk.	5.1. EPA and the NDMA of Liberia should provide and support quick and timely information sharing to the population at risk through direct text messages to individual phones or by radio awareness programmes for timely precautionary actions. 5.2. EPA should create/ develop and support FWS information platform or website. 5.3. EPA to map and regularly update coastal flood risk areas and publish the findings/ results on the FWS platform. 5.4. EPA to produce annual report for stakeholders and decision-makers on the state of the coast highlighting ongoing research, key activities, changes and challenges.

Source: Compiled from Liberia's *TNA Coastal Report II (BA&EF)*

d) Actions to be implemented as Project Ideas

All the above selected Actions for the FWS are inter-related and complement each other for implementation. The five (5) technically selected Actions aim to create an enabling environment for the successful adoption, transfer and diffusion of the FWS technology. As such, all of the Actions are considered very technically important for the Project Idea and should be considered.

1.1.3.4. Stakeholders and Timeline for implementation of TAP for *FWS*

a) Overview of Stakeholders for the implementation of the TAP

This section describes the main stakeholders identified and their roles as required for each of the Actions to be implemented. *Table 13* below identified key stakeholders and their roles.

Table 13: Key Stakeholders and their roles for the implementation of Flood early warning System's TAP

Key Stakeholder	Role
Environmental Protection Agency of Liberia (EPA)	▪ Lead; focal point for FWS implementation; ▪ Conduct desk review of existing framework/ policies/ strategies of flood early warning system to incorporate the coastal zone. ▪ In collaboration with the National Disaster Management Agency (NDMA), prepare or identify laws/ legal policies or framework, actors, institutions and strategies to uphold and sustain the operations of FWS. ▪ With the support of the NDMA and consultation with the University of Liberia (UL) and MME, purchase/ invest in equipment and software to monitor, map and model coastal floods. ▪ Provide, encourage and facilitate FWS cross-sectoral cooperation and coordination. ▪ In partnership with the NDMA, regularly solicit funding for the operations of FWS.
National Disaster Management Agency of Liberia (NDMA)	▪ In collaboration with the hydrological department of MME, provide timely/ quick information sharing / awareness among the relevant institutions, stakeholders and the population at risk. ▪ Provide/ facilitate technical training / capacity building for FWS. Personnel in partnership and collaboration with the UL and EPA. ▪ Participate in flood risk mapping and management flood warning system alongside the EPA.
Ministry of Mines and Energy (MME)	▪ Provide hydrological data for the FWS. ▪ Fully lead data collection on rainfall, rivers basins and discharge and other factors relating to coastal risks and floods in collaboration with EPA. ▪ Coordination and collaboration on mapping.
Ministry of Finance, Development and Planning (MFDP)	▪ Secure in collaboration with the EPA annual national budgetary allotment and or international funding for sustainability of FWS. ▪ Monitor project implementation and accountability of funds.
University of Liberia (UL); Department of Environmental Sciences /Climate Change	▪ Establish a national FWS research/ scientific committee to facilitate the operations of the technology and as well as dialogue and exchange. ▪ Coordinate coastal FWS research and internships; develop partnerships with other research institutions. ▪ Provide regular technical training / capacity building for FWS personnel at all levels.

b) <u>Scheduling and sequencing of specific activities</u>

Table 14 below describes the scheduling and sequencing of those specific activities to be undertaken in order to achieve the selected actions to be considered for the TAP of the Flood early Warning. In so doing, this TAP is planned to be implemented for a period of ten (10) years; 2021- 2031 after which time it is highly recommended to be reviewed and updated as per the prevailing future situation following a needs assessment and gap analysis. As such, the five *actions* envisioned under this TAP for the Flood early Warning System sequencing would be as follows:

***Table 14**:* Scheduling and Sequencing of specific Activities for the TAP of Flood early Warning System

Action	Activity	Timeframe (Planning & implementation)										Responsible body
		Y 1	Y 2	Y 3	Y 4	Y 5	Y 6	Y 7	Y 8	Y 9	Y 10	
Prepare or identify laws/ legal policies or framework, actors, institutions and strategies to uphold the FWS.	Conduct desk review of existing framework/ policies/ strategies on FWS to incorporate coastal zone.											EPA
	If needed, improve / upgrade existing flood early warning system to an international standard & incorporate coastal monitoring.											EPA, MME NDMA,
	Create and support local community groups in vulnerable coastal areas to uphold the FWS regulations and consider gender inclusion.											EPA, NDMA
	Solicit the support of local vulnerable coastal community leaders to facilitate the adoption, transfer and diffusion of the FWS.											EPA
Secure or establish a regular annual national budgetary allotment or international financial support to uphold the operations of the FWS.	Secure FWS funding or financial support from local & international partners that support climate change projects/ activities.											EPA
	Invest in/ purchase high standard and quality FWS software and equipment to monitor, map and model coastal floods, inundations to safe guide livelihood activities.											EPA, MME NDMA,
	Regularly develop climate change adaptation / mitigation funding proposals for the FWS and submit them for support to the reputable climate change partners or funders.											EPA
Provide regular technical training / capacity building for FWS personnel at all levels (institution to local community).	Provide both long and short term technical training for FWS personnel at institutional level.											EPA, NDMA
	Conduct capacity building training in all local vulnerable coastal communities where the FWS technology will be installed.											EPA
	Provide, support and increase FWS research projects/ activities to enable data collection.											EPA, FWS national committee
	Establish a national FWS research/ scientific group /committee to facilitate its operations.											EPA, NDMA
Establish or improve coordination and collaboration among FWS institutions and stakeholders.	Conduct regular cross-sectorial regulatory meetings and technical working sessions to ensure a proper collaboration and information sharing among FWS institutions and local community leaders.											EPA
	Develop/ establish partnerships with overseas universities and coastal research and management institutions.											EPA, NDMA
Provide and improve timely information sharing / awareness among the relevant institutions & the population at risk.	Provide and support timely information sharing to the population at risk through direct text messages to individual phones or by radio awareness for timely precautionary actions.											EPA
	Create/ develop and support FWS information platform or website.											EPA
	Map and regularly update coastal flood risk areas and publish the results on the FWS platform.											EPA, NDMA
	Produce annual report for decision-makers on the state of the coast highlighting ongoing research, key activities, changes and challenges.											EPA, NDMA

1.1.3.5. Estimation of Resources Needed for Actions and Activities

a) Estimation of capacity building needs

The Flood early Warning System requires constant monitoring of meteorological / rain fall and tidal conditions in conjunction with river and coastal flood forecasting models for which the national technical expertise are needed for its successful operations. As such, there is a need to develop and improve the capacity of relevant stakeholders, institutions, technicians, coastal communities through hands-on training concerning tools and equipment of the FWS. The capacity building should be short and long term training and should be conducted continuously throughout the duration for the TAP (2031) at which time a needs assessment is recommended.

b) Estimations of costs of actions and activities

The project would require an estimated budget for its implementation and sustainability over an estimated period of about ten years. *Table 15* provides a summary of such:

Table 15: Estimation of cost and resources needed for FWS Action and Activities

Activity	**Estimated Costs ($USD)**	**Source of funds**	**Justification**
Conduct desk review of existing framework/ policies/ strategies on FWS to incorporate coastal zone.	40,000.00	UNFCCC/GoL /CTCN/ UNEP	Regulatory enhancement
If needed, improve / upgrade existing flood early warning system to an international standard & incorporate coastal monitoring.	810,000.00	GEF; UNEP/ GoL/UNFCCC	Technical improvement of the technology
Create and support local community groups in vulnerable coastal areas to uphold the FWS regulations and consider gender inclusion.	1,500000.00	GEF; CTCN; UNFCCC/ /UNEP/ GOL	Decentralization and enforcement of FWS policies by local communities or end-users
Solicit the support of local vulnerable coastal community leaders to facilitate the adoption, transfer and diffusion of the FWS.	500,000.00	UNFCCC/ /UNEP/ GOL	To promote and encourage coastal communities participation and ownership of the technology
Secure FWS funding or financial support from local & international partners that support climate change projects/ activities.	850,000.00	GOL, GCF; World Bank, UNFCCC	To support/ uphold the implementation of FWS operations and activities
Invest in/ purchase high standard and quality FWS software and equipment to monitor, map and model coastal floods, inundations to safe guide livelihood activities.	4,565000.00	GCF; UNEP World Bank; UNFCCC/GeF	For technical implementation and sustainability of FWS activities
Regularly develop climate change adaptation / mitigation funding proposals for the FWS and submit them for support to the reputable climate change partners or funders.	1,650000.00	GEF; UNEP/ UNFCCC/ GCF/ EU	To support/ facilitate FWS transfer and diffusion locally
Provide both long and short term technical training for FWS personnel at institutional level.	1,520000.00	UNFCCC/UN EP/EU/USAID	To improve and uphold technical capacity building of staff
Conduct capacity building training in all local vulnerable coastal communities where the FWS technology will be installed.	475,000.00	GCF; UNEP UNFCCC/GoL /UNDP/EU/	To improve resilience and local capacity building of vulnerable communities
Provide, support and increase FWS research projects/ activities to enable data collection.	700,000.00	UNFCCC/ EU /UNEP/ GOL	To support and improve data collection
Establish a national FWS research/ scientific group /committee to facilitate its operations.	350,000.00	GOL/ UNEP/ UNFCCC/	For planning of FWS activities and sustainability
Conduct regular cross-sectorial regulatory meetings and technical working sessions to ensure a proper collaboration	100,000.00	GOL/ UNEP UNFCCC/ CI/	To facility and encourage cross-sectorial coordination

and information sharing among FWS institutions and local community leaders.		CTCN/	
Develop/ establish partnerships with overseas universities and coastal research and management institutions.	210,000.00	GOL/ UNDP/ UNFCCC	To increase partnership for knowledge sharing, and capacity building
Provide and support timely information sharing to the population at risk through direct text messages to individual phones or by radio awareness for timely precaution.	102,000.00	UNFCCC/ GOL/ UNDP/ UNEP/ CTCN	To promote information, awareness and knowledge sharing
Create/ develop and support FWS information platform or website.	210,000.00	GoL/UNEP/ UNFCCC	
Map and regularly update coastal flood risk areas and publish the results on the FWS platform.	200,000.00	UNFCCC/GoL GCF/UNEP/	
Produce annual report for decision-makers on the state of the coast highlighting ongoing research, key activities, changes and challenges.	100,000.00	GOL/ UNFCCC	To promote and facility decision making.
Total	**13,882000**		

1.1.3.6. Management Planning

a) <u>Risks and Contingency Planning</u>

Table 16 provides an overview of the main identified risks and the contingency plan for the successful implementation of the TAP for the FWS. *Report II* was carefully considered for such.

Table 16: Risks and Contingency plan for the TAP of FWS

Risk	Level	Contingency plan
No available government funding to purchase FWS equipment and to support and sustain its operations.	High	A regular annual national budgetary allotment should be secured to purchase equipment and support the operations of the FWS. In so doing, it is recommended to develop a comprehensive funding/ project proposals that meet international climate change adaptation/ mitigation funding requirements in order to have access to such funding for the operations and sustainability of the technology. Partnership should also be created/ enhance with external organizations that support climate change adaptation projects through funding, technical training and etc.
No available national strategy / policy plan or framework for flood management, and adoption and diffusion of the Flood early Warning System technology.	Medium	To address the legal and regulatory barrier for the adoption, transfer and diffusion of the FWS, create and adopt a legal framework / policy plan for national flood management and ensure straight acceptance to local and international standards.
Very limited national expertise to operate or implement the activities of FWS;	High	Provide and support adequate capacity building training programs for FWS personnel. The training should be done by institutions and experts that have successfully operated the FWS in other areas. These training should be both short and long term and must be implemented by institutions and experts that have successfully operated the FWS technology in other areas.
Limited available research data and information on flood vulnerable areas.	High	Provide, support and increase funding for coastal flooding research and data collection activities for future improvement. In so doing, provide and improve quick information sharing between institution, stakeholders and the population at risk through direct text messages to individual phones or by radio awareness programmes for timely decisions.
Difficulties in bringing stakeholders together for institutional collaboration or coordination.	Low	Develop, regulate and improve coordination through regular cross-sectorial regulatory meetings and working groups to ensure a proper coordination among institutions and also at individual level.

b) <u>Next steps</u>

Immediate requirements to proceed:

- Constitute a national technical project team to implement the TAP recommendations as stipulated for the FWS.
- Quick actions: Move quickly on actions such as policy plan or strategy for flood management; capacity building education/ training programmes that require less financial commitment and already have a foundation.
- Develop a clear understanding of the project among the stakeholders; get them and the flood vulnerable community leaders involved and build a close coordination among them.
- The lead agency, the EPA including its national TNA coordinator should arrange and conduct a sectoral meeting with (MME, UNDP, NDMA and others) relevant stakeholders for coastal management to discuss the outcome and recommendations of the TNA's TAP to find a way forward for the realization of identified technology's project therein.

Critical steps:

A critical step is to secure funding to support technical capacity and sustainability of the FWS.

- The project committee should engage or solicit funding from the identified recommended climate change related funding sources with the refined project ideas in the TAP.
- Invest or purchase FWS monitoring equipment from national or internal sources.
- Ensure regular capacity building for personnel.

1.1.3.7. Ensure and TAP overview table for Flood early Warning System (FWS)

The overview of the Technology Action Plan (TAP) for the Flood early Warning System is given in *table 17* below

Table 17: TAP overview table for Flood early Warning System

Sector: COASTAL ZONE								
Technology: Flood early Warning System								
Ambition	Detecting threatening events in advance to protect lives and properties in vulnerable coastal areas from flood and storm surge in Liberia							
Benefits	Reduce the level of casualty/ negative impact that could affect the coastal population							
Action	**Activities to be implemented**	**Sources of funding**	**Responsible body & focal point**	**Time frame**	**Risks**	**Success criteria**	**Indicators for Monitoring of implementation**	**Budget per activity ($US)**
Action: 1 **Prepare or identify laws/ legal policies or framework, actors, institutions and strategies to uphold FWS.**	***Activity 1.1*** Conduct a desk review of existing framework/ policies/ strategies of flood early warning system to incorporate the coastal zone.	GCF; CTCN; UNFCCC/UNEP/USAID; GOL	EPA	1 year	No available existing framework/ strategies for FWS	Availability of experts & technicians to review the existing strategy or develop a new one	FWS policy plan or strategy developed, accepted and instituted nationally	40,000.00
	Activity 1.2 Improve/ upgrade the existing FWS to an international standard & incorporate coastal monitoring.	GCF; GeF; UNFCCC/UNEP/ EU/ USAID; GOL	EPA, MME NDMA,	1-5 years	Limited funding for standardize equipment and operations	Potential available funding from climate change partners	Quantity of modern FWS equipment purchase and available in country	810,000.00
	Activity 1.3 Create and support local community groups in vulnerable coastal areas to uphold the FWS regulations. It is highly important that these groups consider gender inclusion.	GCF; GeF; CTCN; World Bank; UNFCCC/UNEP/ EU/ USAID; GOL	EPA, NDMA	10 years	Limited funding to support and sustain the groups	Willingness and availability of the vulnerable communities to participate	Establishment of 15 vulnerable coastal community groups with gender inclusion in flood vulnerable communities	1,500000.00
	Activity 1.4 Solicit the support of local vulnerable coastal community leaders to facilitate the adoption, transfer and diffusion of the FWS technology in vulnerable coastal communities across Liberia.	GCF; GeF; CTCN; World Bank; UNFCCC/UNEP/ EU/ USAID; GOL	EPA	1-2 years	Difficulties in bringing local stakeholders together for coordination.	Information dissemination and awareness conducted to have the local leaders understand and support the FWS	Full participation and collaboration of local vulnerable community leaders in the process;	500,000.00
Action: 2	***Activity 2.1***	GCF; GeF;	EPA	1-10	Difficulties to	FWS funding	Initial FWS funding/	850,000.00

Secure or establish a regular annual national budgetary allotment or international financial support to uphold the operations of the FWS technology.	Secure FWS funding or financial support from local and international partners that support climate change projects/ activities.	CTCN; World Bank; UNFCCC/UNEP/ EU/ USAID; GOL		years	secure national funding from GoL due to limited available funds	proposals are being developed for international support	projects proposals developed and accepted & first international partnership established	
	Activity 2.2 Invest in/ purchase high standard and quality FWS software and equipment to monitor, map and model coastal floods, inundations to safe guide livelihood activities.	GCF; GeF; CTCN; World Bank; UNFCCC/UNEP/ EU/ USAID; GOL	EPA, NDMA, MME	1-8 years	Non availability of quality FWS monitoring software and equipment in country	Standardize FWS software and equipment are available and identified internationally	Initial funds secured, and procurement of initial 20% of the equipment is achieved	4,565000.00
	Activity 2.3 Regularly create/ develop climate change adaptation / mitigation funding proposals for the FWS and submit them for support to the reputable climate change partners or funders.	GCF; GeF; CTCN; World Bank; UNFCCC/UNEP/ EU/ USAID; GOL	EPA	1-10 years	inadequate national experience to prepare international climate change funding proposals	Availability of experienced international experts to be hired	2 International experts / hired and first proposal is developed and ready for submission to climate change donors for acceptance	1,650000.00
Action 3: **Provide regular technical training / capacity building for FWS personnel at all levels (institution to local community).**	***Activity 3.1*** Provide both long and short terms technical training, internships for FWS personnel at institutional level.	GCF; GeF; CTCN; UNFCCC/UNEP/ EU/ USAID; GOL	EPA, NDMA,	8 years	Limited specialized national institutions and experts to conduct the training	Amount of secured funding opportunities & international partnership training institutions	6 FWS personnel trained between year 1 and 2 and are available to be deployed	1,520000.00
	Activity 3.2 Conduct capacity building in all local vulnerable coastal communities where the FWS technology will be installed.	CTCN; UNFCCC/UNEP/ EU/ USAID; GOL	EPA	5 years	Difficulties to fund & support the training activities	Number of training activities planned and targeted communities	12 vulnerable coastal communities trained in year 1	475,000.00
	Activity 3.3 Provide, support and increase FWS research projects/ activities to enable data collection.	GCF; GeF; UNFCCC/ EU/ USAID; GOL	EPA & FWS national committee	1- 8 years	Difficulties in securing funding to support research activities	Number of FWS research projects/ activities developed for funding	4 research projects / activities undertaken in year 1	700,000.00
	Activity 3.4 Establish a national FWS research/ scientific group /committee to facilitate the operations of the technology.	GCF; GeF; UNFCCC/UNEP/ USAID; GOL	EPA, NDMA	1-2 year	Limited national experts or technicians	6 available national experts identified	FWS national scientific research team established	350,000.00
Action 4:	***Activity 4.1***	GCF; GeF;	EPA	1-10	Difficulties in	Cross-sectoral	Successful	100,000.00

Develop, regulate and improve coordination and collaboration among FWS institutions and the concerned stakeholders.	Establish a regular quarterly cross-sectorial regulatory meetings and technical working sessions to ensure a proper collaboration and information sharing among FWS institutions and local community leaders.	CTCN; World Bank; UNFCCC/UNEP/ EU/ USAID; GOL		years	getting stakeholders together	collaboration & coordination strategy established	implementation of first quarter meeting/ working session in year one	
	Activity 4.2 Develop/ establish partnerships with overseas universities and research institutions engaged in coastal floods / risks related data collections, mapping, monitoring and modeling.	GCF; GeF; CTCN; World Bank; UNFCCC/UNEP/ EU/ USAID; GOL	EPA, NDMA	1-5 years	Difficulties to identify research institutions (FWS) & limited expertise to conduct FWS research.	Initial research institutions identified and first group of technicians trained for FWS research works	First partnership established and a research project has been approved and funding secured.	210,000.00
Action 5: **Provide and improve timely/ quick information sharing / awareness among the relevant institutions, stakeholders and the population at risk.**	***Activity 5.1*** Provide & support quick and timely information sharing to population at risk by direct text messages or by radio awareness for timely precaution.	GCF; GeF; CTCN; UNFCCC/UNEP/ EU/ USAID; GOL	EPA	10 years	Very poor communication services (network, internet) in rural areas	Funding secured to improve communication services in rural coastal areas	Network and communication services improved in all coastal vulnerable communities to adopt the FWS	102,000.00
	Activity 5.2 Create/ develop and support/ sustain FWS information platform or website.	GCF; GeF; CTCN; UNFCCC/ USAID; GOL	EPA	10 years	Limited funding access to maintain the platforms for a 10 year service	Availability of funding to develop the FWS information sharing platforms	FWS information sharing platform and networks services established	210,000.00
	Activity 5.3 Map and regularly update coastal flood risk areas and publish the results on the FWS platform.	GCF; CTCN; UNFCCC/UNEP/ EU/ USAID; GOL	EPA, NDMA	9 years	Irregular mapping activities and inadequate up to date service	Amount of active mapping projects/ activities	Number activities results published on the FWS website/ platform regularly	200,000.00
	Activity 5.4 Produce annual report for stakeholders and decision-makers on the state of the coast highlighting on-going research, key activities, changes and challenges.	GCF; GeF; CTCN; UNFCCC/UNEP/ EU/ USAID; GOL	EPA, NDMA	10 years	Irregularity in reporting	Mechanism established to support annual report	Successful regular quarterly reports submitted in year 1	100,000.00

1.1.4. Action plan for technology 3: Rocks' Revetments

1.1.4.1. Introduction

The Rocks revetment is a sloped seaward structure of hard engineering option of coastal defense that protects against erosion caused by wave action, storm surge and tidal effects. It is often built with boulders (rocks), concrete or other durable materials to protect a scarp, shoreline, embankment or sand dune against erosion (UNFCCC, 1999). It minimizes the destructive and hazardous risks to coastal ecosystem, vegetation, sand dunes and important infrastructures. It is in this regard that the technology is targeted for the most high risk and vulnerable cities/ communities with alarming and destructive impacts of coastal erosions that require a quick fix alternative/ solution in Liberia. The TNA project targets to have the revetment technology adopted within the most high risks and vulnerable coastal erosion affected cities in Liberia.

Some benefits of the technology:

- Revetments that are in continuous contact with the water promote the formation of coral reefs and attract many coastal species. This option of coastal defence helps to stabilize the beach environment and in general, reduces coastal vulnerability to climate change impacts.
- It also protects lives, properties and the shoreline from coastal erosion and flooding impacts.

1.1.4.2. Ambition for the TAP on Rock Revetments

The ambition for the TAP with respect to the Revetments aims to have the rocks' revetments adopted, transferred and diffused across all highly vulnerable coastal areas that required a "quick fix" alternative. This process should involve the local community leaders and in so doing, technical capacity building for the engineers and technicians should be carried out.

1.1.4.3. Actions and Activities selected for inclusion in the TAP for Revetments

a) Summary of barriers and measures to overcome barriers

Table 18 below summarizes the identified barriers and measures to meet the ambition set for the deployment/ transfer and diffusion of rocks revetment. These barriers and measures were derived from the TNA *Barrier Analysis and Enabling Framework*.

Table 18: Summary of the identified barriers and measures to overcome the barriers: Revetments

Categories	Measures to overcome barriers
Economic and Financial	• To overcome the high cost of revetment construction and that of the periodic maintenance, a regular annual national budgetary support/ allotment should be secured for the implementation and maintenance of rock revetments in vulnerable coastal communities. • To overcome the inadequate / limited access to funding resources, develop a comprehensive funding proposal that meets international climate change adaptation funding requirements in order to have access to such funding. A partnership could also be created with external organizations the support climate change projects through funding, technical training and etc.
Social, Gender and Behavioral	• To overcome the potential loss of cultural and heritage sites, avoid possible damage of them and most importantly, negotiate with local residents for possible applicable and acceptable suggestions or solutions; • In order to overcome the loss of landing sites for fishermen's canoes and boats, create access / pathway to the

	beach through the revetment during the design stage to avoid disruption of regular livelihood activities. • To overcome the barrier of disruption or change of livelihood for vulnerable groups such as the fish mongers, create and provide alternative livelihood such as eco-friendly drying facilities and storages for vulnerable fish mongers (women & disables);
Information and Awareness	To overcome the limited and inadequate information and awareness of the technology to vulnerable coastal communities, provide and improve awareness of the technology through a detailed community involvement. Create community-based action groups and promote the acceptance of the project by relevant group leaders and end-users.
Technical	• In order to overcome the barrier of limited available data, provide and increase funding for research and data collection; • To overcome the lack and inadequate human skills and institutional ability, provide adequate capacity building training at institutional and individual level. This will allow the personnel to improve their skills to fully implement and operate the technology. It is highly recommended that the trainings should be conducted by institutions and experts that have acceptable relevant expertise in implementing the technology.
Environmental	• To overcome the loss of a beach front to the technology's implementation, create or provide recreational activities or infrastructures such as a volleyball court on the sand at the back of the revetment, landward; • In order to overcome the physical environmental damage of the landscape used for a quarry, convert the abandoned quarry sites / pits into touristic sites or recreational parks. For examples, the abandoned pit could be converted into a fishpond;
Legal & Regulatory	To overcome the limited enforcement of zoning laws and building codes in vulnerable coastal areas, fully enforce the existing zoning laws and building codes in coastal areas to avoid the constructions of private properties on public beaches and owning of those public beaches, and converting them for private use. This will facilitate the smooth implementation and diffusion of revetment.
Market Condition	To overcome the inadequate and limited specialized equipment and materials being available in country, promote and increase funding for the procurement of appropriate specialized equipment for the implementation and construction of rocks' revetments. Also, encourage and facilitate the creation of such business/ market in country to reduce the cost of implementation.
Others	To overcome some of the others barriers, it is important and recommended to solicit political will /support by taking politicians to see the damages/ impacts to help facilitate a smooth implementation, adoption and diffusion of the technology.

Source: Compiled from Liberia's TNA Coastal Report II (BA&EF)

b) <u>Actions selected for inclusion in the TAP for Rocks' Revetments</u>

This section provides a list of narrative descriptions and considerable arguments for each of the measures selected as actions to be included in the TAP for the rock's revetment. The selected measures considered below as actions took into consideration the economic and financial benefits/ potentials which have been identified from the TNA *Report II, BA&EF*.

i. Strengthen and enforce the existing zoning laws and building codes in coastal areas to avoid the constructions of private properties on public beaches and the owning of those beaches, and converting them for private use.

This will facilitate the smooth implementation and diffusion of revetments in vulnerable coastal areas as there is no specific limit or demarcation for private construction between the beach and land. It shall also improve the limited enforcement of zoning laws and building codes.

ii. Secure a regular annual national budgetary support/ allotment for the implementation and maintenance of rocks revetment in vulnerable coastal communities. Stakeholders also recommended the development of international climate change funding proposals. In so doing, partnerships should as well be created with external

organizations that support climate change projects through funding, technical training/ capacity building and etc.

Having this in place will significantly reduce the inadequate / limited access to funding resources by addressing the high cost of revetment construction and that of the periodic maintenance.

iii. Provide adequate capacity building training at both institutional and individual level for technicians in order to improve their skills and to address the issues of limited and inadequate human skills and institutional ability. The recommended actions to address the barrier of limited availability of quality data were to provide and increase funding for research and data collection.

iv. Provide and improve knowledge, awareness and information sharing of the technology (revetment) to the end-users through a detailed community involvement process.

Also, create community-based action groups and promote the acceptance of the project/ technology by relevant group leaders and end-users while considering gender participation.

This action will promote a general acceptance of the technology's implementation and diffusion.

v. To address the loss of a beach front to the technology's (revetment) implementation, it was recommended by stakeholders in the technical working session to create or provide recreational activities or infrastructures such as a volleyball court on the sand at the back of the revetment, landward.

In so doing, to address the issue of physical environmental damage of the landscape used for a quarry, it was recommended to convert the abandoned quarry sites / pits into touristic sites or recreational parks. For examples, the abandoned pit could be converted into a fishpond. *Table 19* summarizes the critical actions selected for inclusion in the TAP for the Rocks Revetment.

Table 19: Actions selected for inclusion in the TAP for the Revetment technology

Barrier category	**Action selected for TAP**
Legal and Regulatory	MPW should strengthen and enforce the existing zoning laws and building codes in coastal areas to avoid the constructions of private properties on public beaches and owning of those public beaches, and converting them for private use.
Economic and Financial	▪ MME should secure a regular annual national budgetary support/ allotment for the implementation and maintenance of rock revetments in vulnerable coastal communities. ▪ It was also recommended by the stakeholders that comprehensive funding proposals that meet international climate change adaptation funding requirements be developed by MME and EPA in order to have access to such funding from GCF, GeF and others. ▪ Partnerships should be created by MME with external organizations that support climate change projects through funding, technical training/ capacity building and etc.
Technical	▪ MME should provide adequate capacity building training at both institutional and individual level for technicians in order to improve their skills and address the issue of limited and inadequate human skills and institutional ability. ▪ MME should provide and increase funding for research and data collection to address the barrier of limited availability of quality data

Information and Awareness	▪ MME & EPA to provide and improve knowledge, awareness and information sharing of the technology (revetment) to the end-users through a detailed community involvement process. ▪ MME to create community-based action groups and promote the acceptance of the project/ technology by relevant group leaders and end-users while considering gender inclusion.
Environmental	▪ To address the loss of a beach front to the technology's (revetment) implementation, GoL Youth and sport should create or provide recreational activities or infrastructures such as a volleyball court on the sand at the back of the revetment, landward. ▪ In so doing, to address the issue or concern of the physical environmental damage of the landscape used for a quarry, GoL should convert the abandoned quarry sites / pits into touristic sites or recreational parks. For examples, the abandoned pit could be converted into a fishpond.

c) Activities identified for implementation of selected actions

Table 20 below presents a detailed list of Activities that are needed to be implanted to make each of the identified Actions work. The above identified Actions are expended into more specific Activities for implementation.

Table 20: Activities identify for the realization/ adoption of rocks' revetments

Actions identified	Activities to make the actions work
Action 1: Strengthen and enforce the existing zoning laws and building codes in coastal areas (along the beaches);	1.1. MPW & LLA to conduct a desk review of the existing zoning laws and building codes; if applicable, strengthen to avoid the construction of private / residential building along and very close to the beach. 1.2. MPW & LLA to give a specific demarcation / limit in length from the shore (beach sand) where all residential construction must stop.
Action 2: Secure or establish a regular annual national budgetary allotment or international financial support to facilitate the construction, transfer and diffusion of revetments nationally.	2.1. MME should regularly develop project/ funding proposals that meet international climate change adaptation funding requirements to have access to such funding of GeF, GCF and others for the construction and maintenance of rocks' revetments; 2.2. MME to Invest in/ purchase revetments construction equipment & materials; 2.3. MME & EPA should create / enhance partnership with climate change adaptation and mitigation support agencies to minimize the high cost of revetment construction;
Action 3: Provide regular technical training / capacity building at both institutional and individual level to develop, increase or improve the national expertise of rocks' revetments / coastal defense construction;	3.1. MME, MPW & EPA should train engineers and technicians on how to conduct feasibility studies for revetment design and construction; 3.2. MME to establish or enhance partnerships with overseas coastal and marine universities and research institutions engaged in coastal erosion risks related data collections, mapping, monitoring and modeling to provide both long and short terms technical trainings and internships for personnel; 3.3. MME to conduct capacity building training on the safe guide, management and sustainability actions or activities in all local vulnerable coastal communities where the revetments will be constructed; 3.4. MME should provide, support and increase revetment research projects/ activities to enable data collection.
Action 4: Promote the awareness and acceptance of the technology by the end-users;	4.1. MME to provide and improve knowledge, awareness and information sharing about the rocks' revetment to the end-users through a detailed community involvement process. 4.2. MME should create community-based action groups and promote/ encourage the acceptance of the project/ technology by relevant group leaders and end-users while considering gender inclusion.

Source: Developed from Liberia's *TNA Coastal Report II (BA&EF)*

d) Actions to be implemented as Project Ideas

All the above selected Actions for the rocks revetment are inter-related and complement each other for implementation. The four technically selected Actions aim to create an enabling

environment for the successful adoption, transfer and diffusion of the Revetment. They are important for the Project's Idea and should all be considered to avoid further barriers.

1.1.4.4. Stakeholders and Timeline for implementation of TAP for Rocks' Revetments

a) Overview of Stakeholders for the implementation of the TAP

This section describes the main stakeholders identified and their roles as required for each of the Actions to be implemented. As such, detailed in *Table 21* below are the identified key stakeholders with their associated roles.

Table 21: Key Stakeholders and their roles for the implementation of Flood early warning System's TAP

Key Stakeholder	Role
Ministry of Mines and Energy (MME)	▪ Lead; focal point for revetments implementation; ▪ With the support of the EPA / MFDP, purchase/ invest in revetment construction equipment and research software to monitor, map and model coastal erosion activities and propose best revetment designs; ▪ Give a specific demarcation / limit in length from the shore (beach sand) where all residential construction must stop. ▪ In collaboration with the EPA, regularly develop project/ funding proposals that meet international climate change adaptation funding requirements to have access to such funding for the construction and maintenance of rocks' revetments; ▪ Conduct capacity building training on the safe guide, management and sustainability actions or activities in all local vulnerable coastal communities where the revetments will be constructed; ▪ In partnership with the EPA, provide, support and increase revetment research projects/ activities to enable data collection; ▪ In collaboration with the EPA, create community-based action groups and promote/ encourage the acceptance of the technology by the end-users while considering gender inclusion.
Ministry of Public Works (MPW)	▪ In collaboration with the MME, provide and improve knowledge, awareness and information about the rocks' revetment to the end-users through a detailed community involvement process; ▪ Conduct desk review of existing zoning laws and building codes to incorporate the coastal zone if applicable.
Environmental Protection Agency of Liberia (EPA)	▪ Create / enhance partnership with climate change adaptation and mitigation support agencies to facilitate the high cost of revetment construction in collaboration with MME; ▪ In collaboration with the MME, lobby/secure international funding for coastal defense projects.
Ministry of Finance, Development and Planning (MFDP)	▪ Secure in collaboration with MME annual national budgetary allotment and or international funding for sustainability of revetments. ▪ Monitor project implementation and accountability of funds.

b) Scheduling and sequencing of specific activities

Table 22 below describes the scheduling and sequencing of those specific activities to be undertaken in order to achieve the selected actions for the TAP of the Rocks' Revetment.

Table 22: Scheduling and sequencing of specific activities for the TAP of Rock Revetments

Action	Activity	Timeframe (Planning & implementation)										Responsible body
		Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	
Strengthen and enforce the existing zoning laws and building codes in coastal areas	Conduct desk review of existing zoning laws and building codes; if applicable, strengthen to avoid the construction of private / residential building very close to the beach.											MME, EPA
	Indicate/ give a specific demarcation / limit in length from the shore (beach sand) where all											MME, EPA

	residential construction must stop.											
Secure or establish a regular annual national budgetary allotment or international financial support to facilitate the construction, transfer and diffusion of revetments nationally;	Regularly develop project/ funding proposals that meet international climate change adaptation funding requirements to have access to such funding for the construction and maintenance of rocks' revetments;											MME, EPA
	Invest in/ purchase revetments specialized construction equipment and materials;											MME
	Create / enhance partnership with climate change adaptation and mitigation supports to minimize the high cost of revetment construction;											EPA, MME
Provide regular technical training / capacity building at both institutional and individual level to increase and improve the expertise of rocks' revetments construction;	Train engineers and technicians on how to conduct feasibility studies, revetment design & construction											MME, EPA
	Establish or enhance partnerships with overseas coastal and marine universities / institutions to provide long & short term technical training											EPA, MME
	Conduct capacity building training on the safe guide, management and sustainability activities in all local vulnerable communities where revetments will be constructed;											MME
	Provide, support and increase revetment research projects/ activities for data collection.											EPA, MME
Promote the awareness and acceptance of the technology by the end-users;	Provide and improve knowledge, awareness and information sharing about the rocks' revetment to the end-users through a detailed community involvement process.											EPA, MME
	Create, support and sustain community-based action groups and promote the acceptance of the revetment by end-users											EPA, MME

1.1.4.5. Estimation of Resources Needed for Actions and Activities

a) <u>Estimation of capacity building needs</u>

Revetment construction requires a high level of expertise with respect to coastal and marine engineering in order to provide the best possible design options in a specific location. Therefore, the national technical expertise is required for its successful implementation. It is in connection to said requirement that *Action 3* and its associated *Activities* call for the need of capacity building for personnel who shall uphold the activities for the implementation of Rock Revetments. Said capacity building should be long and short term training which should be conducted continuously throughout the duration envisioned for the TAP, from the technology's adoption to 2031 at which time a needs assessment is recommended.

b) Estimations of costs of actions and activities

Table 23 below gives the estimated cost for 2 years of construction and maintenance for about 700 linear meters rocks revetment in and around the Monrovia areas. This estimated cost and duration depend on many factors and could vary considering the location of construction, distance of the quarry from the construction site, price of the rocks (per m^3), rental price of ideal equipment and materials and activities leading to the construction such as data collection, feasibility studies and readiness.

Table 23: Estimated cost of action and activities for the construction of about 700m revetment

Activity	Estimated Costs ($USD)	Source of funds	Justification
Conduct desk review of existing zoning laws and building codes; if applicable, strengthen to avoid the construction of private / residential building along and very close to the beach.	40,000.00	GOL/ UNEP UNFCCC/ CTCN/	Gap assessment and regulatory enhancement
Indicate/ give a specific demarcation / limit in length from the shore (beach sand) where all residential construction must stop.	15,000.00	GEF; UNEP/ GoL/UNFCCC	To facility and implement policy and regulation
Regularly develop project/ funding proposals that meet international climate change adaptation funding requirements to have access to such funding	600,000.00	GEF; CTCN; UNFCCC/ /UNEP/ GOL	To support implementation and operational activities
Invest in/ purchase revetments specialized construction equipment and materials;	3,143900.00	GCF/UNFCCC/GeF / GOL	For technical implementation/ construction of revetment
Create/ enhance partnership with climate change adaptation and mitigation support to minimize the high cost of revetment construction;	64,000.00	GOL, GCF; World Bank, UNFCCC	To support implementation and operational activities
Train engineers and technicians on how to conduct feasibility studies, design and construct revetment	800,000.00	GOL; UNEP World Bank; UNFCCC/GeF	For technical implementation and sustainability of the technology and its activities
Establish or enhance partnerships with overseas coastal and marine universities / institutions to provide long & short term technical trainings for personnel.	300,000.00	GEF; UNEP/ UNFCCC/ GCF/ EU	To increase partnership for technical capacity building and knowledge sharing
Conduct capacity building training on the safe guard, management and sustainability activities in all local vulnerable communities where revetments will be constructed;	150,000.00	UNFCCC/UNEP/EU/USAID, GOL	Community empowerment and capacity building on safe guard and resilience
Provide, support and increase revetment research projects/ activities for data collection.	825,000.00	GCF; UNEP UNFCCC/GoL /UNDP/EU/	To support and facility data collection, research and monitoring
Provide and improve knowledge, awareness and information sharing about the rocks' revetment to the end-users through a detailed community involvement process.	32,000.00	UNEP/ GOL UNFCCC/ EU	To promote vulnerable coastal communities involvement, information sharing and gender inclusion
Create, support and sustain community-based action groups and promote the acceptance of the technology by relevant group leaders and end-users while considering gender inclusion.	30,000.00	GOL/ UNEP/ UNFCCC/EU	
Total	**5,999.00**		

1.1.4.6. Management Planning

a) Risks and Contingency Planning

Table 24 below provides an overview of the main identified risks and the contingency plan for the successful implementation of the TAP for the rocks Revetment.

Table 24: Risk and Contingency plan for the TAP of Rocks' Revetments

Risk	Level	Contingency plan
Inadequate enforcement of zoning laws / building code in coastal communities/ areas.	Medium	▪ If needed/ applicable, strengthen the existing zoning laws / building code to capture coastal management regulations; ▪ Create community action groups to enforce / uphold the regulations of the zoning laws / building code in vulnerable coastal areas;
High cost of construction; no national budgetary allotment / support; and limited access to funding for the implementation of Revetment projects.	High	▪ Secure a regular national budgetary allotment to support the implementation of Rocks' Revetments and associated activities; ▪ Develop comprehensive funding/ project proposals that meet international climate change adaptation/ mitigation funding requirements for support; ▪ Created/ enhance partnerships with external organizations that support climate change adaptation projects through funding, technical training and etc.
Very limited/ inadequate national technical expertise and institutional ability or capacity to construct a standard rocks' revetment;	High	▪ Provide and support adequate capacity building training programs for revetment construction; ▪ The training should be both short and long term and must be conducted by institutions and experts with a successfully and historic experience in revetments' construction;
Limited & inadequate information and awareness of the technology to coastal communities	Medium	Provide and improve knowledge, awareness and information sharing about the rocks' revetment to the end-users through a direct and detailed community involvement process (workshops, community meetings, radio programs, etc.) to promote/ encourage community ownership and sustainability.

b) Next steps

Immediate requirements to proceed:

- Identify the highly vulnerable/ affected coastal communities from the impacts of coastal erosion for immediate intervention;
- The lead ministry, MME in collaboration with the EPA should constitute a specific team that will immediately commence developing project/ funding proposals to the GCF, GeF and others to implement revetments along the identified vulnerable shorelines.
- Identify the few existing national coastal experts/ technicians to conduct/ implement technical works; and also commence developing the capacity of more technicians;
- The project manager along with the relevant parties should refine and develop a plan that will allow the TAP to be achieved in accordance with a developed budget line.

Critical steps:

None of the activities proposed in the TAP can be implemented without financial resources. Therefore, a critical step is to secure funding to support the adoption and implementation of the revetments. As such, commence regular technical capacity building for construction and sustainability. In so doing, ensure the acceptance and support of the project by the end-users.

1.1.4.7. TAP overview table for Rocks' Revetment

The overview of the Technology Action Plan (TAP) for the Rocks' Revetments is given in *table 25* below:

Table 25: TAP overview table for Rocks' Revetments

Sector: COASTAL ZONE								
Technology: Revetment								
Ambition	To adopt revetments in highly vulnerable coastal areas to protect lives, properties & the shoreline from coastal erosion and flooding impacts.							
Benefits	Protection of lives, properties and coastal environments. Creation of jobs; Serve as breeding place for many coastal organisms/ species;							
Action	**Activities to be implemented**	**Sources of funding**	**Responsible body & focal point**	**Time frame**	**Risks**	**Success criteria**	**Indicators for Monitoring of implementation**	**Budget / activity ($US)**
Action 1: **Strengthen and enforce the existing zoning laws and building codes in coastal areas (along the beaches);**	***Activity 1.1:*** Conduct desk review of existing zoning laws and building codes; if applicable, strengthen to avoid the construction of private / residential building along and very close to the beach.	GCF; GeF; CTCN; UNFCCC/ UNEP; GOL	MME	1 year	Limited collaboration & delay in completing the review;	Experts / consultants hired; technical review team/ committee established;	First draft report submitted for inputs/ comments and etc.	40,000.00
	Activity 1.2: Indicate/ give a specific demarcation / limit in length from the shore (beach sand) where all residential construction must stop.	GCF; GeF; CTCN; GOL	MPW; MME	1 year	Many private structures already constructed along beaches	Demarcation defined and excepted;	First information and awareness campaign on construction limit conducted in five vulnerable coastal areas	15,000.00
Action 2: **Secure or establish a regular annual national budgetary allotment or international financial support to facilitate the**	***Activity 2.1:*** Regularly develop project/ funding proposals that meet international climate change adaptation funding requirements to have access to such funding for the construction and maintenance of rocks' revetments;	GCF; GeF; CTCN; World Bank; UNFCCC/ UNEP/ EU/	EPA; MME	1-10 years	Inadequate data to justify climate change impacts; inadequate expertise to develop proposals	Two revetments funding/ project proposals developed & submitted for international support;	One project proposal accepted to construct 250 meters revetment; an international partnership established for support and capacity building;	600,000.00
	Activity 2.2: Invest in/ purchase revetments specialized construction equipment and materials;	GCF; GeF; UNFCCC/ UNEP/ EU/ USAID; GOL	MME; MPW	1-3 years	Non specialize revetment construction equipment in country;	Standardize revetment equipment identified and available internationally;	Procurement of initial long reach excavators and five thousand meters long geotextiles completed;	3,143900.00
	Activity 2.3:	GCF; GeF;	MME;	1-10	Difficulties in	First partnership treaty	First draft report	64,000.0

construction, transfer and diffusion of revetments nationally;	Create / enhance partnership with climate change adaptation and mitigation supports to minimize the high cost of revetment construction;	CTCN; UNFCCC/ UNEP/ EU/ GOL	EPA	years	establishing partnership with international agencies;	discussion/ meeting held;	completed on the first discussion;	0
Action 3: **Provide regular technical training / capacity building at both institutional and individual level to increase and improve the expertise of rocks' revetments / coastal defence construction;**	***Activity 3.1:*** Train engineers and technicians on how to conduct feasibility studies, revetment design & construction	GCF; GeF; UNFCCC/ UNEP/EU/ GOL	MME	5 years	Limited national experts and institutions to conduct training;	External /international institution identified to train initial 10 personnel;	Funding secured and agreement (MOU) signed for the personnel to travel;	800,000.00
	Activity 3.2: Establish or enhance partnerships with overseas coastal and marine universities / institutions to provide long & short term technical trainings for personnel.	GCF; GeF; UNFCCC/ UNEP/ EU/ USAID; GOL	MME; EPA	1- 8 years	Difficulties to fund & support the training and research activities;	A partnership established and a funding proposal developed for training of personnel;	Agreement (MOU) signed, and two personnel awarded research training for one year abroad;	300,000.00
	Activity 3.3: Conduct capacity building training on the safe guide, management and sustainability activities in all local vulnerable communities where revetments will be constructed;	GCF; GeF; UNFCCC/ UNEP/ EU/ USAID; GOL	MME	1-2 year	Limited national funding to support the trainings;	A national funding proposal developed and submitted;	Training plan and activities developed; and the first community to be trained is identified;	150,000.00
	Activity 3.4: Provide, support and increase revetment research projects/ activities for data collection.	GCF; GeF; UNFCCC/ UNEP/GoL USAID;	MME; EPA	2 year	Limited funds and inadequate national expertise;	Two national experts identified;	A national coastal research team established;	825,000.00
Action 4: **Promote the awareness and acceptance of the technology by the end-users;**	***Activity: 4.1:*** Provide and improve knowledge, awareness and information sharing about the rocks' revetment to the end-users through a detailed community involvement process.	GCF; GeF; UNFCCC/ UNEP/ EU/ USAID; GOL	MME; EPA	1 year	Difficulties in getting the end-users together for discussions;	Coordination strategy established by incentivising meetings with the local end-users;	Information, awareness & knowledge sharing session on revetments benefits conducted with the end-users;	32,000.00
	Activity 4.2: Create, support and sustain community-based action groups and promote the acceptance of the technology by relevant group leaders and end-users while considering gender inclusion.	GCF; GeF; UNFCCC/ UNEP/ EU/ USAID; GOL	EPA	1 year	Limited financial support to sustain/ uphold the community action groups;	Overwarming willingness of vulnerable community residents to form part of the action group;	Two meetings held and the 10 members for the establishment of 2 community action groups selected;	30,000.00

1.2. Project Ideas for the Coastal Zone Sector

1.2.1. Brief summary of the Project Ideas for the Coastal Zone Sector

The Technology Action Plans and Project Ideas developed in this report were carefully designed by the coastal zone technical working group with specific Actions and Activities that are interrelated and if applied as indicated, will together contribute to the successful adoption, implementation and diffusion of the proposed technologies through their Project Ideas. In so doing, the following PIs presented herein for the coastal zone sector were identified and retained due to their potential socio-economic, environmental management and climate change adaptation or mitigation benefits they stand to provide while protecting lives and properties in vulnerable coastal areas. As such, the proposed PIs are listed below:

1) *Formulation of an ICZM policy framework/ plan for Liberia's ICZM.*
2) *Installation of FWS within the Bushrod Island area, near Monrovia".*
3) *Construction of Rocks' Revetment along the coast of Mississippi Street in Sinoe County to protect the highly vulnerable lives and properties therein from the impacts of Climate Change coastal erosion and flooding.*

1.2.2. Specific Project Ideas for the Coastal Zone sector

Listed below and summarized in *tables 26, 27 and 28* are the details of the specific Project Ideas identified and retained by the technical working group on Liberia's coastal zone sector.

1.2.2.1. Project Idea 1:

Summarized in *table 26* below is the Project idea 1; *"Formulation of an Integrated Coastal Zone Management policy framework/ plan for Liberia".*

Table 26: Project Idea 1: "*Formulation of an Integrated Coastal Zone Management policy framework/ plan for Liberia's ICZM".*

Introduction/ Background	The coastal zone is one of the nation's greatest environmental and economic assets of Liberia. However, the evolution of coastline variations is considered as one of the most dynamic processes affecting this area. Currently in Liberia, the coastal zone is faced with the following climate change impacts: coastal erosion, coastal flooding and marine/ saline intrusion into fresh drinking waters. Climate Change impacts have become a national concern as they are disrupting livelihood activities and destroying properties, coastal ecosystems, socio-economic activities in majority of Liberia´s coastal areas. To therefore address these climate change impacts, the ICZM was prioritized as a cross-cutting (adaptation & mitigation) technology to be adopted, transferred and diffused nationally. In so doing, the lack of legal and regulatory policy framework/ plan was one of the main barriers for its implementation. Therefore, this project idea aims at formulating an Integrated Coastal Zone Management (ICZM) policy framework/ plan for Liberia's coastal zone.
Objectives	The objective of this PI is the formulation of an Integrated Coastal Zone Management policy framework/ plans for its adoption, transfer and diffusion to enable a proper and sustainable management of the coastal zone of Liberia.
Outputs	1. Bibliographic analysis of relevant policies and legal instruments governing the utilization and management of the resources in Coastal Zones; 2. Overview of the coastal zone and diversity of resources and their socio-economic importance; 3. Five-days workshops to define the framework policy´s vision, mission, policy objectives and guiding principle;

	4. Specific policy statements addressing issues on integrated planning and coordination of coastal development, community empowerment and resource use conflicts, environmental conservation, management of environmental risks, awareness creation and education; 5. Official review of the first drafts conducted and revised ICZM framework finalized; 6. Implementation of a framework guide;
Relationship to the country's sustainable development priorities;	Climate change adaptation and mitigation of the coastal zone are key priorities of the government of Liberia. Some national sustainable development priority documents in this regard are a) Liberia's Intended Nationally Determined Contribution (INDC, 2015); b) National Disaster Management Policy of Liberia (NDMP, 2012); c) The Pro-Poor Agenda for Prosperity and Development (PAPD, 2017);
Project Deliverables e.g. Value/ Benefits/ Messages	• Promote integrated planning and coordination of coastal developments across the various sectors. • Manage environmental risks associated with changes in shoreline and climate. • Conserve the coastal and marine resources and environment for sustainable development. • Promote sustainable economic development to secure livelihoods of coastal communities; • Develop capacity in research and education and enhance stakeholder awareness and participation in sustainable resource management. • Establish effective institutional and legal frameworks for implementation of the ICZM policy. • Promote climate change adaptation and mitigation in coastal areas;
Project Scope and Possible Implementation	The project intends to cover national level in terms of policy/ regulation for the sustainable management of the coastal zone. It also aims at soliciting the involvement/ participation of vulnerable coastal communities across the country by means of establishing coastal community action groups to enable the smooth adoption, transfer and diffusion of the ICZM policies.
Project Activities	1. Identification of barriers, lack of instruments, opportunities and challenges; 2. Map relevant stakeholders and establish a Steering Committee; 3. Conduct an inception meeting; define the policy objectives through a workshop; 4. Identify major coastal zone issues and challenges that the policy will seek to address; 5. Prioritization of major coastal issues and challenging through a participative process; 6. Define the framework policy vision and mission (1 or 2 days – open to all stakeholders); 7. Formulate a draft of framework policy based on the inputs received during the 5-days workshops; 8. Policy Statement on Integrated Planning and Coordination; 9. Policy Statement on Sustainable Economic Development and Environmental Risk Management; 10. Policy Statement for the Conservation of Mangroves and the Coastal and Marine Environment; 11. Policy Statement on Capacity Building, Education, Awareness and Research; 12. Conduct official review of the draft ICWM policy/ framework;
Timelines	The project is envisioned to be implemented within 3 years.
Budget/ Resource requirements	1. The budget would be about USD 550,000 and this would need to be funded through a project grant either from GeF, CTCN, and GCF; although in-kind co-funding and involvement of staff could be provided from the government of Liberia; 2. The project would be coordinated by the Ministry of Mines and Energy (MME) and the Environmental Protection Agency of Liberia (EPA) but some activities could be subcontracted to local NGOs or consultants (e.g. training programs, data collection and etc.);
Measurement/ Evaluation	The successes or the achievement of this project activities can be measured by: 1. The different reports of the indicated activities, 2. The establishment of the steering committee, 3. Identification of the relevant stakeholders; 4. Inception workshop report; 5. First draft of the policy document and etc.
Possible Complications /Challenges	1. Limited and inadequate national expertise to develop, implement and sustain the project; 2. Difficulties in accessing funds to support the project; 3. Inadequate institutional coordination / corporation;
Responsibilities and Coordination	Statutorily, the ministry of mines and energy (MME) will lead the implementation of this project. The MME shall held the implementation and collaborate with other government line-institutions and agencies such as the EPA, NDMA and MPW whose function and responsibilities are indicated in the TAP overview table for ICZM.

1.2.2.2. Project Idea 2:

Summarized in *table 27* below are the details of Project Idea 2, *"Construction/ Installation of Flood Early Warning System (FWS) in the Bushrod Island area, near Monrovia".*

Table 27: Project Idea 2 for Liberia's Coastal Zone

Introduction/ Background	In Liberia, climate change impacts are visible and mostly demonstrated through extreme weather events such as long period of coastal rain fall that leads to flooding in many coastal communities in Liberia. Hence, many of the communities remain vulnerable to flooding as livelihood activities are being disrupted while leaving more than thousands of families homeless and dozens of children, disable and elderly people dead nationally on a yearly basis. To therefore address the problem, the Flood Early Warning System has been prioritized and retained as the preferable adaptation technology to the problem and is hereby recommended to be implemented in and around the Bushrod Island area near Monrovia.
Objectives	To detect threatening events in advance to protect lives, properties and livelihood activities in vulnerable coastal areas from flooding and storm surge impacts.
Outputs	1. Flood vulnerability assessment, and topographic map and assessment; 2. Feasibility study and rainfall data collection for construction of the FWS; 3. Identification of suitable and up to date standard Flood early Warning System; 4. Construction/ implementation and maintenance plan; 5. List of required materials and equipment;
Relationship to the country's sustainable development priorities;	Climate change adaptation and mitigation of the coastal zone are key priorities of the government of Liberia. Some national sustainable development priority documents in this regard are a) Liberia's Intended Nationally Determined Contribution (INDC, 2015); b) National Disaster Management Policy of Liberia (NDMP, 2012); c) The Pro-Poor Agenda for Prosperity and Development (PAPD, 2017);
Project Deliverables e.g. Value/ Benefits/ Messages	• Manage environmental risks associated with climate change. • Detecting threatening events in advance to protect lives and properties; • Promote climate change adaptation measures to flooding; • Promote sustainable development to secure livelihoods of coastal communities; • Creation of jobs; • Develop capacity building and improve knowledge in flood management;
Project Scope and Possible Implementation	The project intends to cover/ protect the entire Bushrod Island area which includes more than 15 communities with more the 8000 homes. The recommended location hosts some of the largest businesses in the country and could be considered as the nation's industrial zone.
Project Activities	1. Community awareness and stakeholders engagement and consultations; 2. Secure funding for implementation; 3. Identification of national expertise for the implementation and maintenance; 4. Assessment and identification of an ideal location for its installation/ construction; 5. Identification of possible barriers, challenges, 6. Establishment of a community action group to sustain the project
Timelines	The project is envisioned to be implemented within about 3 years.
Budget/ Resource requirements	1. The budget would be about USD 2.5 million and this would need to be funded through a project grant either from GeF, CTCN, GCF and World Bank; although in-kind co-funding and involvement of staff could be provided from the government of Liberia; 2. The project would be headed by the Environmental Protection Agency of Liberia (EPA) while collaborating with the National Disaster Management Agency of Liberia (NDMA) but some activities could be subcontracted to local NGOs or consultants (e.g. Installation, training programs, data collection and etc.);

Measurement/ Evaluation	The successes or the achievement of this project activities can be measured by: 1. Availability of funds for implementation; 2. Completion of feasibility study and the availability of historic rainfall data; 3. Identification of the required expertise; 4. Identification and accessibility of the ideal site for installation/ construction;
Possible Complications /Challenges	1. Difficulties in accessing funds to implement and sustain the project; 2. Lack of policy framework for the technology; 3. Limited and inadequate national technical expertise to implement the project; 4. Inadequate institutional coordination / corporation on implementation;
Responsibilities and Coordination	Statutorily, the Environmental Protection Agency of Liberia (EPA) will lead the implementation for the construction / installation of the Flood early Warning System. In so doing, the EPA will then collaborate with the NDMA and other government line- ministries, institutions and agencies as required by their mandates.

1.2.2.3. Project Idea 3:

Summarized in *table 28* below is Project idea 3: *"Construction of Rocks' Revetment along the beach side of Mississippi Street in Sinoe County to protect the highly vulnerable lives and properties therein from the ongoing impacts of Climate Change coastal erosion and flooding".*

Table 28: Project Idea 3: "Construction of Rocks' Revetment along the beach side of Mississippi Street in Sinoe County".

Introduction/ Background	The coastal zone is one of Liberia's greatest environmental and economic assets; however, Sinoe County located along the southeastern coast is currently vulnerable to climate change impacts of coastal erosion, coastal flooding and marine/ saline intrusion into fresh drinking waters. Hence, livelihoods activities are being disrupted. To address the problem, the rock revetments which have been prioritized and retained as the second coastal zone adaptation technologies is hereby recommended as a Project Idea to be implemented in Greenville, Sinoe County.
Objectives	To protect lives, properties and the shoreline from coastal erosion and flooding impacts in order to minimize the disruption of livelihood activities.
Outputs	1. Coastal vulnerability and risk study in the county; 2. Feasibility study and data collection for construction of rock revetment; 3. A suitable rock revetment design for the location; 4. Construction/ implementation and maintenance plan; 5. A list of specialized equipment and materials for revetment construction;
Relationship to the country's sustainable development priorities;	Climate change adaptation and mitigation of the coastal zone are key priorities of the government of Liberia. Some national sustainable development priority documents in this regard are a) Liberia's Intended Nationally Determined Contribution (INDC, 2015); b) National Disaster Management Policy of Liberia (NDMP, 2012); c) The Pro-Poor Agenda for Prosperity and Development (PAPD, 2017);
Project Deliverables e.g. Value/ Benefits/ Messages	• Manage environmental risks associated with changes in shoreline and climate. • Conserve the coastal and marine resources and environment for sustainable development and serve as breeding place for some coastal organisms/ species; • Promote climate change adaptation measures in coastal areas; • Promote sustainable development to secure livelihoods of coastal communities; • Creation of jobs; • Develop capacity in research and education and enhance stakeholder awareness and participation;
Project Scope and Possible Implementation	The project intends to cover/ protect the entire vulnerable coastline of Greenville City which includes the Mississippi Street areas and continues to the Sinoe river areas around the Fanti Town community. The length of the project area or the revetment is estimated to be around 1200 linear meters.

Project Activities	1. Community awareness and stakeholders engagement and consultations 2. Identification of local coastal experts and technicians; 3. Identification of possible barriers, challenges, lack of instruments and opportunities; 4. Identification of the nearest and ideal quarry by considering the quality of rocks, capacity of production and ability to supply. 5. Establishment of a community action group to sustain the project
Timelines	The project is envisioned to be implemented within 3 years.
Budget/ Resource requirements	1. The budget would be about USD 13 million and this would need to be funded through a project grant either from GeF, CTCN, GCF and World Bank; although in-kind co-funding and involvement of staff could be provided from the government of Liberia; 2. The project would be headed by the Ministry of Mines and Energy (MME) while collaborating with the Environmental Protection Agency of Liberia (EPA) but some activities could be subcontracted to local NGOs or consultants (e.g. training programs, data collection and etc.);
Measurement/ Evaluation	The successes or the achievement of this project activities can be measured by: 1. The different reports on the vulnerability and risk studies; 2. Report on data collection and feasibility study; 3. Acceptance of the project by stakeholders through consultations; 4. Completion of revetment design and identification of the proper equipment and materials; 5. Identification of national coastal experts / engineers and the completion of the initial 100 meters of revetment.
Possible Complications /Challenges	1. Difficulties in accessing funds to implement and sustain the project; 2. Limited and inadequate national coastal expertise to implement the project; 3. Inadequate institutional coordination / corporation on implementation;
Responsibilities and Coordination	Statutorily, the ministry of mines and energy (MME) will lead the implementation for the construction of revetments and its associated activities. In so doing, the MME shall collaborate with other government line-ministries, institutions and agencies such as the EPA and MPW whose responsibilities will be determined in accordance with their statutory functions.

Chapter 2: Cross -cutting Issues for the Coastal Zone Sector

2.1. Cross-cutting Issues for technology 1, 2 and 3

The Action Plans for the three prioritized technologies of Liberia's coastal zones have been elaborated along with their Project Ideas. In so doing, there were some cross-cutting issues/ barriers identified that the three technologies commonly share. Said issues need to be addressed in order to have a successful adoption and implementation of the technologies. As such, this chapter presents the common cross-cutting issues and as well provides a proposed common enabling actions which if apply, would help address the common identified barriers for the three technologies. *Table 29* below summarizes the common cross-cutting barriers and their cross-cutting enabling measures.

Table 29: Summary of Crosscutting Issues and their proposed enabling measures

Crosscutting Barrier Category	**Crosscutting Barrier**	**Technologies**	**Crosscutting Enabling Measures**
Economic & Financial	▪ High capital cost for implementation; ▪ Limited access to funding;	1-ICZM 2-FWS 3-Rock Revetments	▪ Secure a national budgetary allotment for the adoption, transfer and diffusion of coastal technologies. ▪ Develop funding/ project proposals that meet international climate change adaptation/ mitigation funding requirements for the operations and sustainability of the technology. ▪ Create/ strengthen partnership with external organizations that support climate change adaptation projects through funding, technical training and etc.
Technical	▪ Inadequate/ limited national expertise; ▪ Limited / lack of quality data;	1-ICZM 2-FWS 3-Rock Revetments	▪ Provide and support adequate capacity building training programs at individual and institutional level; the trainings should be both short and long term and must be conducted by institutions and experts with a successfully track record regarding the technology; ▪ Provide, support and increase funding for coastal research and data collection activities.
Legal & Regulatory	Inadequate / lack of legal framework or policy plan	1-ICZM 2-FWS	Develop / create and adopt a national legal framework / policy plan and ensure straight acceptance and compliance for climate change coastal technologies.
Information & Awareness	Limited & inadequate information, knowledge sharing and awareness on the technology	1-ICZM 2-FWS 3-Rock Revetments	Provide and improve knowledge, awareness and information sharing about the technologies to the end-users through a direct and detailed community involvement process (workshops, community meetings, radio programs, etc.) to promote/ encourage community ownership and sustainability.

List of References

Chambers, R. (2005). 'Notes for Participants in PRAPLA Familiarisation Workshops in 2005, Sussex', Participation Resource Centre IDS.

DAI (2008), Liberia Environmental Threats and Opportunities Assessment (ETOA) Final Report to USAID/Liberia, Office of Economic Growth, Development Alternatives International, Bethesda, MD.

EPA (2007). National Report on the Marine and Coastal Environment in Liberia, Report to the Abidjan Convention.

French, P.W. (2005). Coastal Zone Management in Schwartz, M.L. (ed.). Encyclopedia of Coastal Science. The Netherlands: Springer, 313-319.

Haselip, J., Narkeviciute, R., Rogat, J., Traerup, S. (2019). TNA Step by Step – A guidebook for countries conducting a Technology Needs Assessment and Action Plan

INDC EPA Liberia (2015). Intended Nationally Determined Contributions, UNFCCC INDC, viewed 2 February 2021,

McSweeney, C., New, M., Lizcano, G., Lu, X. (2010) The UNDP Climate Change Country Profiles. Bulletin of the American Meteorological Society 91, 157-166.

NAPA. (2008). National Adaptation Program of Action, Republic of Liberia

National Disaster Management Agency 2012, National Disaster Management Policy (NDMP) of Liberia, PreventionWeb, viewed 28 January 2021,

National Policy and Response Strategy on Climate change (NPRSCC). (2018). National Policy and Response strategy on Climate change Liberia, NUDRR Prevention Web, viewed 5 December 2020,

Nygaard, I. and Hansen, U. (2015). Overcoming Barriers to the Transfer and Diffusion of Climate Technology: Second edition. UNEP DTU Partnership, Copenhagen.

Rogat (Ed.) (2017). Identification and Engagement of Stakeholders in the TNA Process: A Guide for National TNA Teams. UNEP DTU Partnership, Copenhagen.

Rocheleau, D. and Slocum, R. (1995). 'Participation in Context: Key Questions'. In Slocum, R., Wichhart, L., Rocheleau, D., Thomas, B. (1995). Power, Process and Participation: Tools for Change. London: Intermediary Technology Publications.

TNA Report -I, (2019). Liberia's Coastal Zone Technology Needs Assessment for Climate Change Adaptation, Report-I, Environmental Protection Agency of Liberia, EPA

TNA Report –II, (2020). Barrier Analysis & Enabling Framework for the Diffusion of Climate Change Coastal Zone's Adaptation Technologies in Liberia, Environmental Protection Agency of Liberia, EPA

Tumbey, A. (2015). Analytical research on climate change impacts on key sectors in Liberia. Environmental Protection Agency of Liberia (Unpublished Report).

UNEP DTU Partnership. Retrieved from http://www.tech-action.org/Publications/TNA Guidebooks

UNFCCC (2004). National Adaptation Programmes of Action, Least Developed Countries Expert Group, UNITAR, Geneva, Switzerland

USAID. (2013). Liberia Climate change assessment. Prepared by USDA Forest Service Office of International Programs. Liberia.

Wiles, D. L. (2005). Coastal zone vulnerability and adaptation to climate change in Liberia. In Training Workshop on Adaptation and Vulnerability to Climate Change, Maputo, Mozambique.

Annex I. List of stakeholders involved and their contacts

Table 30: Names and Contacts of the Coastal Zone Technical Working Group for the TAP

Name		Sex	Institution	Email	Consultation Mode
1	Patience Jackie	F	Head: vulnerable coastal women; King-Gray Community	patiencejackie@gmail.com	Workshop Discussion & Coastal Technical Working Session
2	John C.L Mayson II	M	National Expert, Coastal Zone	johnclmaysonii@gmail.com	Workshop Discussion & Coastal Technical Working Session
3	Ansumana Turay	M	Environmental Protection Agency of Liberia (EPA)	turayansu23@gmail.com	Workshop Discussion & Coastal Technical Working Session
4	Dennis K. Yeberth	M	Coastal Community Youth Empowerment	Koffa1908@gmail.com	Workshop Discussion & Coastal Technical Working Session
5	Ruth M. T. Wilson	F	University of Liberia	ruthmtoe@gmail.com	Workshop Discussion & Coastal Technical Working Session
6	Augustine M. Kollie	M	National Disaster Management Agency of Liberia (NDMA)	augustinekollie11@gmail.com	Workshop Discussion & Coastal Technical Working Session
7	Archiebald Browne III	M	Ministry of Mines (MME)	abrowne3@yahoo.com	Workshop Discussion & Coastal Technical Working Session
8	Patricia Togba	F	Ministry of Gender-Children & Social Protection (MGCSP)	mgcspdmrppta@gmail.com	Workshop Discussion & Coastal Technical Working Session
9	Lorine A. Saizonou	F	Youth Climate Change InitiativeLiberia (YCCI)	alexialorine@gmail.com	Workshop Discussion & Coastal Technical Working Session
10	Anthony A. Yokie	M	NaFAA	Ayokie2017@gmail.com	Workshop Discussion & Coastal Technical Working Session