

**Summary of the analytical framework for coastal ecosystem accounts in  
Liberia: extent, condition and ecosystem services**

## 1. EXTENT ACCOUNT

### Overall workplan

The plan of work for the development of ecosystem extent accounts involve the following five steps:

- (1) Define EAA
- (2) Compile ecosystem map including defining ecosystem classes
- (3) Compile land account
- (4) Compile ecosystem account
- (5) Share data and capacity building

### Options for determining analysis

#### *Proposed Approach for Mapping Ecosystems*

We propose to follow a tiered approach for mapping coastal EAs within a pre-defined EAA (see next section for details). The tier 1 map will depend on available global and national information and maps that we compiled through the MENC Project and CI-NASA Partnership. Ecosystem classification will follow the IUCN GET Ecosystem Functional Groups (level 3 and 4) and, if applicable, the SEEA CF land use classification (at the 3-digit level or better). As more data is collected, we will refine the tier 1 map and produce a tier 2 map by adding/subtracting classes. The initial tier 1 map may include up to 32 classes listed below:

Realm (Level 1)	Biome (Level 2)	Ecosystem Functional Group (Level 3)	Liberian-Specific Coastal Ecosystems (Level 4)	Source Data/Method
Terrestrial	T1 Tropical-subtropical forests	T1.1 Tropical-subtropical lowland rainforest	Mature Tropical Lowland Annual Rainforest	NASA map
			Mature Tropical Lowland Biannual Rainforest	NASA map
			Moderately Degraded Tropical Lowland Annual Rainforest <sup>[4]</sup>	NASA map
			Moderately Degraded Tropical Lowland Biannual Rainforest	NASA map
			Severely Degraded Tropical Lowland Annual Rainforest	NASA map
			Severely Degraded Tropical Lowland Biannual Rainforest	NASA map
	T7 Intensive land-use	T7.3 Plantations	Plantation	NASA map
		T7.4 Urban and industrial ecosystems	Build-up Area	NASA map
			Barren Land	NASA map
Freshwater	F1 Rivers and streams	F1.2 Permanent lowland rivers	Rivers	NASA map/Global GIS data
	F2 Lakes	F1.2 Large permanent freshwater lakes	Lakes	NASA map/Global GIS data
	F3 Artificial fresh waters	F3.1 Large reservoirs	Reservoirs	NASA map/Global GIS data
Freshwater-Terrestrial	TF1 Palustrine wetlands	TF1.3 Permanent marshes	Freshwater Marsh	NASA map/Height data/GIS analysis
Freshwater-Marine	FM1 Semi-confined transitional waters	FM1.1 Deep water coastal inlets	Inlets	GIS analysis

		FM1.2 Permanently open riverine estuaries and bays	Estuaries	GIS analysis
		FM1.3 Intermittently closed and open lakes and lagoons	Lagoons	GIS analysis
Marine	MT1 Marine shelves	M1.1 Seagrass meadows	Seagrass	Global GIS data
		M1.3 Photic coral reefs	Reefs	Bathymetry maps
		M1.6 Subtidal rocky reefs	Rocks	Bathymetry maps
	M2 Pelagic ocean waters	?	Neritic waters	Bathymetry maps
	M3 Deep sea floors		Oceanic waters	Bathymetry maps
	M4 Anthropogenic marine systems	M4.1 Submerged artificial structures	Wrecks	Bathymetry maps
		M4.2 Marine aquafarms	Shrimp farm	High resolution imagery
Marine-Terrestrial	MT1 Shoreline systems	MT1.1 Rocky shorelines	Rocky shorelines	Global GIS data
		MT1.2 Muddy shorelines	Muddy shorelines	Global GIS data
		MT1.3 Sandy shorelines	Sandy shorelines	Global GIS data
		MT1.4 Boulder and cobble shorelines	Boulder and cobble shorelines	Global GIS data
	MT2 Supralittoral coastal systems	MT2.1 Coastal shrublands and grasslands	Shrublands and grasslands	GIS analysis
	MT3 Anthropogenic shorelines	MT3.1 Artificial shorelines	Artificial shorelines	High resolution imagery
Marine-Freshwater-Terrestrial	MFT1 Brackish tidal	MFT1.1 Coastal river deltas	River deltas	GIS analysis
		MFT1.2 Intertidal forests and shrublands	Mangrove	NASA map/Height data/GIS analysis
		MFT1.3 Coastal saltmarshes and reedbeds	Saltmarsh	NASA map/Height data/GIS analysis

<sup>[4]</sup> The degraded classes may be eliminated if we decide to treat them as part of the condition account.

### *Proposed Approach for Defining EEA*

Following the SEEA EA recommendations described in the Chapter 3. We will define the coastal EEA for Liberia using a combination of ecological approaches, environmental and administrative boundaries. A simple overlay GIS model will be used for the tier 1 map boundary.

### **Outstanding issues for discussion with TAC**

- National land and marine boundaries. Coastal zone boundary.
- Acquire land use maps if they exist. Obtain forest inventory maps (spatial and tabular).
- Find out what data management and stats systems they use.
- Find out who will be data custodian and trained in NCA techniques.

## 2. CONDITION ACCOUNTS

### Overall plan of work

The goal of the condition accounts is to assess the state of ecosystem based on characteristics that are both dynamic and quantifiable and assessed with respect to ecosystem structure, function, and composition. The NCA technical team determined the following steps to implement condition accounts for coastal areas in Liberia:

- Identify coastal ecosystem types that are relevant for Liberia
- Develop the ecosystem condition typology (ECT)
- Identify condition variables and reference condition/levels
- Calculate EO variables and use those variables to help with stratification of field work sites
- Collect field data based on identified needs for condition variables and indicators
- Develop condition indicators and create condition indices

### Options for determining analysis

The following table provides different options to choose from for determining the reference condition, which will serve as a benchmark to compare the overall health of coastal ecosystems in Liberia.

Reference condition based on:	Ecologically relevant	Useful for management	Feasible to implement	Notes
Stable or resilient ecological state maintaining ecosystem integrity	Yes	Yes	Maybe	This method requires long term ecological monitoring, which is likely not available. Perhaps could use expert input and data from other places to supplement. Worth investigating.
Sites with ecosystems with minimal human disturbance	Yes	Yes	Yes	This method could be applied using the historical land-cover data and metrics of human footprint/disturbance. Alternative dense spectral time series such as LandTrender could be useful
Modelled reference conditions	Yes	No	No	There are too many unknowns to model the ideal conditions. Historical modeling of vegetation may not be relevant.
Statistical approaches	No	Yes	Yes	The reference condition is rather arbitrary based on the sample available. This can lead to shifting baselines. "If it is all degraded, is the least degraded pristine?"
Historical reference condition (baseline)	Yes	Yes	Yes	Depending on the reference period chosen, this could be an option. Historical data for setting reference condition may be difficult to measure. Also choosing a baseline year may be challenging.
Contemporary reference condition (baseline)	No	Yes	Yes	Assume that current condition is the reference condition and only measures changes moving forward. Does not provide much information on the ecological condition
Stable state or sustainable socioecological equilibrium	No	Yes	No	More appropriate for coupled human-ecological systems. Require long-term data
Prescribed levels or target levels in terms of legislated quality measures or expert judgement	No	Yes	Yes	Setting targets for condition based on policy is useful but can be a challenge when trying to determine reference condition. Could introduce political bias.

### Methods and requirements

For developing condition accounts, for each ECT group (i.e. abiotic, biotic and landscape characteristics) a number of variables will be measured. The following are some variables and corresponding data collection methods

**Ecosystem Variables**

mm of sediment accumulated per year

oz plastics per ha

Parts per thousand of dissolved salt

Parts per million of lead and mercury

Tonnes per hectare of carbon

Abundance of indicator species (mollusks, crabs, coastal birds...)

Species richness (vegetation, marine)

Canopy height (m)

Maximum annual NDVI

Annual difference NDVI

Vertical structure (unit unknown)

Age profiles

tons per hectare of carbon

NOT INCLUDED CURRENTLY

Meters of migration potential without obstruction

Patch size (ha)

Fragstats (Clumpy, edge-perimeter ratio, others...)

**Data type**

Field survey

Field Survey

Field survey

Field survey

Field survey

Field survey

Field survey

Remote sensing

Remote sensing

Remote sensing

Remote sensing

Field survey

Field survey

n/a

Remote sensing

Remote sensing

Remote sensing

**Outstanding Issues for discussion with TAC**

- What are the most relevant biotic and abiotic characteristics represented by coastal ecosystems in Liberia?
- What are the key element of ecosystem service supply that are affected by ecosystem characteristics?
- What methods for setting reference condition are most applicable?
- Sites for data collection: Lake Piso, Monrovia and Buchanan are three primary sites in the north west. To cover the SE region Sonoe and Riversees counties could be considered. The GoL has identified several hotspots (e.g., Ramsar sites) which are also candidates for field surveys

### 3. ECOSYSTEM SERVICES ACCOUNTS

#### Overall workplan

The general workplan for the development of ecosystem services accounts are as follows:

- Selection of ecosystem services based on priority and relevance for coastal ecosystems and beneficiary communities;
- Assessment of data and development of methods for each services;
- Implementation of biophysical modeling of each services based on data availability;
- Implementation of monetary valuation of each services based on data availability;
- Development of biophysical and monetary supply-use tables

#### Options for determining analysis:

The technical analysis for ecosystem services will be largely driven by the services of interest and data availability. As such, the technical team have made an initial determination of the list of services for further consideration based on criteria such as: relevance of the service for coastal areas in Liberia, data availability and technical feasibility. This list is a subset of all services recommended in SEEA EA guidance document and will be finalized after further review and consultation with Technical Advisory Committee.

PROVISIONING SERVICES		Relevant?	Data available?	Technically feasible?
Biomass provisioning services	Crop provisioning services	?	Y	Y
	Timber provisioning services	?	Y	y
	Non-wood forest products (NWFP)	Y	Y	y
	Wild animals, plants and other biomass provisioning services (incl. those related to hunting and trapping and bio-prospecting activities)	Y	Y	y
	Fish and other aquatic products provisioning services	Y	Y	y
REGULATING AND MAINTENANCE SERVICES				
Global climate regulation services		Y	Y	y
Soil erosion control services (includes also sediment retention services and landslide mitigation)		Y	Y	Y
Water purification services (water quality amelioration)	Retention and breakdown of excess nutrients	Y	Y	Y
	Retention and breakdown of other pollutants		Y	Y
Water flow regulation services	Baseline flow maintenance	?	Y	Y
	Peak flow mitigation	?	Y	Y
Flood mitigation services	Seawater (Tidal) surge mitigation (Coastal protection services)	Y	Y	Y
Storm mitigation services		Y	Y	Y
Nursery population and habitat maintenance services		Y	Y	Y
CULTURAL SERVICES				
Recreation-related services		Y	Y	Y

## Methods and data requirements

The technical team has advanced assessment of modeling and data needs for biophysical measurements and monetary valuation of services. Based on the initial assessment, two primary data sources have been identified as household surveys and market surveys supplemented by any existing datasets collected in other projects such as National Forestry Inventory.

- Household survey: e.g. demographic info, consumption of fish, bushmeat (kg/day), firewood (kg/year), timber (m<sup>3</sup>/year), water (m<sup>3</sup>/day), NWFP etc.
- Market surveys: e.g types of bushmeat and fish species sold, unit price of products (e.g. \$/m<sup>3</sup> timber, \$/kg fish etc.), seasonal variation of products sold

## Outstanding issues

- Benefits: e.g., what species of fish is being fished and have nurseries in mangroves, what species of mangroves are used for what?
- Beneficiaries: Who are the different beneficiaries for different services (e.g., fish for subsistence by households)?
- Where are the locations of services (e.g., where are the fishing grounds and nurseries, where the water comes from)?
- What is the current accounting system and accounting standards followed by LISGIS and what was their past efforts to integrate SEEA EA accounts?
- Additional issues for discussion with TAC:
  - Importance of agricultural crops in coastal areas
  - Importance of water supply services in coastal areas and the role of mangroves in water provisioning
  - Specific NWFPs are produced in mangroves (e.g. medicinal plants)