Report of the comprehensive evaluation and analysis of available national and regional data and their integration into the CHW system with a gender perspective

- Deliverables 2.1 to 2.4 -

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Introduction

The West African littoral, as well as Cameroon are among the most vulnerable regions of the world to the effects of coastal erosion and climate change, including sea level rise. Coastal risk reduction, mobilizing all sectors and actors involved on the coast, requires the provision of reliable and up-to-date information, shared and made available at the various decision-making levels with a view to improving the strategic quality of decisions related to the development, occupation and conservation of coastal areas (MOLOA / UEMOA & IUCN, 2016). In this context, indentifying climate-related risks on the West African and Cameroonian littorals is essential in order to manage potential risks in a timely manner, which is particularly difficult in developing countries where data, expertise and economic resources are limited, combined with extremely rapid population growth.

A number of methodologies and approaches exist to assess coastal risks and manage vulnerability to climate change in the littoral zone yet, no harmonized or standardized method had been chosen by the countries from the West African and Cameroonian littoral. In 2018, WACOM and the National Designated Entities (NDEs) from 9 countries identified the Coastal Hazard Wheel (CHW) as a relevant tool and universal system of coastal risk classification and, to this end, they requested the assistance of the CTCN.

The consortium formed by Globalcad (lead), WE&B, Meteosim and WASCAL was selected by the CTCN to complete this task with the aim to develop a standardized methodology based on a common language at the regional level, to collect, manage, share, compare and analyze data on an ongoing basis to support decision-making processes related to sustainable risk assessment and management and building the resilience capacity of the coastal regions of West Africa and Cameroon.

Specific objectives include:

- Developing planning and communication documents
- Updating the national and WACOM coordination unit's databases with CHW (including Cameroon's).
- Identifying and promoting specific adaptation options and technologies most appropriate for coastal risks

This report presents the results of the first part of phase 2 which aims at updating with CHW the national and WACOM coordination unit's databases. More specifically, this phase involved:

- Conducting a comprehensive collection, evaluation and analysis of available national and regional data and their integration into the CHW system (activity 2.1)
- Organizing a regional training session for the focal points of the national antennas and the regional coordination unit of WACOM as well as the Technical Counterpart of Cameroon on the methodology and the practical application of the CHW tool (activity 2.2)

The corresponding deliverables include[1]:

- Deliverable 2.1 Report of the comprehensive evaluation and analysis of available national and regional data and their integration into the CHW system
- Deliverable 2.2 Evaluation study on the management of gender issues in coastal risk planning and management in West Africa and Cameroon

[1] For any complementary information please see inception report

- Deliverable 2.3 Collection and inventory work of available data, pre-processing and preliminary analysis (shared by technical antennas)
- Deliverable 2.4. Report of the training of at least 11 experts

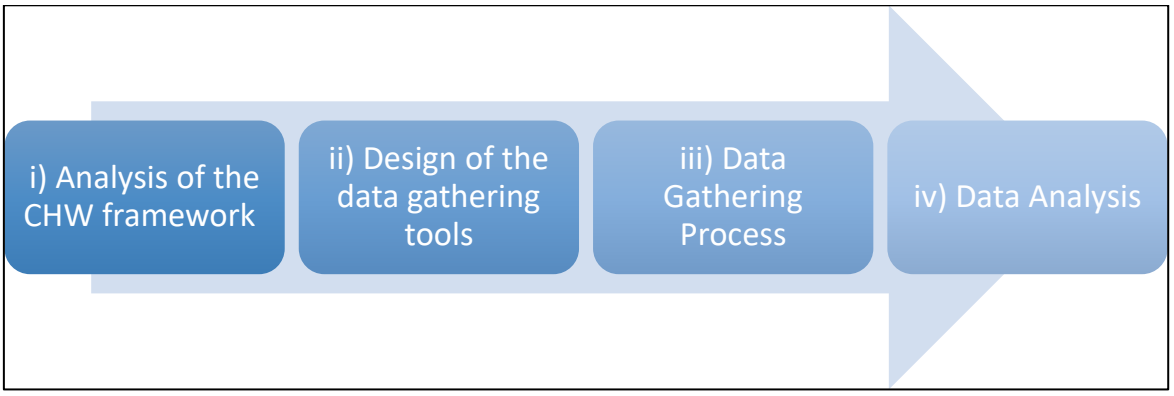
1. Methodological approach

The approach taken for these activities started with the comprehensive collection, evaluation and analysis of available national and regional data for their integration into the CHW system (section 1.1) and on the other hand the analysis the management of gender issues in coastal risk planning and management in West Africa and Cameroon (section 1.2). This work led to the implementation of a regional training session for the focal points of the national antennas and the regional coordination unit of WACOM as well as the Technical Counterpart of Cameroon on the methodology and the practical application of the CHW tool.

1.1. Evaluation and analysis of available national and regional data and their integration into the CHW system

The evaluation and analysis of the data was conducted following a four-step approach described below (see Figure 1):

Figure 1. Phases for the analysis of data



i) Analysis of the Coastal Hazard Wheel framework

The first phase consisted in developing a thorough list of quantitative metrics aiming at quantifying in detail the data availability as well as the data quality and accessibility of the different dimensions related to coastal risk analysis identified by the consultants. This framework considered all the data options and variables integrated on the Coastal Hazard Wheel system in order to quantify the data availability, quality and accessibility of them (see table 1).

Table 1. Framework analysis from the coastal risk management dimensions

CHW parameters	Indicators	Availability	Quality	Accessibility
1. Coastal geomorphology data	%Sedimentary plain			
	% Barrier			
	%Delta/ low estuary island			
	%Tidal inlet/ sand spit/ River mouth			
	% Sloping soft rock coast			
	% Flat hard rock coast			
	%Slopping hard rock coast			
	%Coral island			
2. Wave exposure	%Coast exposed			
	%Coast moderately exposed			
	% Coast Protected			
3. Tidal range	%Micro-tidal environment			
	%Meso-tidal environment			
	%Macro-tidal environment			
4. Biodiversity (flora and marine and coastal fauna),	% intermittent marsh			
	% Vegetated			
	% Non vegetated			
	% Coral			
	% intermittent mangrove			
	% marsh/tidal flat			
	% mangrove/tidal flat			
	% marsh/mangrove			
5. Sedimentology (sediment balance)	% Land with sediment balance/deficit			
	% Land with sediment surplus			
	% Beach land			
	% Not beach land			
6. Storms	% Tropical cyclone influence area			
	% Not tropical cyclone influence area			

ii) Preparation of the data collection

Once the framework was finalized, the consultants developed and designed a series of tools to perform the data gathering process:

a) Data base of contacts - A matrix was prepared including all the updated contact information provided by the CTCN about WACOM focal points, CTCN NDEs, and other relevant stakeholders for following-up the information exchanges, mainly for monitoring and managing the next phases of the project (survey and semi-structured interviews).

b) Online survey - In order to gather the necessary data identified in the previous phase, an on-line survey was conceived for the WACOM National Antennas and CTCN NDEs (see annex 3). For each of the 6 CHW parameters, a series of questions addressed the three dimensions (availability, quality and accessibility) through a qualitative and quantitative scoring system, depending on data required. The survey enabled to identify the available databases and documents related to the 6 CHW parameters (shoreline databases, orthophotos, satellite images, geological and lithological maps).

Some complementary information was also asked in terms of:

- **General Awareness,** in order to determine the general awareness on the consequences of climate change and gender disparities into the different countries of the regions, and the state of knowledge about the CHW tool in each country.
- **Gender,** with purpose of completing the gender study (see section 1.2), The aim was to assess to what extent gender was taken into account on coastal risk management.
- **Others,** with the purpose of identifying other relevant key experts and institutions that could provide key information.

c) Semi-structured interview

Following the survey format, assessing the 3 dimensions mentioned above (availability, quality and accessibility) on each of the 6 CHW identified parameters, the consultants designed a semi-structured interview model. The purpose of the interview was to complete the gaps of information and identify further key experts to solve the precedent gaps, already identified on the surveys. In order to facilitate the gathering information process and to better understand the interrelations between institutions on the different countries, interviews were organized by **country groups with WACOM National Focal points and CTCN NDE's**. This format enabled the consultants to understand more in detail country backgrounds, and to prepare the training according to country and regional needs.

d) Regional workshop

The two regional workshops were also conceived in order to gather relevant inputs from WACOM National Antennas on the different aspects addressed during the training.

iii) Data gathering process & data analysis

a) Survey

The survey was sent to all NDEs and National Antennas and a total of 14 surveys were completed (see table 2), ensuring a coverage of all the 8 countries.

Table 2. Completed surveys

	WACOM National Antennas	CTCN NDEs
Benin	1	1
Cameroon	1	0
Cote d'Ivoire	1	1
Gambia	1	0
Ghana	1	0
Guinea	2	1
Senegal	1	1
Togo	1	1
Total	9	5

b) Interviews

All the NDEs and National Points were contacted in order to organize a complementary interview. A total of **5 complementary interviews were finally organized with 10 experts by country groups**. Despite a number of intents it was not possible to interview Benin, Gambia and Guinea. It was decided to continue the process based on their surveys without complementary interviews in order to avoid delays.

c) Data analysis

The last step of the review process consisted in the analysis of the information collected. All the results gathered in the aforementioned table (see table 1) were aggregated in a matrix aiming at providing an overview of each country situation regarding availability, quality and accessibility (see table 3).

Table 3. Country analysis and regional approach

Thematic dimensions	Characteristics of evaluation and analysis	Benin	Cameroun	Cote d'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo	Regional
Coastal geomorphology data	Availability									
	Quality & Reliability									
Oceanographic data	Availability									
	Quality & Reliability									
Climate	Availability									
	Quality & Reliability									
Sedimentology	Availability									
	Quality & Reliability									
Biodiversity	Availability									
	Quality & Reliability									
Socio-economic activities	Availability									
	Quality & Reliability									
Integrated coastal zone management measures	Availability									
	Quality & Reliability									

A traffic light system was applied to the 6 CHW parameters to visually indicate, as a quick reference guide, the readiness level of each parameter (section 2.1) and for each country (section 2.2) in terms of the availability quality and accessibility of the data. The table below provides a key for the traffic light system in relation to the data availability, quality and accessibility.

Table 4: Traffic light classification system for data readiness

Availability	Data available	Some data available but not enough to implement the CHW classification	No data available
Quality	Digital format and satellite/plane photos (for ortophotos and flora/fauna)	One of the required formats	Data not in a digital format that can allow for the CHW classification
Accessibility	Publicly available	Data only available upon request	Not accessible

d) Regional Workshop

The workshop included the focal points of the national antennas and the regional coordination unit of WACOM as well as the technical counterpart in Cameroon. Two regional workshops were undertaken one in English for the English-speaking countries and one in French for the French-speaking countries.

Table 5: English-speaking training workshop participants

Country	Organization	Name
Cameroon	Technical Counterpart	Zouhtem Isabella
Gambia	MOLOA	Fafanding Katiir Kinteh
Ghana	MOLOA	Kwasi Appeaning Addo

Table 6: French-speaking training workshop participants

Country	Organization	Name
Benin	CTCN	Raphiou Adissa Aminou
Benin	MOLOA	Moussa Biodjara
Cote d'Ivoire	CTCN	Kumasi Phillipe Kouadio
Guinea	MOLOA	Mohammed Lamine Sidibé
Senegal	MOLOA	Luc Mathurin Malou
Togo	CTCN NDE	Mery Yaou
Togo	MOLOA/WACOM	Tchabinni Bakatimbé
Regional	MOLOA	Moussa Sall
Regional	MOLOA	Marième Soda Diallo

The participants were formed on the approach and the procedures for collecting, processing and disseminating data of the CHW. The CHW and GIS expert together with the workshop and gender experts implemented the training and provided support in order to ensure appropriate understanding and assimilation of the training modules. The discussion undertaken with the WACOM focal points and regional unit, and the Technical counterparts from Cameroon, assured all country information gaps and needs were identified to proceed to the next steps of the project.

All webinars are available online on the public page: https://www.ctc-n.org/technical-assistance/projects/west-african-coastal-classification-hazard-management-and-standardized and a full report of the training is presented in annex II.

1.2. Evaluation study on management of gender issues in coastal risk planning and management in West Africa and Cameroon

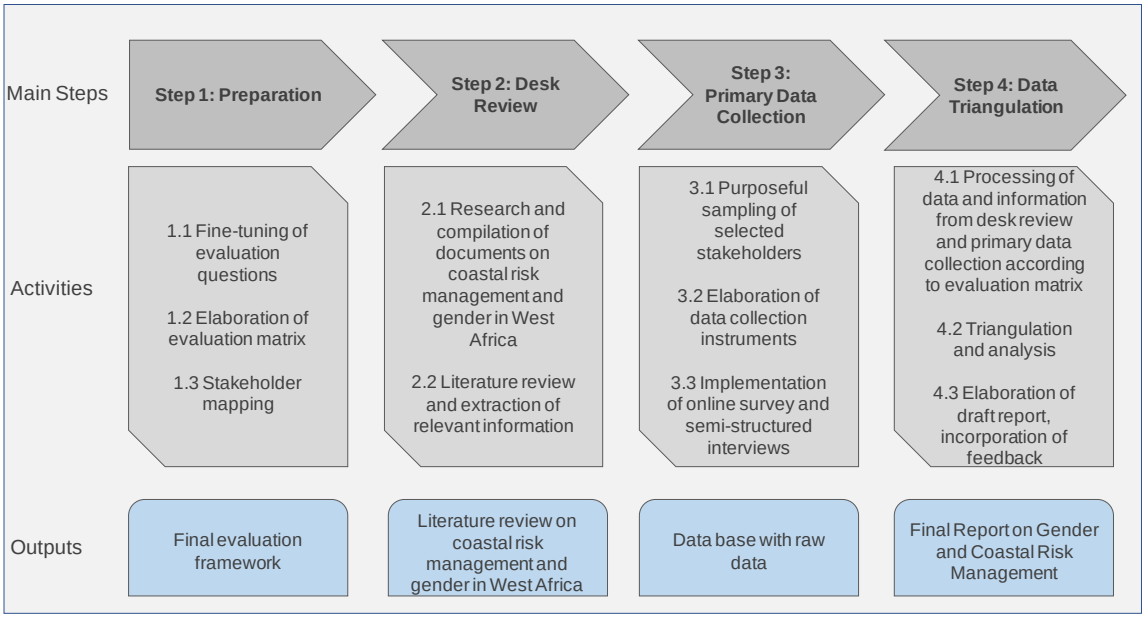
The evaluation study was conducted in line with the Terms of Reference of the assignment, based on five key evaluation questions:

1) To what extent is vulnerability gender-specific in the West African and Cameroonian coastal area?
2) How does WACOM countries and Cameroon perceive and deal with vulnerability and resilience to coastal risks, taking into account gender?
3) How do WACOM countries and Cameroon intend to change the gender roles in coastal risk planning and management?
4) How do WACOM countries and Cameroon measure changes in gender roles in coastal risk management? and

5) What are the factors that encourage changes in gender roles (drivers of change) and what are the limitations and challenges?

The study was based on the following methodological steps:

Figure 2: Methodological steps of the evaluation study



Step 1: Preparation

The consultants reviewed jointly with the CTCN/UNIDO the proposed evaluation questions to clarify the exact information needs and the purpose of the study. As a result, no further adaptations to the main questions were made as they sufficiently covered the research objectives. Based on the five main questions, the consultants elaborated an evaluation matrix with evaluation questions, as well as related assumptions and sub-questions, and a number of indicators as guiding tools to answer each question.

In addition, the consultants conducted a stakeholder mapping to identify at each country level, as well as at the regional and international level, relevant key informants. These included the CTCN national antennas, government representatives, individual experts on climate change adaptation and gender, as well as representatives from NGOs and international organizations working in this field.

Step 2: Desk Review

The consultants then conducted an extensive literature research and review to obtain relevant information that helps to answer the evaluation questions. Literature included national development plans and gender policies of WACOM countries and Cameroon, nationally determined contributions (NDCs) and national adaptation plans (NAPs), coastal risk management strategies (when available), project and programme documents related to coastal risk management, vulnerability and gender, academic literature and other studies on the topic, as well

as other types of documents such as fact sheets, guides and handbooks on gender and coastal management or climate change adaptation. [2]

Step 3: Primary Data Collection

At the beginning of the research, a brief survey was sent out to the CTCN national antennas that served to gain a first overview on how the relation of gender and coastal risk management is perceived, and in how far countries already consider gender when it comes to coastal risk management.

The literature review then allowed the consultants to gain a more comprehensive overview of the available information, as well as to identify information gaps that needed to be filled through primary data collection. Based on this, they elaborated a data collection instrument in the form of a semi-structured interview guide and contacted the selected key informants to schedule interviews.

Twelve interviews were conducted with CTCN national antennas, some UNFCCC gender focal points, as well as subject matter experts from international, regional or national organizations.[3]

Step 4: Data Triangulation

As a final step, the consultants triangulated the information obtained through the literature review with the primary data collected in order to cross-check the information and validate findings. To this end, they organized all information according to the questions in the evaluation matrix to compare information from different data sources.

Challenges

While general literature on gender mainstreaming is abundant, and the link between climate change and gender has also become more prominent in recent years, the specific topic of gender in coastal risk management still seems to be a blind spot. Secondary literature on this topic is extremely scarce in general, and for the countries included in this study, basically non-existent.

In addition, it has been challenging to find interviewees that are knowledgeable on this specific topic, which seems to confirm that gender and coastal risk management is not (yet) an issue that is widely acknowledged as a priority by decision makers and development practitioners.

Likewise, it was challenging to find experts that are knowledgeable on the specific aspect of coastal risk management and gender mainstreaming, which further indicates that this topic is just emerging and there is still a lack of experiences with implementation.

For this reason, the analysis has been for the most part based on expert knowledge, documents and secondary literature related to gender and climate change adaptation, as coastal risk management can be seen as part of adaptation initiatives. Specific information on coastal risk management has been integrated when available.

[2] A bibliography with all information sources used is included in the annex of the chapter 3 of this document.
[3] A list of all interviewees is included in the annex of the chapter 3.

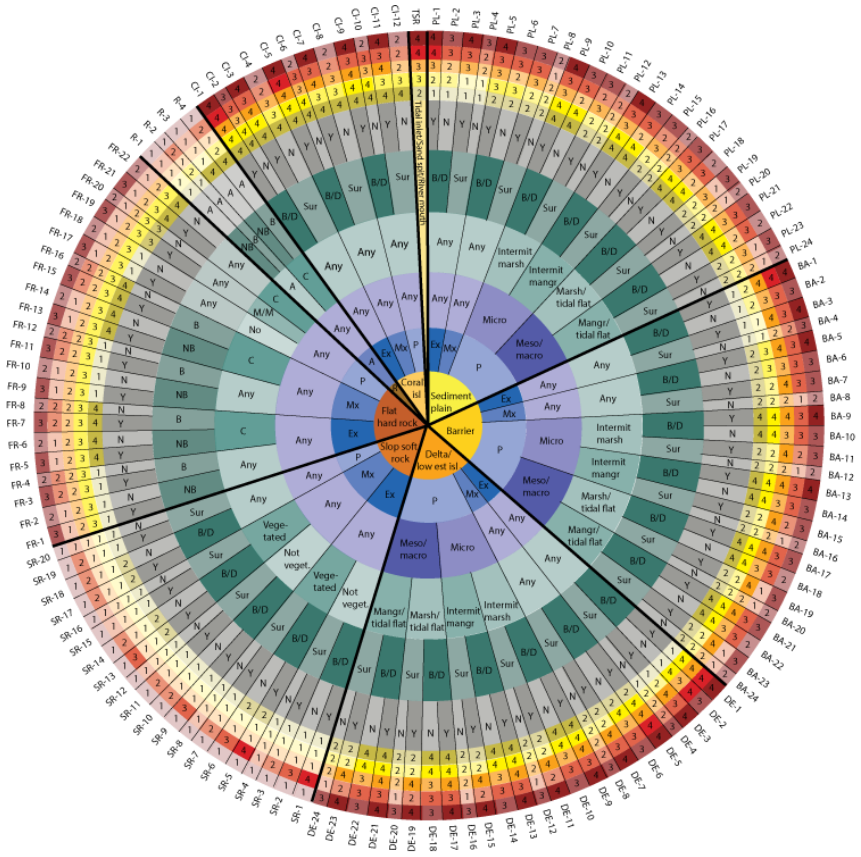
2. Analysis of national and regional data for their integration into the CHW system (D. 2.1)

This chapter presents first an exhaustive analysis per each parameter of the Coastal Hazard Wheel methodology before presenting the situation of each of the 8 countries of the assignment.

1) Parameter analysis

The parameter analysis considers the information available for the 6 parameters of the Coastal Hazard Wheel methodology, namely the geological layout, wave exposure, tidal range, biodiversity, sedimentology, and storm climate (see figure 3) in order to define the level of readiness for implementing the CHW methodology.

Figure 3. The Coastal Hazard Wheel 3.0.



The classification follows a 3 steps data gathering process that allows deepening into the data, each parameter having different required steps based on the data availability and accuracy requirements (see table 7). In general, because of the significant resources and time needed to implement Step 3 at sub regional, regional and national level, it is recommended to apply step 1 and 2. Step 3 would be then applied to stretches specific detailed assessment on hazards-hotspots identified at Step 1 and 2.

Table 7. Coastal Hazard Wheel classification process

Parameters	Step 1 (low data requirements)	Step 2 (medium data requirements)	Step 3 (high data requirements)
Geological Layout	Basic geologic map of the assessment area by Google Earth's satellite images and Google Earth's terrain elevation function.	Representative field verification	High quality data on coastal geology
Wave Exposure	Google Earth, Local wind climate measurement, wave exposure classification table (see annex 1) and Global wave environments map (see figure)		Detailed wave data based on the Hs 12h/y
Tidal Range	Global tidal environment map (see figure 10)		Supplementary data on tidal range (e.g. from commercial harbors)
Biodiversity	Google Earth's satellite images, information on the latitude of the assessment area and the UNEP-WCMC global coral reef database.	Representative field verification of vegetation cover, vegetation type and if relevant coral presence.	
Sedimentology	Google Earth's satellite images and Google Earth's timeline function.	Representative field verification of signs of longer-term erosion/accretion, changes in the vegetation line and human alterations.	Systematic temporal data on shoreline stability
Storm Climate	Global wave environment map (see figure 9)		

Following the steps above-mentioned, a first analysis by parameter, with low and medium data requirements was undertaken. For each parameter, a brief overview is given presenting its characteristics and contribution to the overall classification, before presenting the detailed results in terms of availability, quality and accessibility in a format of regional benchmark (see table 8.).

Table 8. Example of overview of parameter

	Benin	Cameroun	Cote d'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo
Coastal geomorphological classification of the coast								
Shoreline database								
At national level								
At regional level								
At global level								
Geological map								
At national level								
At regional level								
At global level								
Lithological map								
At national level								
At regional level								
At global level								
Digital Elevation Model covering the emerged coastal strip								
Report or study in relation to coastal geomorphology for your country or region								
Orthophotos or a composition of orthophotos taken by plane								

2) **Country analysis**

Considering the overall results obtained at the parameter level and at the regional level, the consultants present a country-by-country analysis to deepen the analysis. This enables to identify the specific data gaps, the responsible institution for gathering and sharing the data, and the readiness to implement CHW (taking into consideration the available data) by country. For each country the analysis is presented following a similar structure:

i) Analysis by parameters for each country and the respective action items linked to them;
ii) Recommendations for implementing the Coastal Hazard Wheel methodology;
iii) Proposed roadmap for the implementation of CHW

The recommendations and action points highlighted on the present chapter will guide WACOM focal points and CTCN NDEs to make the appropriate choices in terms of data gathering and processing for the CHW implementation.

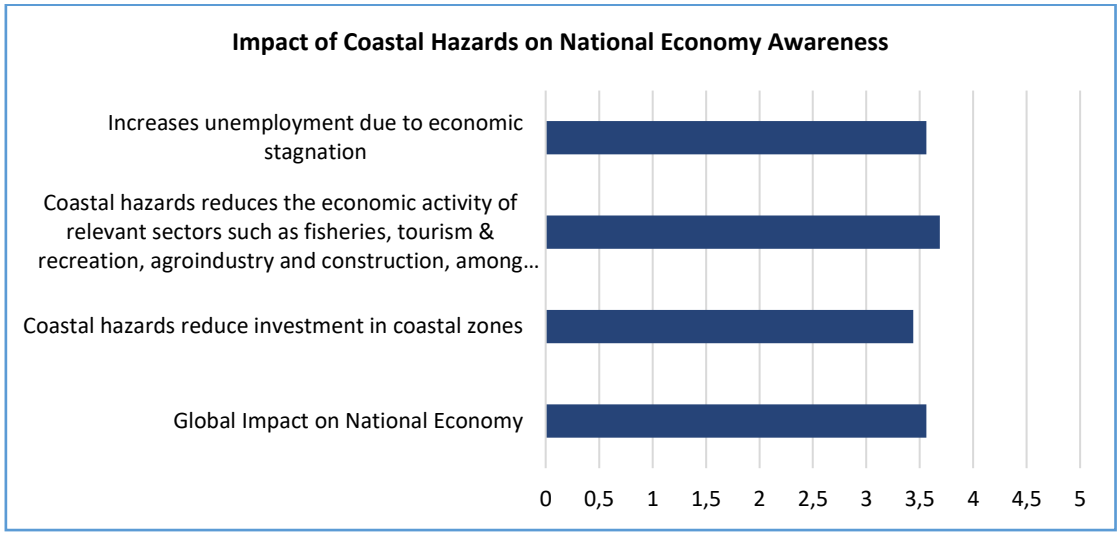
2.1. Analysis of data per parameter

Prior to the analysis of the six CHW parameters, the surveys and interviews integrated a series of questions aiming to determine the level of awareness on the consequences of coastal hazards and gender disparities and measure the state of knowledge about the CHW tool. It focused on four main areas: economy, environment, coastal communities and gender.

1) Level of awareness on the impact of coastal hazards on the economy

Overall, WACOM Focal points and CTCN NDEs agree on the fact that coastal hazard have a direct impact on the economy (see Figure 4). There is a consensus that it reduces economic activities such as tourism, agroindustry and construction sectors, and therefore has a direct impact in the increase of unemployment, reduction of investments and therefore a global impact on the economy.

Figure 4. Impact of Coastal Hazards on National Economy Awareness



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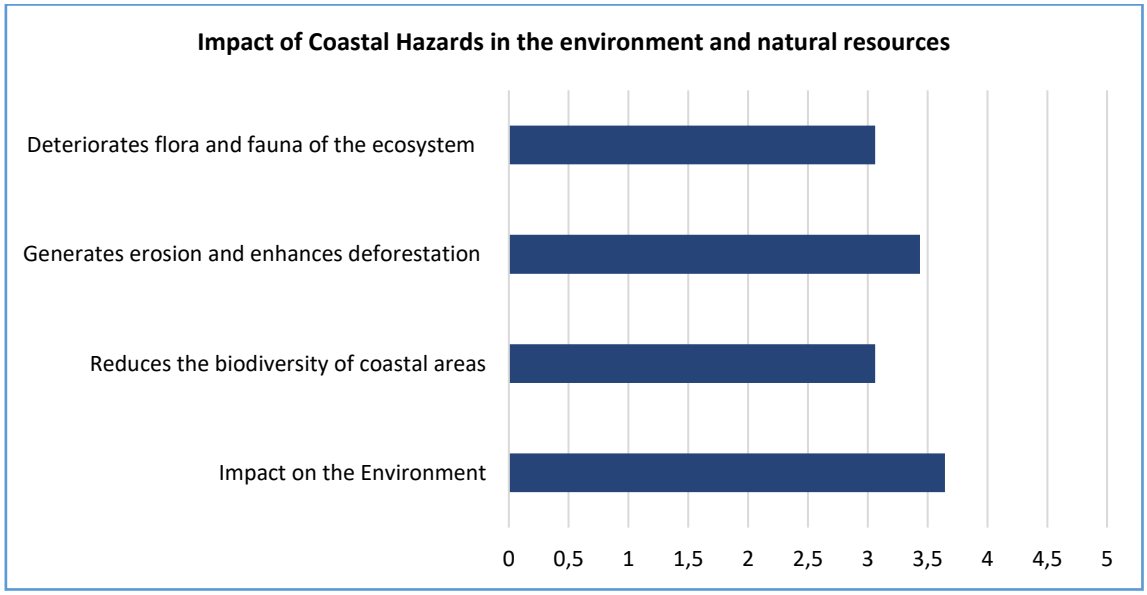
2) Awareness on the impact of coastal hazards in the environment and natural resources

Similarly, there is an overall consensus on the impact coastal hazards have on the environment and natural resources. In particular, CTCN NDE's and WACOM focal points agreed on the impact coastal hazards have in erosion and deforestation, the deterioration of flora and fauna and the reduction of biodiversity.

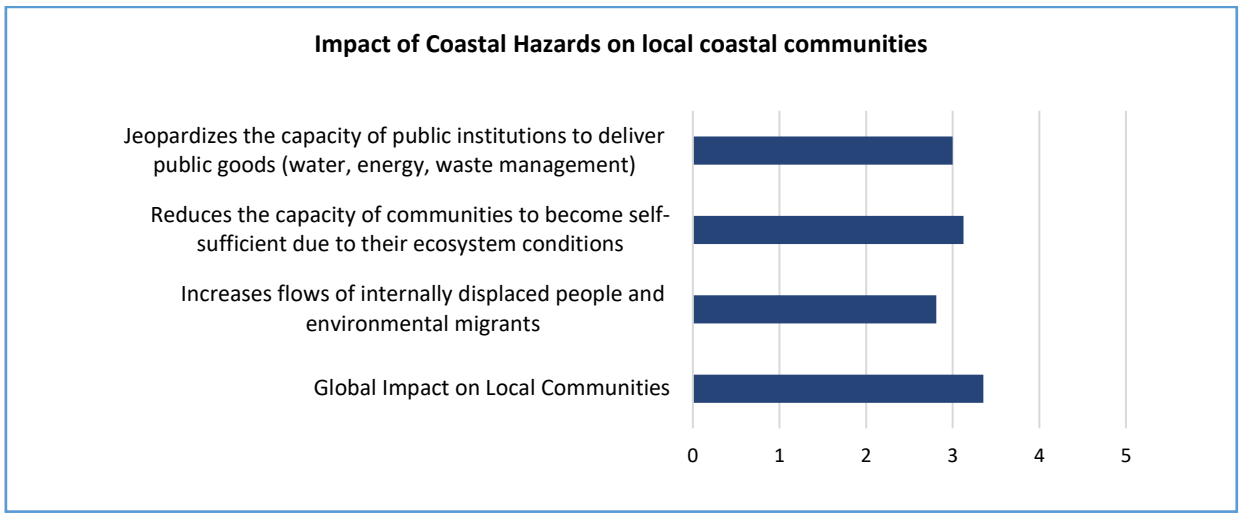
Figure 5. Impact of Coastal Hazards on Environment and natural resources Awareness



3) Awareness on the impact of coastal hazards on local coastal communities

Similarly, WACOM focal points and NDEs are highly aware of the impact of coastal hazards on local communities. They are aware coastal hazards jeopardize the capacity of public institutions to cover basic needs such as water energy or waste management, reduce the capacity of communities in becoming self-sufficient and increase the flows of internally displaced people.

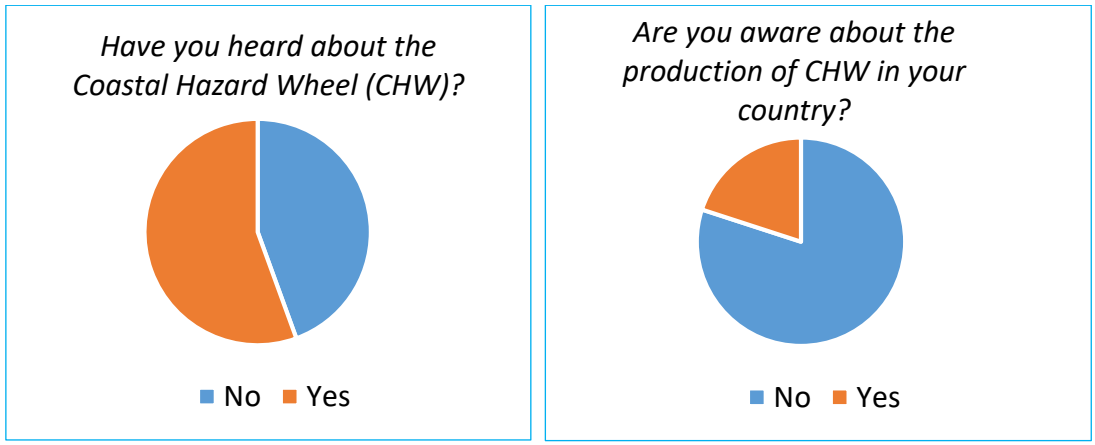
Figure 6. Impact of Coastal Hazards on coastal communities



4. Awareness on the Coastal Hazard Wheel Tool

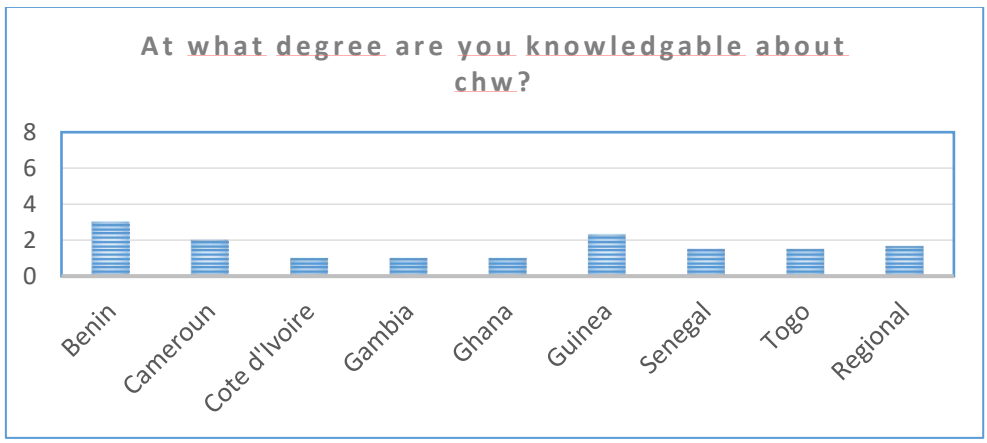
Although 56% of the CTCN NDEs and WACOM focal points stated they had heard about the tool, only 20% of the respondents were aware of the production of the CHW tool in their countries.

Figure 7. Awareness about CHW in the region



The knowledge of the CHW remains very basic level (2 out 8) in all the countries highlighting the need for training and capacity building of all the participants of the programme (see figure 8).

Figure 8. Knowledge of CHW in the countries



2.1.1. Parameter 1: Geological Layout

Overview

The geological layout is the first variable to be characterized to apply the CHW. It serves to defines the type of dominant coast and, thus, to determine the potential hazards and consequences along the area to be analysed.

The geological layout constitutes the basis on which the dynamic processes act and has been created by various past dynamic processes including glacial, fluvial, marine, volcanic and tectonic. The geological layouts included in the CHW are defined based on a thorough analysis of the world's costal environments and are framed in a way so they cover all major types of geological layouts worldwide. They are defined to include important generic characteristics while still maintaining an appropriate simplicity.

The geological layout categories considered in CHW are: sedimentary plain, barrier, delta/low estuary island, sloping soft rock coast, flat hard rock coast; sloping hard rock coast, coral island, tidal inlet/sand spit/river mouth.

The sedimentary plain category is defined as coasts with an average elevation of less than 6-8 meters 500 meter inland of the Mean Sea Level (MSL), and which are composed of sedimentary deposits such as clay, silt, sand, gravel, till or larger cobbles. If coastal dunes are present, the elevation may locally be higher at the dune peaks, but the coast will still fall into the sedimentary plain category. Sedimentary plains are often formed by glacial and fluvial processes or through coastal progradation.

The **barrier** category is defined as coasts that consist of non-sloping/low-lying, shore parallel sedimentary bodies with cross distances ranging from less than 100 meters to several kilometres, and lengths ranging from less than 100 meters to over 100 kilometres (Davis and Fitzgerald 2004). Narrow barriers often exist where the sediment supply is or has been limited while broad barriers are formed in areas with sediment abundance. The seaward side of a barrier often contains a wave dominated beach environment, while the landward side consists of protected lagoons and estuaries with various kinds of marsh or mangrove vegetation depending on climatic conditions and tidal range. In meso-tidal and macro-tidal environments, barriers are frequently cut by tidal inlets. In the CHW, a barrier can occur in parallel to coastlines of other geological layouts, located landwards of the barrier. This would e.g. be the case where a sedimentary plain or sloping soft rock coast is located landwards of a barrier. Barriers may occur as part of a delta and in that case the most appropriate categorisation would be the delta/low estuary island category.

The **delta/low estuary island** category is defined as coasts composed of fluvial transported sediment that is deposited in front of a river mouth. These landforms form in the coastal-fluvial interface where riverine sediment supplied to the coastline is not removed by marine processes. The formation of deltas/low estuary islands is therefore strongly dependent on the fluvial sediment discharge as well as the waves, tides and currents of a particular location. Plate tectonics and regional geological conditions also influence delta formation. Larger deltas are generally found on trailing edge and marginal sea coastlines4 where large drainage basins provide a high fluvial discharge and wide continental shelves provide a relatively shallow depositional. The delta/low estuary island category is defined as coasts composed of fluvial transported sediment that is deposited in front of a river mouth. These landforms form in the coastal-fluvial interface where riverine sediment supplied to the coastline is not removed by marine processes. The formation of deltas/low estuary islands is therefore strongly dependent on the fluvial sediment discharge as well as the waves, tides and currents of a particular location. Plate tectonics and regional geological conditions also influence delta formation. Larger deltas

are generally found on trailing edge and marginal sea coastlines4 where large drainage basins provide a high fluvial discharge and wide continental shelves provide a relatively shallow depositional

The **sloping soft rock** coast category is defined as coasts comprised of soft rock material with an average elevation of more than 6-8 meters 500 meter inland of the MSL. Sloping soft rock coasts can be comprised of a range of different sedimentary deposits such as chalk, moderately cemented laterite, clay, silt, sand and till with larger pebbles or cobbles. Their geological origin can range from old uplifted seabed to more recent glacial deposits. Hard sedimentary rocks are not included in this category and it can therefore be necessary to assess the level of sediment cementation in order to determine whether a particular coast should be classified as soft or hard rock. In the classification system, a rock will fall into the soft rock category if the sediment is poorly cemented and as a general rule, it should be possible to push a knife some centimetres into the rock material without using excessive force. However, assessing this in the field is not always straightforward as hard rock material may be covered by a layer of sediments. The recommended approach is therefore to make use of a basic geologic map, if possible combined with field observations. Sloping soft rock coasts can both be present as coastal cliffs and vegetated hills.

The **flat hard rock** coast category is defined as coasts consisting of igneous, sedimentary and metamorphic rock with an average elevation of less than 6-8 meters 500 meter inland of the MSL. Igneous rocks are formed from magma and are comprised of a range of different minerals and grain sizes depending on their chemical composition and solidification process. Sedimentary rocks consist of sediment that has undergone different stages of diagenesis, where the sediment has been compacted and cemented under increased temperature and pressure, creating a solid rock structure. Metamorphic rocks have formed from both igneous and sedimentary rocks when they have undergone recrystallization under high temperature and pressure (Press and Siever 2001). The specific physical and chemical rock properties influence the weathering and erosion processes, but for the coastal CHW, hard rock material is considered as one uniform group. Flat hard rock coasts can be present in different forms such as rocky coastal plains, islands and archipelagos and the hard rock can sometimes be partly hidden by a layer of weathered rock/ loose sediments.

The **sloping hard rock** coast category is defined as coasts consisting of igneous, sedimentary or metamorphic rock with an average elevation of more than 6-8 meters 500 meter inland of the MSL. Sloping hard rock coasts can be present in different forms such as coastal mountain chains, hills, headlands, islands and archipelagos and the hard rock can sometimes be partly hidden by a layer of weathered rock/ loose sediments.

The **coral island** category is defined as low-lying coral islands in the form of tropical atolls and coral cays. Tropical atolls are open ocean coral islands that rest on a subsiding volcanic foundation. The coral base can be as old as 30 million years and reef material can be found at depths of over 1000 meters beneath the atoll. Atolls have a round shape with diameters ranging from a few kilometres to more than hundred. Coral cays are younger islands formed on top of coral reefs or adjacent to atolls due to the accumulation of reef-derived sediment in one location as a result of wave action. These islands can rise up to three meters above high water level and can be composed of coarse reef fragments or fine carbonate sand. The beaches of both atolls and coral cays can have cemented to form beachrock and coral sandstone that help stabilize the islands.

The **tidal inlet/sand spit/river mouth** category is established as a separate grouping in the CHW as these environments can be highly morphologically active and respond quickly to changes in other coastal processes. In the CHW, tidal inlets are defined as the coastline of a tidal inlet itself and one kilometre parallel to the shore on each side of the inlet. Tidal inlets are found along barrier coastlines throughout the world and provide water exchange between an open coast and adjacent lagoons and estuaries. Their morphology depends on a range of different parameters such as tidal range, wave climate and sediment availability (Davis and Fitzgerald

2004). In special cases, where the tidal inlet side consists of a hard rock headland, the inlet side should fall into one of the hard rock categories. Sand spits are defined as elongate sedimentary deposits that are formed from longshore currents losing their transport capacity and subsequently depositing sediment at particular locations. They can be present in different shapes and are generally classified into simple linear spits, recurved spits with hook-like appearances, and complex spits with plural hooks (Schwartz 2005). River mouths are defined as the coastline one kilometre on each side of a well-defined river mouth. Tidal inlets, sand spits and river mouths are assigned high priority in the CHW, meaning that e.g. a sedimentary plain will fall into this category if it is located less than one kilometre on each side of a river mouth.

In many coastal locations, there is a **gradual transition** between related geological layouts, e.g. between barriers and delta/low estuary islands and in these cases it is up to the user to decide on the most appropriate layout category.

The required level of definition of this parameter is relatively simple, being mainly of qualitative nature, in which a given coastal stretch is classified using a set of categories covering all major types of geological layouts worldwide.

Data requirements for classifying the geological layout vary depending on the step of application of the CHW. Thus, at step 1, basic geologic map together information derived from Google Earth's satellite images and Google Earth's terrain elevation function are enough. At step 2, in those areas where existing information on geology and/or elevation is not precise, the data should be supplemented by representative field verification. At step 3, additional high quality data on coastal geology and elevation would be required.

Approach

In order to verify existing data to be used to classify the coast along the study area, a series of specific questions regarding their availability and quality were made to the national antennas. In essence, these data will be needed, not only to start the application of the CHW but, specially, to apply it at steps 2 and 3 where field verification and high quality data will be required. The questions are summarized in the following table:

Availability of the data:	
i.	Do you already have a coastal geomorphological classification of your coast?
ii.	Do you have a shoreline database?
iii.	If yes, at what level has the shoreline database been produced?
iv.	Do you have a geological map?
v.	If yes, at what level is the geological map available?
vi.	Do you have a lithological map?
vii.	If yes, at what level is the lithological map available?
viii.	Do you have a Digital Elevation Model covering the emerged coastal strip?
ix.	Do you have any report or study in relation to coastal geomorphology for your country or region?
x.	Do you have orthophotos or a composition of orthophotos taken by plane?

Quality of the data:	
i.	Is the shoreline database available in digital format?
ii.	In which file format is the shoreline database available?
iii.	What is the date of the last update of the shoreline database?
iv.	What is the frequency of update currently been used for the shoreline database?
v.	What is the resolution of the shoreline database (in meters)?
vi.	Is that finer than 50 m?
vii.	Is the geological map available in a digital and georeferenced format?
viii.	Is the lithological map available in a digital and georeferenced format?
ix.	Is the Digital Elevation Model available in a digital and georeferenced format?

x. What is the date of the last orthophotos taken by plane?
xi. Are the orthophotos available in a digital and georeferenced format?
xii. Are the studies/reports about coastal geomorphology available in digital format (PDF)?

Accessibility of the data:

i. Is the shoreline database publicly available to everyone?
ii. Is the shoreline database available in electronic or printed version? Please choose all options that apply:
    - Electronic open version
    - Electronic version upon request
    - Printed version on public information centres
    - Printed copies upon request
    - Not publicly available
    - Other:

i. Do you know the local institution/s responsible for the production and management of the shoreline database or any other information in relation to coastal geomorphology?

If yes, could you please provide the name of the responsible institution/s:

Apart from the surveys, online interviews were carried out with each of the national antennas in order to clarify the answers obtained in the surveys and to analyse the steps to be followed in order to obtain the data that is currently lacking. Concerning Geological Layout, the CHW methodology was explained focusing on the type of data needed to implement the CHW.

Main findings

In what follows, reported existing data are described and discussed in terms of their availability, quality and accessibility. In any case, it has to be considered that these findings directly rely on provided information by national antennas and, this does not preclude the existence of other sources not identified at this phase of the study. It is also worth of mentioning that, quality mostly refers to the type and format of the data and not to the information to be extracted from such data since they have not been yet analysed.

a) Data availability

The most important data (geomorphology, geology, shoreline, DEM, aerial photos) are available for most of countries of the region. Main gaps for relevant data are reported for Togo (geomorphology, shoreline, DEM, aerial photographs) and Cameroun (geomorphology, aerial photographs). When existing, the data has a national coverage.

In addition this information, all countries report the existence of studies related to coastal geomorphology and /or geology issues that can also be used as an additional source of information for a more accurate classification of the geological layout. However, no further description and coverage of such studies are reported.

Table 9. Data availability for Geological Layout

	Benin	Cameroun	Cote d'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo
Coastal geomorphological classification of the coast								
Shoreline database								
At national level								
At regional level								
At global level								
Geological map								
At national level								
At regional level								
At global level								
Lithological map								
At national level								
At regional level								
At global level								
Digital Elevation Model covering the emerged coastal strip								
Report or study in relation to coastal geomorphology for your country or region								
Orthophotos or a composition of orthophotos taken by plane								

b) Data quality

The reported quality of these data is variable among parameters and among countries. Thus, the most basic data (shoreline) is available at digital format in nearly all countries (when existing) and, in this sense, it would be ready to use. Their exact date of acquisition is not provided for all countries, although for using it as base layer to build up the database, a recent date is not an important requirement provided it properly represents the National coastline morphology.

The most important variable (geological map) presents a different quality with a digital version reported for five of the eight countries. A similar situation is also found for DEMs which are reported in digital format for six of the eight countries. It has to be considered that, by definition, DEMs have to be in digital format, and otherwise they would be topographic maps. With respect to aerial photographs, only five of the eight countries report them in digital and georeferenced format. Finally, the mentioned additional information in form of studies and reports are also variable in quality with only the half of the countries reporting their availability in pdf format.

Table 10. Data quality for Geological Layout

	Benin	Cameroun	Cote d'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo
Shoreline database available in digital format?								
CSV Format								
Shapefile format								
Date of the last update	2018					2018	2019	
Quarterly								
Semi annual								
Annual								
Resolution of the shoreline database (in meters)								
Is that finer than 50 m?								
Geological map available in a digital and georeferenced format?								
Lithological map available in a digital and georeferenced format?								
Digital Elevation Model available in a digital and georeferenced format?								
Date of the last orthophotos taken by plane								
Orthophotos available in a digital and georeferenced format?								
Studies/reports about coastal geomorphology available in digital format (PDF)?								

c) Data accessibility

Information provided on data accessibility show a general picture in which open access to existing information by electronic means is seldom available. The most frequent situation is the access to data upon request, although procedures are not reported in detail. In some cases, some fees have to be covered to access the data. Also, a quite common aspect for some countries is the absence of details on how to access existing data.

Nearly in all the countries, institutions responsible for the production of the shorelines and geomorphology/geology- related information have been properly identified (exceptions are Cameroun and Togo).

Table 11. Data accessibility for Geological Layout

	Benin	Cameroun	Cote d'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo
Shoreline database publicly available								
Electronic open version								
Electronic version upon request								
Printed version on public information centres								
Printed copies upon request								
Not publicly available								
Knows the institution/s responsible for the production of the shoreline database or related information								

Conclusions

On the basis of the information provided by National antennas and the subsequent analysis performed by the consultants, most countries have the minimum information to be used in the characterization of the Geological layout component of the CHW. However, this does not necessarily imply that this can be done in a straightforward and simple manner in all countries, since the detected differences will be reflected in their direct application. Thus, in what follows we resume the overall picture regarding this CHW component in practical terms:

- Overall, nearly all the countries of the region have the required basic data regarding the Geological layout to implement the CHW.
- Togo still requires compiling basic data, which can be obtained in the worst of the cases from global databases (see annex 1)
- Benin, Gambia, Ghana, Guinea and Senegal have the information in right format to be operative at the most advanced step 3 of application of the CHW.
- Cameroun, Cote d'Ivoire needs to convert some of their data to digital format to be operative.

2.1.2. Parameter 2: Wave exposure

Overview

The wave exposure is the dominant energy source in the nearshore environment and a highly important parameter for the coastal morphodynamics. Although some incoming wave energy is reflected by the shoreline, most energy is transformed to generate nearshore currents and sediment transport and is a key driver of morphological change. The wave height is the generally applied measure for incoming wave energy and is defined as the difference in elevation between the wave crest and wave trough.

Gravity waves generated by wind stress on the ocean surface constitute the main type of waves affecting coastal systems. The restoring force for this wave type is earth's gravity and gravity waves are generally composed of sea- and swell waves. Sea waves are formed under direct

influence of the wind on the ocean surface and have peaked crests and broad troughs. They are often complicated with multiple superimposed sets of different wave sizes and whitecaps can be present during high wind speeds. Swell waves develop when the wind stops and when the waves travel outside the area where the wind is blowing. They have a sinusoidal shape and commonly have long wavelengths and small wave. Whether a coast is primarily affected by sea or swell waves is largely determined by the general climatic conditions and coastline geography.

The CHW applies a wave environment perspective and distinguishes between **exposed**, **moderately exposed** and **protected** coastlines based on the wave height. The simplified way of estimating the wave exposure makes use of information on the general wave climate, the waterbody size (fetch length) and the wind conditions and is done through the following process:

1) The general wave climate of an area is determined based on the figure below. All coastlines falling into “West coast swell”, “East coast swell” and “Trade/monsoon influences” are classified as swell wave climates, while the remaining types are classified as non-swell wave climates.

2) The specific exposure level for a coastal site is determined based on the table below.

If detailed wave data is available, including for inner waters, the wave exposure should ideally be determined based on the significant wave height occurring continuously for 12 hours per year, the Hs 12h/yr. In that case, a coastline with a Hs 12h/yr > 3 m is classified as exposed, a Hs 12h/yr = 1-3 m is classified as moderately exposed and a Hs 12h/yr.

Figure 9. Global wave environment

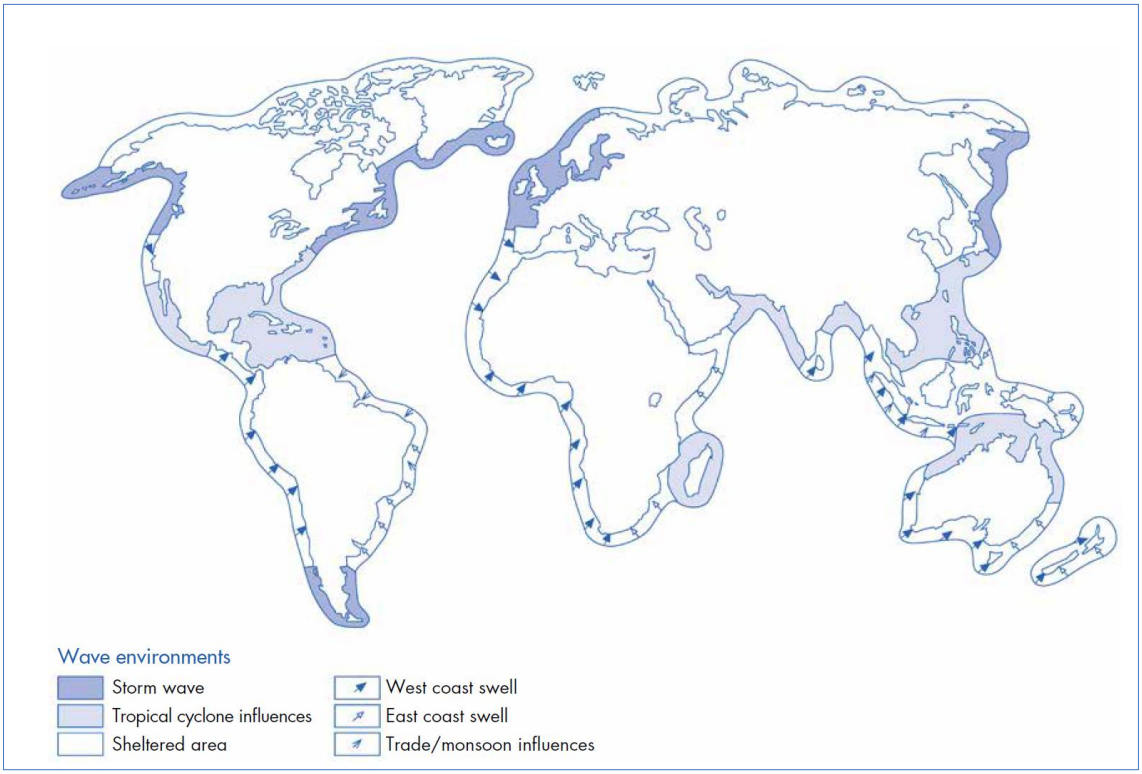


Table 12. Wave exposure classification for the CHW system

General wave climate	Waterbody size (fetch length)	Specific coastal conditions	CHW classification
Swell wave climate **(West coast swell, East coast swell, Trade/ monsoon influences)**	Any	Extreme swell (West coast swell south of 30°S)	**Exposed**
		Swell	**Moderately exposed**
		Backbarrier, inner waters, inner estuary, fjord	**Protected**
Non-swell wave climate **(Storm wave, Tropical cyclone influences, Sheltered area)**	> 100 km	m Stronger on-shore winds	**Exposed**
		Weak on-shore winds	**Moderately exposed**
	10 -100 km	Stronger on-shore winds	**Protected**
		Weak on-shore winds	**Protected**
	< 10 km	Any	**Protected**

Approach

In order to verify existing data to be used to classify the coast along the study area, a series of specific questions regarding their availability and quality were made to the national antennas. The classification of this component at steps 1 and 2 can be done without local wave data by using an indirect method, which is based on the use of a global map for wave conditions together simple geometric rules to indicate local wave exposure. However, the application of CHW at step 3 requires local wave data, and even the application of earlier steps the use of wave data is recommended. The questions are summarized in the following table:

Availability of the data:

i. *Do you have wave time series measured from buoys?*
ii. *Do you have a wave hindcast or wave reanalysis available?*

Quality of the data:

iii. How many buoys do you manage and where are they located? Do you know their exact geographical coordinates?
iv. Are the buoys measuring Significant Wave Height, Wave Period and Wave Direction?
v. How long have the buoys been recording without gaps?
vi. If a wave hindcast is available, which is their horizontal resolution in km?
vii. What is the time step of wave time series?

Accessibility of the data:

viii. Are the wave time series available to everyone?
ix. Are the wave time series in electronic or printed format?
    - Electronic open version

- Electronic version upon request
- Printed version on public information centres
- Printed copies upon request
- Not publicly available

x. Is there a local institution responsible for the production and management of wave time series? If yes, could you please provide the name of the responsible institution/s

Apart from the surveys, online interviews were carried out with each of the national antennas in order to clarify the answers obtained in the surveys and to analyse the steps to be followed in order to obtain the data that is currently lacking. Concerning Wave Exposure, the CHW methodology was explained focusing on the type of data needed to implement the CHW.

Main findings

In what follows, reported existing information is described and discussed in terms of their availability, quality and accessibility. In any case, it has to be considered that these findings directly rely on provided information by national antennas and, this does not preclude the existence of other sources not identified at this phase of the study. It is also worth of mentioning that, quality mostly refers to the type and format of the data and not to the information to be extracted from such data since they have not been yet analysed.

a) Data availability

Wave local information is seldom available at the study area, with only few countries reporting the existence of instrumental (wave buoys) data (Benim, Gambia and Ghana) or reanalysis data (Gambia and Ghana).

However, it has to be considered that, even in the absence of local data in each country; this does not mean that these data does not exist. In fact, there are different global wave databases (instrumental and reanalysis) that cover the study area which could be used to get such information.

Table 12. Data availability for wave exposure

	Benin	Cameroun	Cote d'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo
Wave information coming from buoys								
Wave information from reanalysis data								

b) Data quality

In addition to the scarcity of available data, the reported quality of these data is even lower, with only one country reporting basic characteristics of existing data (Gambia). None of the antennas were able to properly define the quality of existing data in terms of temporal and spatial coverage's.

Responsible institutions for managing wave records in the mentioned three countries (Benim, Gambia and Ghana) have been identified.

Table 13. Data quality for wave exposure

	Benin	Cameroun	Cote d'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo
Number of buoys and location								
Measured Wave Parameters								
Lengths of wave registers and gaps								
Horizontal resolution of wave hindcast								
Time resolution of wave time series								
Responsible institution for managing wave records								

c) Data accessibility

Data accessibility is reported as open and in digital format only for Gambia and Ghana.

Table 14. Data accessibility for wave exposure

	Benin	Cameroun	Cote d'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo
Open access to wave time series								
Wave time series available in a digital numerical format								

Conclusions

On the basis of the information provided by National antennas and the subsequent analysis performed by the consultants, most countries of the area do not have local information to characterize the Wave exposure component of the CHW. The only exceptions are Gambia and Ghana and, in a lesser extent, Benin.

However, this information can be obtained from existing global databases (see Annex I): In spite of this, the computation of this component at steps 1 and 2 can easily be done following the recommendations for implementing CHW by using indirect information, which is computed by graphic means based on the location of each coastal stretch. For step 3 computations, local wave data are required.

2.1.3. Parameter 3: Tidal range

Overview

Tides can have major impact on shoreline processes and on the development of coastal landforms. They are a manifestation of the moon's and sun's gravitational force acting on earth's hydrosphere and are present in the form of oceanic waves with wavelengths of thousands kilometres, resulting in periodic fluctuations in coastal water levels. Tides fluctuate on a daily basis following diurnal, semidiurnal and mixed tidal cycles. Diurnal tides exhibit one tidal cycle daily whereas semidiurnal tides exhibits two cycles daily. Mixed tides have components of both diurnal and semidiurnal tides varying throughout the lunar cycle.

From a morphodynamic perspective, it is the tidal range that significantly influences coastal processes and controls the horizontal extent of the intertidal zone, the vertical distance over which coastal processes operate and the area being exposed and submerged during a tidal

cycle. The tidal range is defined as the height difference between the high water and low water during a tidal cycle.

The tidal range is the third variable to be characterized to apply the CHW once a coastal stretch has already been classified according to wave exposure. It serves to characterize the vertical dimension where shallowest coastal processes take place as well as the extension of the intertidal zone, which influence coastal processes and local morphodynamics.

For classification purposes, coastlines can be grouped into various tidal environments based on tidal range and a generally used classification system operates with the three main categories micro-tidal, meso-tidal and macro-tidal.

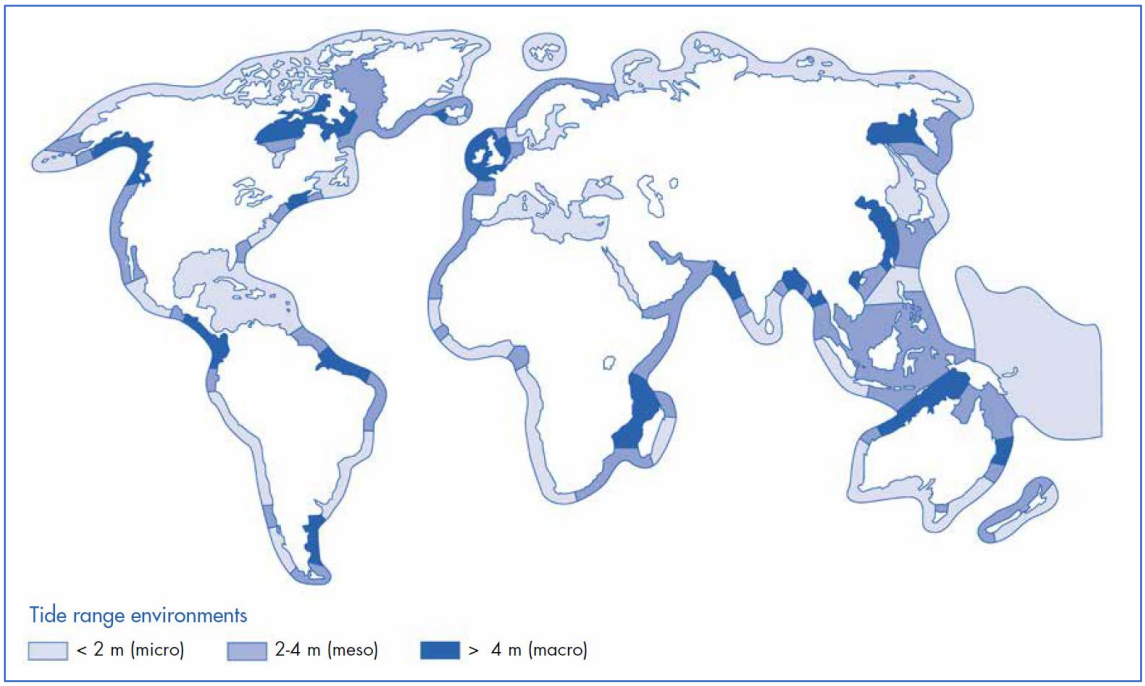
Micro-tidal environments are defined as coasts where the tidal range does not exceed 2 meters and can be found on open ocean coastlines such as the southern seaboard of Australia and the majority of the African Atlantic coast.

Meso-tidal environments are defined as coasts with a tidal range of 2-4 meters and examples of these are found on the Malaysian and Indonesian coasts and on the eastern seaboard of Africa.

Macro-tidal environments are defined as coasts where the tidal range exceeds 4 meters and examples of these are found on some of the northwest-European coasts and in parts of northeastern North America.

The global distribution of micro-, meso- and macro-tidal environments is shown in the following figure:

Figure 10. Map over global tidal environments



Specific questions regarding their availability and quality were made to the national antennas. Although the classification of this component at steps 1 and 2 can be done without local data, the application of CHW at step 3 requires tidal data. The questions are summarized in the following table:

Availability of the data:
i. Do you have tidal records from harbours available?
ii. *Do you work with tidal data from satellite missions?*

Quality of the data:

i. *In how many harbours do you have tidal records?*

ii. *Is there an entity responsible for reviewing and analyzing the quality of the tidal records?*

iii. *If yes, could you please provide the name of the responsible institution/s:*

Accessibility of the data:

i. *Is there a local institution responsible for the production and management of the tidal data?*

ii. *If yes, could you please provide the name of the responsible institution/s:*

iii.

iv. *Is the database publicly available to everyone in digital format?*

v. *Is the tidal data available in electronic or printed format?*

- *Electronic open version*
- *Electronic version upon request*
- *Printed version on public information centres*
- *Printed copies upon request*
- *Not publicly available*
- *Other:*

Apart from the surveys, online interviews were carried out with each of the national antennas in order to clarify the answers obtained in the surveys and to analyse the steps to be followed in order to obtain the data that is currently lacking. Concerning Tidal Range, the CHW methodology was explained focusing on the type of data needed to implement the CHW.

Main findings

In what follows, reported existing data are described and discussed in terms of their availability, quality and accessibility. In any case, it has to be considered that these findings directly rely on provided information by national antennas and, this does not preclude the existence of other sources not identified at this phase of the study. It is also worth of mentioning that, quality mostly refers to the type and format of the data and not to the information to be extracted from such data since they have not been yet analysed.

a) Data availability

Local tide information from tidal gauges is available in five countries of the study area (Benim, Gambia, Ghana, Guinea and Senegal).

However, it has to be considered that, even in the absence of local data in each country; this does not mean that these data does not exist. In fact, there are global tidal databases covering the study area which could be used to get such information, specially taking into account the required precision for such data.

Table 15. Data availability for tidal range

	Benin	Cameroun	Cote d'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo
Tidal records in harbours								
Tidal data from satellite missions								

b) Data quality

In addition to the scarcity of available data, only three countries (Gambia, Guinea and Senegal) reported the availability of tidal data at different locations along the coast.

Responsible institutions for gathering and managing tidal records have been identified for countries where the existence of data has been reported (Benim, Gambia and Ghana).

Table 16. Data quality for tidal range

	Benin	Cameroun	Cote d'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo
Multiple locations with tidal data along the coast								
Responsible institution for managing tidal records								

c) Data accessibility

Data accessibility is reported as open and in digital format only for Gambia and Ghana.

Table 17. Data accessibility for tidal range

	Benin	Cameroun	Cote d'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo
Public Access to tidal data								
Tidal records available in digital numerical format								

Conclusions

On the basis of the information provided by National antennas and the subsequent analysis performed by the consultants, five countries of the area have access to local information to characterize the Tidal range component of the CHW.

In spite of this and taking into account the low accuracy required to characterize this component, this can easily be solved. Thus, the computation of this component at steps 1 and 2 can be done following the recommendations for implementing CHW by using the geographic location of each site with respect to the global distribution of tidal ranges and, for step 3 the information can be obtained from existing global databases (see annex 1).

2.1.4. Parameter 4: Flora/Fauna

Overview of the parameter

Different types of flora and fauna have different degrees of vulnerabilities to climate change. Within the CHW system, the flora/fauna is a parameter that has been included where it is considered to play an important role in the coastal characteristics. The Flora/Fauna classification within the CHW methodology refers essentially to the type of vegetation and the surface it occupies within a particular coastal region. The categorization of this parameter depends on the classification of the coast in accordance with the first levels of classification, namely: the geological layout, the wave exposure and the tidal amplitude. In total, the classification system operates with **nine different categories** in this parameter, namely: intermittent marsh; intermittent mangrove; marsh/tidal flat; mangrove/tidal flat; marsh/mangrove; vegetated; non vegetated; coral and any.

The intermittent marsh and marsh/tidal flat categories are applied to coastlines whose geological layout falls into the categories sedimentary plain, barrier and delta/low estuary island. The marsh is a grass-like vegetation of salty and brackish areas along *protected*, low energy coastlines. It colonizes higher parts of the intertidal environment, forming coastal wetlands that

act as a sediment trap for fine grained sediment. Marsh areas gradually build up from continuous flooding and subsequent sediment deposition which can be particularly significant during storm events. Due to the continuous accumulation of sediment, marsh areas in some cases can follow sea level rise but will eventually be flooded if the sea level rises too quickly. In locations with a high tidal range, marsh areas are often continuous and combined with extensive tidal flats. It is for this reason that the CHW classification distinguishes between the intermittent marsh category applied to areas with micro-tidal conditions and the marsh/tidal flat category applied to areas with meso/macro-tides.

The intermittent mangrove and mangrove/tidal flat categories are applied to coastlines falling into the geological layout categories sedimentary plain, barrier and delta/low estuary island. Mangrove is a woody shrub vegetation that grows along protected, low energy coastlines, forming a swampy environment. It is very dependent on air temperature and cannot tolerate cold to freezing conditions and its geographical extension is therefore limited to low and moderate latitudes. The extensive root network of mangroves acts as an efficient trap for fine grained sediment and reduces coastal wave erosion. Similar to marsh areas, mangrove forests are rich ecosystems that provide nursing grounds for many animals in addition to limiting erosion and flooding from tropical storms. In the classification system, the intermittent mangrove category is applied to areas with micro-tidal conditions, while the mangrove/tidal flat category is applied to areas with meso/ macro-tides (although mangroves often colonize most of the tidal flats). The combined marsh/mangrove category is applied to protected, flat hard rock coasts that have a band of marsh/mangrove vegetation. If a sloping hard rock coast has a significant band of marsh/mangrove vegetation, it will automatically fall into the flat hard rock category.

The vegetated and non-vegetated categories is applied to the geological layout category sloping soft rock coast where vegetation of the coastal slopes plays an important role for the coastline characteristics and determines whether it can be considered a coastal cliff or not. The vegetated category is applied when there is more than 25% of the initial coastal slope that is covered with vegetation while the non-vegetated category is used when less than 25% of the initial slope is vegetated. Possible vegetation includes different grasses, scrubs and trees depending on the soft rock properties, slope and climatic conditions. Although some types of vegetation have a better stabilizing effect than others, the important criteria from a coastal classification perspective is whether the coastal slope is vegetated or not. Sloping soft rock coasts may have a narrow band of marsh or mangrove vegetation but this is not considered of major importance from a coastal classification perspective. In cases where the fronting marsh or mangrove areas are more extensive, the coastline will automatically fall into one of the non-sloping geological layout categories.

The coral category is only available for flat hard rock coasts and sloping hard rock coasts where the corals have a hard substrate to thrive on. Corals are living organisms living in large colonies as polyps with an external skeleton of calcium carbonate. Since they generally attach to hard substrates, rocky shorelines provide suitable coral habitats. Coral species that can form reefs only thrive in water temperatures of between 18°C and 34°C and are thus limited to tropical and subtropical environments. Reef building corals are very light sensitive and reefs and thus reefs are seldomly created at depths greater than 50 meters. Water turbidity and salinity can be important parameters for reef formation, and high turbidity can decrease light penetration and increase sedimentation, thereby inhibiting coral growth. Corals can survive in high energy wave environments and even shows enhanced growth on exposed coastlines. Therefore, in the classification system, the coral category includes both fringing and barrier reefs fronting rocky coastlines. The separate geological layout category for coral islands is also assumed to be surrounded by coral reef environments.

The Any category (also indicated with an A in the CHW) is used when the flora/fauna is not considered to play an important role for the coastal characteristics and hazard profile. In some

cases, the flora/fauna may have relevant functions, but compared to the other classification parameters it is not expected to influence the coastal character significantly.

Thus, the Flora/Fauna classification parameter can be summarized as follows:

- If the geological layout has the form of a **sedimentary plain, a barrier or a delta**, the type of flora and fauna is only important if the classification in terms of wave exposure falls in the type of protected coasts. In this case, the coast is classified between mangrove or marsh which, in turn, are micro or mesotidal depending on the type of tidal range.
- When the geological layout falls within the type of **sloping soft rocky coast** the flora and fauna are only important for exposed and moderately exposed coasts, and the classification is not related to the type of vegetation (mangrove or marsh) but to the proportion of vegetated surface. Thus, the coast is classified as vegetated or non-vegetated when the percentage of vegetated surface is above or below 25%.
- In **hard rocky coasts**, either sloping or flat, flora and fauna do not play a role in the classification unless there is a coral reef. A specific type is defined for this situation
- In the particular case of **protected flat hard rock**, flora and fauna is divided into coral, marsh/mangrove or non vegetated
- In **coral islands** flora and fauna do not play a role in the classification

Approach

The principle data requirements for classifying the flora/fauna in the CHW classification is through Google Earth's satellite images. Further to this, information on the latitude of the assessment area and the UNEP-WCMC global coral reef database available at http://data.unep-wcmc.org/datasets/1 (UNEP-WCMC 2015). The Google Earth satellite images are used to visually evaluate the extension and type of coastal vegetation, the information on latitude is used to determine whether coastal wetlands are vegetated with marsh or mangroves (local photos from Google Earth can also be used for this), and the coral reef database is used to identify stretches of coastal coral reefs. It may be difficult to determine the percentage of vegetation cover for sloping soft rock coasts based on Google Earth's satellite images and to avoid underestimating the hazard levels, it is recommended to assume that the coastline has no vegetation in cases where there are doubts about the actual percentage.

As part of the data gathering process to understand the readiness level of the countries participating in the study, a series of questions were devised and sent out to the national antennas to obtain a clearer understanding of the status of the biodiversity (flora/fauna) data.

These questions refer to the availability, quality and accessibility of the data. The questions go beyond the identification of CHW-ready data to gain a deeper understanding of what data, the countries forming part of the assessment, have in case a deep dive is required in biodiversity analysis with regards to risks hazards. The questions are summarized in the following table:

Availability of the data:
(i) Do you have a database of flora and fauna cover made of satellite images from Google Earth?
(ii) If you have a database, please indicate if the following data is included: ○ Phytoplankton population dynamics + chlorophyll-a (water quality) ○ Invasive species (land and marine) ○ Species (threatened, endangered, protected) ○ Total catch by species and quota
(iii) Do you have a source to measure the latitude of the assessment area?
(iv) Do you have a database specifying the marine and coastal protected areas?

(v) Do you have a database updated from other external sources (as UNEP coral reef database, or field studies)?
    - If yes, please specified the sources used
(vi) Has the database been produced nationally/regionally/globally?
(vii) Is there a local institution responsible for the production and management of the shoreline database)

If yes, could you please provide the name of the responsible institution?

Quality of the data:

(viii) What is the date of the last update of the biodiversity database?
(ix) Frequency of the update currently used for the database
(x) Is there an entity responsible for reviewing and supervising the quality of the database updates?
    - If yes, could you please provide the name of the responsible institution/s?

Accessibility of the data:

(xi) Is the database publicly available to everyone?
(xii) Is the data available in electronic or printed format? Please chose from one of the options below:
    - Electronic open version
    - Electronic version upon request
    - Printed version on public information centres
    - Printed copies upon request
    - Not publicly available

Apart from the surveys, online interviews were carried out with each of the national antennas in order to clarify the answers obtained in the surveys and to analyse the steps to be followed in order to obtain the data that is currently lacking. Concerning biodiversity, the CHW methodology was explained focusing on the type of data needed to implement the CHW.

Main findings

Overall, the evaluation and data gathering phase shows that the status of the biodiversity data in the region is mixed with some countries that have the availability of good data for the flora/fauna parameter while other countries are lacking data availability and/or quality.

a) Data availability

Concerning the availability of data, Gambia and Guinea are the best prepared, they both possess databases of satellite images that are especially useful for the CHW biodiversity classification. Moreover, they have extensive studies that detail the significant diversity with specific data concerning invasive and threatened species, which can be used to complement the risk evaluation. Other countries including Benin, Cameroon and Ghana have different types of information available mainly through biodiversity studies in the coastal areas that would need to be processed in order to be used for CHW classification. However, the lack of aerial photos, Google Earth images or the like, indicate that significant data gathering (of coastal images) in terms of flora and fauna coverage along their coasts would need to be undertaken. Finally, the Ivory Coast, Senegal and Togo have the scarcest availability of data terms of biodiversity (flora/fauna) in terms of the CHW classification. It should be noted however that institutions responsible for shoreline databases were identified for Benin, Gambia, Guinea and Senegal. The data availability is summarized in the following table, the table is developed based on the answers from the surveys of each country representative. The colours, green, red and white correspond to positive, negative and no answer, respectively.

Table 18. Data availability for flora/fauna

	Benin	Cameroon	Cote d'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo
Flora and fauna database cover with satellite images by Google Earth								
Phytoplankton dynamics + chlorophyll-a								
Invasive species								
Threatened species								
Total catch by species and quota								
Source to measure latitude of assessment area								
Marine and coastal protected areas								
Database updated with other sources								
At national level								
At regional level								
At global level								
Local institution responsible for shoreline database								

b) Quality of data

Concerning the quality of the database, little information was obtained based on the surveys and interviews with the national antennas. An institution responsible for supervising the quality of the database updates, however, were identified for Benin, Cameroon, Gambia, Guinea and Senegal. However, none of the national antennas have information regarding the last update or the regular frequency at which these databases have been updated through the surveys and subsequent interviews. The data availability is summarized in the following table, which is developed following the answers of the surveys obtained from each country. As above, the colours green, red and white correspond to positive, negative and no answer, respectively.

Table 19. Data quality for flora/fauna

	Benin	Cameroun	Cote d'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo
Knowledge of last update of the biodiversity database								
Frequency of update currently been used for the database								
Knows of the institution/s responsible for reviewing and supervising the quality of the database updates								

c) Accessibility

The information from the countries regarding the accessibility of the data was also scarce following the results of the surveys and interviews. Gambia and Guinea state that there is a publicly available database, whereas Ghana and Senegal highlight the possibility of obtaining electronic or printed information upon request. The rest of the country representatives were unaware of the accessibility of the data. The data accessibility is summarized in the following table, which is built based on the answers of the surveys obtained from each country. Again, green, red and white correspond to positive, negative and lacking answer, respectively.

Table 20. Data accessibility for flora/fauna

	Benin	Cameroun	Cote d'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo
Database publicly available								
Electronic open version								
Electronic version upon request								
Printed version on public information centres								
Printed copies upon request								
Not publicly available								

Although the availability and quality of data for the flora/fauna classification is based solely on the Google images or aerial photos, we note that only Gambia and Guinea are ready to implement the CHW classification for this parameter. The implications of these findings is that the data for the flora/fauna parameter for Benin, Cameroon, Gambia, Guinea and Senegal would need to be collected before classifying sections of their coastal areas.

Conclusion for the Flora/Fauna

On the basis of the inventory work and analysis performed by the consultants, it appears that apart from Gambia and Guinea, most countries are not ready for assessing the Biodiversity (flora/fauna) parameter following the CHW classification system:

- The general lack of aerial photographs or satellite images of coastal flora in the region somewhat inhibits the application of the CHW methodology concerning the flora and fauna classification
- The identification of mangrove and marsh areas has not been undertaken in most cases or there doesn't exist the required quality (photo detail) to classify an area as mangrove or marsh.
- Vegetated and non-vegetated areas, and especially in the areas that are geologically classified as a slope soft rock, have not been identified
- Similarly, coral reefs have to be identified along the whole region
- Positively there is rich information on Biodiversity in technical reports and studies (e.g. Cameroon) however, this is complementary information to Biodiversity parameter in the CHW classification

Finally, Guinea and Gambia are ready to implement the CHW methodology concerning the flora/fauna classification. On the other hand, the rest of the countries would need to work on gathering and processing the information (Databases, Google Earth Images, Open Access) in order to be able to follow the procedure as laid out in the CHW classification. Specifically, the coastline should be followed through Google Earth images in order to identify the areas with the different types of vegetation (marsh or mangrove) and the amount of vegetated surface. However, positively as this data can be "collected" at the time of doing the classification, by using Google Earth images, the implications of not having the data ready for this parameter are not significant.

2.1.5. Parameter 5: Sediment Balance

Overview

The sediment balance is an essential morphodynamic parameter and particularly important for coastlines falling into the sedimentary/soft rock categories. The sediment balance determines whether there is a net balance, deficit or surplus of sediment at a particular coastline over time and is largely determined by the sediment transport/availability and the relative sea level change.

The Sediment Balance is the fifth variable to be characterized to apply the CHW once a coastal stretch has already been classified according to the flora/fauna component. It serves to characterize the evolutionary stage of sedimentary and soft rock coastlines.

It uses a simple classification system which varies depending on the geological nature of the analysed coastal stretch (sedimentary/soft rock or hard rock). In the first case it determines the net sediment balance and, in the second case, it simply determines the presence or absence of beaches.

In the CHW, the sediment balance section includes the two main categories **balance/deficit** and **surplus** and the two special categories **no beach** and **beach** that applies to the hard rock coastlines. It has been decided to group the balance/deficit categories together to simplify the classification system and to ease the difficult evaluation of the sediment balance. Coastal areas that are currently experiencing sediment deficits or only have sufficient sediment to remain stable at current conditions are likely to suffer from sediment deficits with a rising sea level unless new sediment sources emerge (Haslett 2009). Coastal areas that currently experience sediment surplus might suffer deficits at a later stage if sea level rises sufficiently or there is a change in local sediment supply, but these coastlines are less likely to experience severe sediment deficits in the near future.

For achieving an optimal accuracy of the sediment balance evaluation, detailed temporal data on coastline stability would be valuable. The CHW system therefore makes use of basic historical satellite data available in Google Earth to evaluate the sediment balance. In case there is any doubt about the sediment balance evaluation, the user should assume a balance/deficit as this is the default category for the CHW system. This is also recommended where there are any indications of short-term human alteration of the sediment balance.

For hard rock coastlines, the CHW does not require a sediment balance evaluation but simply apply a no beach category if the coast consists of bare rock and a beach category if some kind of beach environment is present.

Data requirements vary in type and/or accuracy according to the step of application of the CHW. Step 1 requires the less detailed information and analysis and, essentially, it consists of the comparison of coastal configurations obtained from remote sensing data to assess their qualitative evolution. Step 2 implies field verification of classified balance, and step 3 requires detailed data to quantitatively assess coastline evolution.

Approach

In order to verify existing data to be used to classify the coast along the study area, a series of specific questions regarding their availability and quality were made to the national antennas. Although the classification of this component at step 1 does not require local information, the application of CHW at further steps 2 and 3 requires local verification of remote classifications and local data respectively. The questions are summarized in the following table:

Availability of the data:

(i) Do you have available studies or reports about coastline erosion?
(ii) Do you have historical orthophotography available?
(iii) Do you have digitalized historical shorelines?
(iv) Do you have an inventory of anthropogenical actions against or for coastal erosion?
(v) Is there a local institution responsible for the production and management of the shoreline database?
(vi) If yes, could you please provide the name of the responsible institution/s:

Quality of the data:

(vii) Are the orthophotos available in digital and georeferenced format?
(viii) What are the dates with orthophotos available?
(ix) What are the dates of the historical shorelines?
(x) What is the file format of the historical shorelines? Shapefile, CSV?

Accessibility of the data:

(xi) Is the database publicly available to everyone?
(xii) Is the data available in electronic or printed format? Please chose from one of the options below:

- Electronic open version
- Electronic version upon request
- Printed version on public information centres
- Printed copies upon request
- Not publicly available

Apart from the surveys, online interviews were carried out with each of the national antennas in order to clarify the answers obtained in the surveys and to analyse the steps to be followed in order to obtain the data that is currently lacking. Concerning Sediment Balance, the CHW methodology was explained focusing on the type of data needed to implement the CHW.

Main findings

In what follows, reported existing information is described and discussed in terms of their availability, quality and accessibility. In any case, it has to be considered that these findings directly rely on provided information by national antennas and, this does not preclude the existence of other sources not identified at this phase of the study. It is also worth of mentioning that, quality mostly refers to the type and format of the data and not to the information to be extracted from such data since they have not been yet analysed.

a) Data availability

The main source of information to characterize this component are orthophotos covering a time period long enough to assess significant changes in coastline position. Nearly all countries in the study area with the exception of Togo have reported the existence of historical ortophotos susceptible to be used. This is complemented with the case of the existence of derived shorelines which is reported by four countries (Benim, Gambia, Ghana and Guinea).

In addition to this, all countries report the existence of local studies dealing with erosion problems, which could be used in step 2 as a way of in-situ verification. Responsible institutions for producing and managing shoreline database have been identified in five of the eight countries.

Table 21. Data availability for sediment balance

	Benin	Cameroun	Cote d'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo
Studies / reports on coastal erosion								
Availability of historical ortophotos								
Availability of digital historical shorelines								
Inventory of anthropogenic actions to fight coastal erosion								
Local institution responsible for the production and management of the shoreline database								

b) Data quality

All countries reporting the existence of orthophotos indicate that they are in digital format and have already been georeferenced. However, the exact dates of available photos and shorelines are insufficiently described by most of the countries, and it is necessary to identify their temporal coverage to see if they are covering a time period long enough to properly characterize long-term changes.

Table 22. Data quality for sediment balance

	Benin	Cameroun	Cote d'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo
Orthophotos in digital and georeferenced format								
Available dates of historical ortophotos		1980 -2015	various – non regular		2005	2018		
Format of digital historical shorelines	shapefile				shapefile			
Available dates of historical shorelines					1974			

c) Data accessibility

As with most of the previous data, data accessibility is reported in digital format upon request.

Table 23. Data accessibility for sediment balance

	Benin	Cameroun	Cote d'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo
Are the historical shorelines publicly available?								
Electronic open version								
Electronic version upon request								
Printed version on public information centres								
Printed copies upon request								
Not publicly available								

Conclusions

On the basis of the information provided by National antennas and the subsequent analysis performed by the consultants, nearly all countries of the area seem to have local information to characterize the Sediment balance component of the CHW. The only exception is Togo. Also, there is additional local information on erosion problems along the coast in form of studies/reports that could be used as a way of field verification of observed changes.

However, to properly assess their adequacy to quantify this component is necessary to identify the temporal and spatial coverage of the data. Also, it is necessary to identify which parts of the coast are covered by existing reports/studies to assess the need of further field verification. In the case that existing information do not have an adequate time and/or spatial coverage, existing global databases can be used to characterize this component (see annex 1).

2.1.6. Parameter 6: Storm climate

Overview

The storm climate is the last variable to be characterized to apply the CHW once a coastal stretch has already been classified according to all previous parameters. It serves to characterize very extreme conditions that may significantly affect coastal morphodynamics and hazard profiles.

The classification system is based on a binary rule by distinguishing if the analysed coastal stretch is located in an area with or without tropical cyclone activity, without considering neither their frequency nor intensity. The classification system uses the map shown earlier in 1.1.3. This is applied at all steps of the implementation of the CHW. This implies that data requirement for this component is almost null, so it can be covered by just an assessment of the location of each coastal stretch with respect to the global distribution of tropical cyclone activity.

Approach

In spite of this low data requirement, and to verify existing data to check the theoretical influence of cyclone activity with respect to the real one, a series of specific questions through a survey were made to the national antennas. The questions are summarized in the following table:

Availability of the data:

(i) Do you have a database reporting storms in terms of their intensity and the damage to the coast?
(ii) If no, do you have any other database reporting storms with other indicators?
(iii)
(iv) How has the database been produced?
(v) Is there a local institution responsible for monitoring the storms in terms of their hydrodynamics?
(vi) If yes, could you please provide the name of the responsible institution/s:

Quality of the data:

(i) How many storms have been reported in the storm database?

Accessibility of the data:

(i) Is the storm database publicly available to everyone?
(ii) In which format is the data available?
- Electronic open version
- Electronic version upon request
- Printed version on public information centres
- Printed copies upon request
- Not publicly available

Apart from the surveys, online interviews were carried out with each of the national antennas in order to clarify the answers obtained in the surveys and to analyse the steps to be followed in order to obtain the data that is currently lacking. Concerning Storm Climate, the CHW methodology was explained focusing on the type of data needed to implement the CHW.

Main findings

Only three countries of the region reported the compilation of information on storm impacts and associated damage in their coasts (Gambia, Ghana and Senegal). Two of the three countries (Gambia and Senegal) reported that the storm database has of nationwide coverage. The accessibility to this database is only indicated for Gambia, although the included information is insufficiently described,

Table 24. Data availability for sediment balance

	Benin	Cameroun	Cote d'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo
Database reporting storm intensity and damage								
Reports on storm characteristics								
Institution of storm monitoring								

Table 25. Data quality for sediment balance

	Benin	Cameroun	Cote d'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo
Storm database Level:								
National								
Regional								
Local								
Length of storm database								

Table 27. Data accessibility for sediment balance

	Benin	Cameroun	Cote d'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo
Open Access of Storm database								
Digital numerical format								

Conclusions

On the basis of the information provided by National antennas and the subsequent analysis performed by the consultants, only three countries of the area have local information about storm impacts on the coast to be used to verify the real importance of the storms activity in their coast.

In spite of this, the computation of this component does not strictly require such information and, in consequence, can be easily assessed by considering the geographic location of each site with respect to the global distribution of tropical cyclone activity.

2.2. Integration into the CHW system: overview of countries and proposed roadmap

In the present chapter, linked to the analysis per parameter performed in section 2.1, an overview of the situation of each country is given in terms of data requirements to implement CHW.

The analysis is based on the availability, quality and accessibility of a list of datasets. This has been tackled through a standardization of these aspects in three categories (red, orange and red) as shown in the following table (see table 28):

Table 28. Traffic light classification system for data analysis

	Availability	Quality	Accessibility
	Dataset exists	Dataset reviewed fulfils all the CHW requirements	Dataset is accessible straight from the institution
	It is unknown if the dataset exists.	Dataset partially fulfils the CHW requirements	Dataset is accessible, but need to request to other institutions
	Dataset does not exist.	Dataset not received or useless for CHW	Dataset is not accessible at all

From the aggregation of the availability, quality and accessibility arises the concept of "Readiness", which transmits the preparedness of the country to implement CHW. The readiness is also classified in three categories corresponding to the three steps of the CHW methodology (see data requirements for each dimension in the introduction of this chapter[4]). Even if no field data is available, CHW can be implemented in "Step 1" using publicly open access databases. As a result of the this analysis, each country will be evaluated whether it is ready to extend the CHW to "Step 2" and "Step 3" (which both must include field observations), or if only "Step 1" is feasible, based on open access data.

From the previous results, a list of actions (roadmap) per country is compiled to ensure the integration of the existent data (field and open access datasets) into CHW.

2.2.1. Benin

a) Overview and analysis per CHW parameters

Table 10 provides an overview of the situation of **Benin** in terms of availability, quality, accessibility and readiness level of the required datasets for CHW application, classified by CHW dimension, according to the responses of surveys and remote meetings with *Projet d'Investissement, de Résilience, des Zones Côtières en Afique de l'Ouest (WACA ResIP)*.

[4]More information: https://www.coastalhazardwheel.org/media/1217/main-manual-coastal-hazard-wheel.pdf

Table 29. Data overview in Benin for implementing CHW

Dimension	Responsible institution	Datasets required	Availability	Quality	Accessibiliy	Readiness (step as per CHW)
1. Geological Layout	Institut de Recherche Halieutique et Océanographique du Bénin	Costal geomorphology classification				1
		Shoreline database				
		Current ortophotografies				
		Geological/Lithological map				
		DEM				
		Other report/studies on geomorphology				
2. Wave Exposure	Institut de Recherche Halieutique et Océanographique du Bénin	Buoy datasets				1
		Wave reanalysis				
3. Tidal Range	Institut de Recherche Halieutique et Océanographique du Bénin	Tidal records based on harbour tidal gauges				1
		Tidal datasets based on satellite altimetry				
4. Flora/Fauna	Institut de Recherche Halieutique et Océanographique du Bénin	Flora and fauna database cover with satellite images by Google Earth				1
		Local institution responsible for biodiversity database				
5. Sediment Balance	Institut de Recherche Halieutique et Océanographique du Bénin	Reports about coastline erosion				1
		Historical ortophotography				
		Digitalized historical shorelines				
		Inventory of anthropogenic actions influencing coastal erosion				
6. Storm Climate	Unknown	Storm database				3

In the following paragraphs an analysis per CHW dimensions is performed. Final level of readiness is provided and recommendations for further working on data are suggested.

Parameter 1: Geological Layout

As indicated in table 29, local data is available to characterize Geological Layout, but not accessible (still not provided to the Consultants). Consequently, their quality is unknown. According to the surveys and interview, digital shoreline, current ortophotos, geological map and Digital Elevation Model (DEM) are available.

Readiness level: step 1

Benin is only ready to apply CHW in Geological Layout at Step 1, which only requires access to open access datasets (see the global datasets available in Annex 1). Local datasets are theoretically available, but their quality is not guaranteed for steps 2 or 3.

Shifting the Geological Layout classification to Step 2 and 3, would imply the following:

- Action 1: Assess the quality of the available digital shoreline and ortophotos. In order to use the CHW, the resolution and age (when the picture was taken) of both data sets are key: the resolution of the digital shoreline should be 50 meters or finer and the digital shoreline pictures be frequently updated, at least every 2-3 years.

- Action 2: Prepare and ensure the geological map and DEM are available, in digital format and georeferenced. If not, a GIS expert should work on this to make sure they are made available.

Parameter 2: Wave Exposure

As can be seen in table 29, wave datasets from buoys are available to characterize Wave Exposure, but they are not accessible (still not provided to the Consultants). Consequently, their quality is unknown. Wave reanalysis are not available from the country.

Readiness level: **step 1**

Benin is only ready to apply CHW in Wave Exposure at Step 1, which requires having access to a Geological Layout classification and a global distribution of wave conditions, provided by the CHW methodology (see Annex 1). Local wave buoy dataset are theoretically available, but their quality is not guaranteed.

Shifting the Wave Exposure classification to Step 2 and 3 would imply the following:

- Action 1: Wave buoy datasets should be collected and their quality assessed. The quality must be assessed considering the recorded variables, the length of the time series and the spatial coverage of the coast. First, significant Wave Height (H_s) must be recorded with at least an hourly time step. Timeseries must be homogeneous (not manipulated during recording) and they must contain multiannual data, ideally, 20 years or more.
- Action 2: If wave buoys do not fulfil the required quality thresholds, global wave reanalysis are publicly available as an alternative (see Annex 1). It is recommended to consider using global wave reanalysis as an alternative if wave buoy datasets can not be produced at this time at national level.

Parameter 3: Tidal Range

As can be seen in table 29, tidal datasets from harbours and from satellite missions are available, but they are not accessible (not provided to the Consultants). Consequently, their quality is unknown.

Readiness level: step 1

Benin is only ready to apply CHW in Tidal Range at Step 1, which requires to have access to global tidal information and the map provided by the CHW methodology (see annex 1). Local tidal datasets are theoretically available, but their quality is not guaranteed.

In order to extend Tidal Range classification to Step 2 and 3, local data is required. In this sense the following actions would be necessary:

- Action 1: collect time series from tidal gauges and check their quality. To this end, it is required they have a time-span of at least 20 years and record the sea level from a well defined reference level. With this information, tidal harmonic analysis can be performed and basic statistics can be calculated.
- Action 2: consider using global data sets from satellite altimetry (see annex 1) as an alternative to tidal gauges. Satellite altimetry provides a solution globally to measure precisely sea surface height, derived from the time taken by a radar pulse to travel from the satellite antenna to the surface and back to the satellite receiver.

Parameter 4: Flora/Fauna

As shown in table 29, Benin has some information about biodiversity in the coastal region that is useful for the analysis (protected areas and database updated with other sources). However, it lacks other sources of data (mainly aerial images) that are key for the classification system proposed in CHW. The Institut de Recherche Halieutique et Océanograohique du Bénin is the institution responsible of the availability and quality of biodiversity data in Benin.

Readiness level: step 1

It is unclear if **Benin is ready to apply CHW in Flora/Fauna at Step 1**, which requires having enough quality in aerial images in order to identify the type of vegetation. Nevertheless it is estimated that an acceptable first approximation can be achieved with Google Earth Images.

In order to consolidate Step 1 and to extend Flora/Fauna classification to Step 2 and 3, local data is required. In this sense the following actions should be taken:

- Action 1: analyse Google Earth images in order to check their quality and the feasibility of identifying the type of vegetation on the distinction between marsh and mangrove areas
- Action 2: look for complementary coastal photographs (taken from the ground) that can help to identifying these types of vegetation
- Action 3: perform field trips to those areas that remain unclear after applying the previous recommendations.

Parameter 5: Sediment Balance

As can be seen in table 29, historical orthophotos, historical shorelines, local studies and an inventory of anthropogenic actions are available, but they are not accessible (not provided to the Consultants). Consequently, their quality is unknown.

Readiness level: step 1

Benin is ready to apply CHW in Sediment Balance at Step 1, which requires only to have access to Google Earth timeline application, in combination with Geological Layout classification.

In order to extend Sediment Balance classification to Step 2 and 3, local data is required. In this sense the following recommendations are suggested:

- Action 1: collect historical orthophotos and historical shorelines. Data gathered should be digitalized and georeferenced. Ideally, multiple ortophotos/digital shoreline should be available covering a period as long as possible, e.g., 20 years.
- Action 2: build an inventory of all coastal anthropogenic actions along the coast during the past years. This should include urbanisation in coastal areas, coastal protection infrastructures and other coastal activities. This is a very useful way to identify coastal stretches with erosion/accretion problems.

Parameter 6: Storm Climate

As indicated in Table 29, there is not storm database available. However, there is no need of local information within the 3 steps of CHW methodology, as the West African Coast is not affected by tropical cyclones (see annex 1 for more information).

Readiness level: step 3

Benin is ready to apply CHW in Storm Climate at Step 3. Storm Climate classification is immediate, since all country is classified as non-tropical cyclone affected.

There is no further recommendation to apply CHW in Storm Climate.

Conclusion

Benin is only ready to implement the CHW at step 1 using open access datasets provided in Annex 1. Further implementation of step 2 and 3 will imply further data collection, quality analysis and a processing of all the existing data.

b) Recommendations for enabling the environment for CHW implementation

In order to enable a proper environment for the implementation of CHW, it is recommended to take the following actions in Benin:

- Recommendation 1: name a national coordinator within WACA ResIP, who will be responsible of CHW implementation and interaction with the consultants.
- Recommendation 2: establish direct contact with the *Institut de Recherche Halieutique et Océanographique* du Bénin and other institutions with the objective of exchanging information and expertise.
- Recommendation 3: establish a CHW team in *WACA ResIP*, led by CHW coordinator, composed by technical staff with expertise in data analysis, GIS and/or oceanography.
- Recommendation 4: check the available computer resources in *Institut de Recherche Halieutique et Océanographique*. At this level, it is essential to have a Geographic Information System (GIS) software. It is advised to use Quantum-GIS[5], an open source GIS software that can be used in a laptop or a desktop computer with any operating system. Alternatively, ArcGIS can be used, but implies purchasing a license.

c) Proposed agenda for CHW implementation (to be agreed upon with WACOM Antennas and Cameroon):

The implementation of CHW starts with the mapping of the coast for each CHW dimension. To this end, the consultants suggest the following phases for Benin:

Phase 1: using the open access digital shoreline, define basic units segmenting it in coastal stretches in which the Geological layout (Parameter 1) is uniform. This can result in stretches from hundreds of meters to kilometres, depending on the Geological Layout spatial variability. Recent Google Earth satellite images can be used in this case as a basis, together with a geological map and a DEM.

This task is estimated to be completed **in three weeks** by a GIS specialist.

Phase 2: classify the basic units defined in phase 1 according to Wave Exposure, Tidal range and Storm Climate. Wave exposure and Storm climate can be classified according to the Global Wave Environments map (Davies 1980, modified by Masselink and Hughes 2003 and Rosendahl Appelquist) map, Wave exposure classification for the CHW system[6] and Map over global todañ environment (Davies 1980, modified by Masselink and Hughes 2003) (see annex 1).

This task is estimated to be completed **in one week** by a GIS specialist.

Phase 3: classify the basic units defined in phase 1 according to Flora/Fauna. We propose that Google Earth images should be revised in order to identify those areas where resolution is enough to describe the type of vegetation and the percentage of area with vegetation. This process should be carried out in **two weeks**.

For those areas without enough resolution, complementary information should be acquired that allows the identification of these variables. Additionally, field trips should be performed to those areas where vegetation cannot be identified and quantified otherwise.

These processes should be carried out in **two weeks**.

[5] https://qgis.org/en/site/

[6] https://www.coastalhazardwheel.org/media/1217/main-manual-coastal-hazard-wheel.pdf

Phase 4: classify the basic units defined in phase 1 according to Sediment Balance by comparing multiple historical shorelines and/or historical ortophotos In the timeline function of Google Earth, satellite and ortophotos are available. Coastal deficit, balance or surplus in each basic unit has to be assessed through the identification of coastline retreat or advance across the last decades by comparing the evolution of historical coastlines. It is important to note if a dominant erosion/accretion behaviour is possible to be related with some anthropogenic action. Only ortophotos from the same month or season must be taken in consideration in order to filter inter-annual oscillation of the coast.

This task is estimated to be completed in **two weeks** by a GIS specialist.

2.2.2. Cameroon

a) Overview and analysis per CHW dimension

Table 30 provides an overview of the situation of **Cameroon** in terms of availability, quality, and accessibility of the required datasets for CHW application, classified by CHW dimension, according to the responses of surveys and remote meetings with *National Observatory on Climate Change*. The following table provides an overview of the situation of the country

Table 30. Data overview in Cameroon for implementing CHW

Dimension	Responsible institution	Datasets required	Availability	Quality	Accessibiliy	Readiness (step as per CHW
Geological Layout	Unknown	Costal geomorphology classification				1
		Shoreline database				
		Current ortophotografies				
		Geological/Lithological map				
		DEM				
		Other report/studies on geomorphology				
Wave Exposure	Institue de Research Geologiques et Minerie (IRGM)	Buoy datasets				1
		Wave reanalysis				
Tidal Range	National Marine Service	Tidal records based on harbour tidal gauges				1
		Tidal datasets based on satellite altimetry				
Flora/fauna	Unknown	Flora and fauna database cover with satellite images by Google Earth				1
		Local institution responsible for biodiversity database				

Sediment Balance	Unknown	Reports about coastline erosion				1
		Historical ortophotography (Years: 1980, 2005)				
		Digitalized historical shorelines				
		Inventory of anthropogenic actions influencing coastal erosion				
Storm Climate	Unknown	Storm database				3

In the following paragraphs an analysis per CHW parameter is proposed with the readiness level of the country and specific recommendations for the implementation of the CHW in the country.

Parameter 1: Geological Layout

As seen in Table 30, local data are available to characterize the Geological Layout. A digital shoreline and a geological map were received by the Consultants. The provided digital shoreline is in Shapefile format, although geographical projection is not clearly provided and the date is unknown. The geological map is in PNG format (no georeferenced), but can be still used. No current ortophotos are available. A DEM should be available, but it is not accessible by the Consultants. Therefore, its quality has not been assessed.

Readiness level: step 1

Cameroon is only ready to apply CHW in Geological Layout at Step 1, which only requires access to open access datasets (see the global datasets available in Annex 1). Local datasets are theoretically available, but their quality is not guaranteed for steps 2 or 3.

Shifting the Geological Layout classification to Step 2 and 3, would imply the following:

- Action 1: identify the geographical projection and date of the digital shoreline. In order to use the CHW, it is necessary to know the date of the shoreline pictures that should be frequently updated, at least every 2-3 years.
- Action 2: Ensure the geological map is in digital format and georeferenced. It is recommended to work on a georeferenced geological map.

Parameter 2: Wave Exposure

As can be seen in the table, wave datasets from buoys or reanalysis are not available to characterize Wave Exposure. Publicly datasets can be used instead.

Readiness level: **step 1**

Benin is only ready to apply CHW in Wave Exposure at Step 1, which requires having access to a Geological Layout classification and a global distribution of wave conditions, provided by the CHW methodology (see Annex 1).

Shifting the Wave Exposure classification to Step 2 and 3 would imply the following:

- Action 1: use global wave reanalysis as an alternative as wave buoys datasets are not available. The teams should start familiarizing with these data sets.

Parameter 3: Tidal Range

As can be seen in Table 30, tidal datasets from harbours and from satellite missions are not available.

Readiness level: step 1

Cameroon is only ready to apply CHW in Tidal Range at Step 1, which requires to have access to global tidal information and the map provided by the CHW methodology (see annex 1).

In order to extend Tidal Range classification to Step 2 and 3, local data is required. In this sense the following actions should be taken:

- Action 1: As local tidal gauges are not available in Cameroon, use global data sets from satellite altimetry (see annex 1) as an alternative to tidal gauges. Satellite altimetry provides a solution globally to measure precisely sea surface height, derived from the time taken by a radar pulse to travel from the satellite antenna to the surface and back to the satellite receiver.

Parameter 4: Flora/fauna

Cameroon has some information about biodiversity in the coastal region that is useful for the analysis (invasive species, threatened species, source to measure latitude, protected areas). However, it lacks other sources of data (mainly aerial images) that are key for the classification system proposed in CHW. Moreover, accessibility of the data is not clearly defined and should be checked before implementing CHW. The National Marine is the institution responsible of the availability and quality of biodiversity data in Cameroon.

Readiness level: step 1

It is unclear if **Benin is ready to apply CHW in Flora/Fauna at Step 1**, which requires having enough quality in aerial images in order to identify the type of vegetation. However, it is estimated that an acceptable first approximation can be achieved with Google Earth Images.

In order to consolidate Step 1 and to extend Flora/Fauna classification to Step 2 and 3, local data is required. In this sense the following actions should be taken:

- Action 1: analyse Google Earth images in order to check their quality and the feasibility of identifying the type of vegetation on the distinction between marsh and mangrove areas
- Action 2: look for complementary coastal photographs (taken from the ground) that can help to identifying these types of vegetation
- Action 3: perform field trips to those areas that remain unclear after applying the previous recommendations.

Parameter 5: Sediment Balance

As can be seen in Table 30, historical orthophotos of 1980 and 2005 and local studies about coastal erosion are available, but they are not accessible (not provided to the Consultants) and consequently, their quality remains unknown. Besides the year the ortophoto was taken, it is also necessary to know the month. Only ortophotos from the same month or season can be compared, as there is some intra-annual variability of coastline.

No historical shorelines are digitalized and there is no inventory of anthropogenic actions.

Readiness level: step 1

Cameroon is ready to apply CHW in Sediment Balance at Step 1, which only requires to have access to Google Earth timeline application, in combination with Geological Layout classification.

In order to extend Sediment Balance classification to Step 2 and 3, local data is required. In this sense the following actions are suggested:

- Action 1: assess tte historical orthophotos. They must be correctly georeferenced and projected. As 2005 and 1980 are very distant in time, it is recommended to complete the database with Google Earth images. Ideally, multiple shorelines should be available covering a period as long as possible, e.g., 20 years.
- Action 2: build an inventory of all coastal anthropogenic actions along the coast during the past years. This should include urbanisation in coastal areas, coastal protection infrastructures and other coastal activities. This is a very useful way to identify coastal stretches with erosion/accretion problems.

Parameter 6: Storm Climate

As shown in the table 30, no storm database is available. However, there is no need of local information within the 3 steps of CHW methodology, as the West African Coast is not affected by tropical cyclones (see annex 1 for more information).

Readiness level: step 3

Cameroon is ready to apply CHW in Storm Climate at Step 3. Storm Climate classification is immediate, since all country is classified as non-tropical cyclone affected.

There is no further recommendation to apply CHW in Storm Climate.

Conclusion

As a conclusion from the analysis of each CHW dimension, it is recommended to Cameroon to work on CHW implementation at step 1. This would possible using the open access datasets provided in annex 1. Further implementation of step 2 and 3 implies a collection, quality analysis and a processing of all the existent data.

b) Recommendations for enabling the environment for CHW implementation

In order to enable a proper environment for the implementation of CHW, it is recommended to Cameroon to take the following actions:

- Recommendation 1: name a national coordinator within *National Observatory on Climate Change*, who will be responsible of CHW implementation and interaction with the consultants.
- Recommendation 2: establish direct contact with the Institue de Research Geologiques et Minerie and other institutions with the objective of exchange information and expertise.
- Recommendation 3: establish a CHW team in within *National Observatory on Climate Change*, led by CHW coordinator, composed by technical staff with expertise in data analysis, GIS and/or oceanography.
- Recommendation 4: check the available computer resources within *National Observatory on Climate Change*. At this level, it is essential to have a Geographic Information System (GIS) software. It is advised to use Quantum-GIS[7], an open source GIS software that can be used in a laptop or a desktop computer with any operating system. Alternatively, ArcGIS can be used, but implies purchasing a license.

c) Proposed agenda for CHW implementation:

The implementation of CHW starts with the mapping of the coast for each CHW dimension. To this end, the Consultants suggests the following phases for Benin:

Phase 1: using the open access digital shoreline, define basic units segmenting it in coastal stretches in which the Geological layout (Parameter 1) is uniform. This can result in stretches from hundreds of meters to kilometres, depending on the Geological Layout spatial variability.

[7] https://qgis.org/en/site/

Recent Google Earth satellite images can be used in this case as a basis, together with a geological map and a DEM.

This task is estimated to be completed **in three weeks** by a GIS specialist.

Phase 2: classify the basic units defined in phase 1 according to Wave Exposure, Tidal range and Storm Climate. Wave exposure and Storm climate can be classified according to the Global Wave Environments map (Davies 1980, modified by Masselink and Hughes 2003 and Rosendahl Appelquist) map, Wave exposure classification for the CHW system[8] and Map over global todañ environment (Davies 1980, modified by Masselink and Hughes 2003) (see annex 1).

This task is estimated to be completed **in one week** by a GIS specialist.

Phase 3: classify the basic units defined in phase 1 according to Flora/Fauna. We propose that Google Earth images should be revised in order to identify those areas where resolution is enough to describe the type of vegetation and the percentage of area with vegetation. This process should be carried out in **two weeks**.

For those areas without enough resolution, complementary information should be acquired that allows the identification of these variables. Additionally, field trips should be performed to those areas where vegetation cannot be identified and quantified otherwise.

These processes should be carried out in **two weeks**.

Phase 4: classify the basic units defined in phase 1 according to Sediment Balance by comparing multiple historical shorelines and/or historical ortophotos In the timeline function of Google Earth, satellite and ortophotos are available. Coastal deficit, balance or surplus in each basic unit has to be assessed through the identification of coastline retreat or advance across the last decades by comparing the evolution of historical coastlines. It is important to note if a dominant erosion/accretion behaviour is possible to be related with some anthropogenic action. Only ortophotos from the same month or season must be taken in consideration in order to filter inter-annual oscillation of the coast.

This task is estimated to be completed in **two weeks** by a GIS specialist.

2.2.3. Côte d'Ivoire

a) Overview and analysis per CHW dimension

Table 31 provides an overview of the situation of **Côte d'Ivoire** in terms of availability, quality, and accessibility of the required datasets for CHW application, classified by CHW dimension, according to the responses of surveys and remote meetings with the *Ministère de l'Environnement et du Developpement Durable*.

The following table provides an overview of the situation of the country (see table 31):

Table 31. Data overview in Côte d'Ivoire for implementing CHW

[8] https://www.coastalhazardwheel.org/media/1217/main-manual-coastal-hazard-wheel.pdf

Dimension	Responsible institution	Datasets required	Availability	Quality	Accessibiliy	Readiness (step as per CHW)
Geological Layout	Centre de Recherche Oceanographique	Costal geomorphology classification				1
		Shoreline database				
		Current ortophotografies				
		Geological/Lithological map				
		DEM				
		Other report/studies on geomorphology				
Wave Exposure	Unknown	Buoy datasets				1
		Wave reanalysis				
Tidal Range	Unknown	Tidal records based on harbour tidal gauges				1
		Tidal datasets based on satellite altimetry				
Flora/fauna	Unknown	Flora and fauna database cover with satellite images by Google Earth				1
		Local institution responsible for biodiversity database				
Sediment Balance	Unknown	Reports about coastline erosion				1
		Historical ortophotography				
		Digitalized historical shorelines				
		Inventory of anthropogenic actions influencing coastal erosion				
Storm Climate	Unknown	Storm database				3

In the following paragraphs an analysis per CHW parameter is proposed with the readiness level of the country and specific recommendations for the implementation of the CHW in the country.

Parameter 1: Geological Layout

As seen in table 31, no local data is available to characterize Geological Layout.

Readiness level: step 1

Côte d'Ivoire is only ready to apply CHW in Geological Layout at Step 1, which only requires access to open access datasets (see the global datasets available in Annex 1).

Extension of Geological Layout classification to Step 2 and 3 is not possible at this moment. We suggest starting to work on:

- **Action 1**: the digitalization of the most updated satellite image, which can be found in Google Earth.
- **Action 2:** familiarizing with global databases: geological maps and DEM (see annex 1 for the existing global databases).

Parameter 2: Wave Exposure

As can be seen in table 31, wave datasets from buoys or reanalysis are not available to characterize Wave Exposure. Publicly datasets can be used instead (see annex 1 for the existing global databases).

Readiness level: **step 1**

Côte d'Ivoire is only ready to apply CHW in Wave Exposure at Step 1, which requires having access to a Geological Layout classification and a global distribution of wave conditions, provided by the CHW methodology (see Annex 1).

In order to extend Wave Exposure classification to Step 2 and 3, local data is required. In this sense the following actions are proposed:

- Action 1: use global wave reanalysis as an alternative as wave buoys datasets are not available. The teams should start familiarizing with these data sets.

Parameter 3: Tidal Range

As can be seen in Table 31, tidal datasets from harbours and from satellite missions are not available.

Readiness level: step 1

Côte d'Ivoire is only ready to apply CHW in Tidal Range at Step 1, which requires to have access to global tidal information and the map provided by the CHW methodology (see annex 1).

In order to extend Tidal Range classification to Step 2 and 3, local data is required. In this sense the following actions should be taken:

- Action 1: As local tidal gauges are not available in Côte d'Ivoire, use global data sets from satellite altimetry (see annex 1) as an alternative to tidal gauges. Satellite altimetry provides a solution globally to measure precisely sea surface height, derived from the time taken by a radar pulse to travel from the satellite antenna to the surface and back to the satellite receiver.

Parameter 4: Flora/fauna

Côte d'Ivoire has little information about biodiversity in the coastal region that is useful for the analysis (only invasive species). Moreover, it lacks other sources of data (mainly aerial images) that are key for the classification system proposed in CHW. Also, quality and accessibility of the data is not clearly defined and should be checked before implementing CHW. No institution has been identified in Ivory Coast as responsible of data availability, quality and accessibility.

Readiness level: step 1

It is unclear if **Côte d'Ivoire is ready to apply CHW in Flora/Fauna at Step 1**, which requires having enough quality in aerial images in order to identify the type of vegetation. However, it is estimated that an acceptable first approximation can be achieved with Google Earth Images.

In order to consolidate Step 1 and to extend Flora/Fauna classification to Step 2 and 3, local data is required. In this sense the following actions should be taken:

- Action 1: analyse Google Earth images in order to check their quality and the feasibility of identifying the type of vegetation on the distinction between marsh and mangrove areas
- Action 2: look for complementary coastal photographs (taken from the ground) that can help to identifying these types of vegetation
- Action 3: perform field trips to those areas that remain unclear after applying the previous recommendations.

Parameter 5: Sediment Balance

As can be seen in Table 31, no information about Sediment Balance is available.

Readiness level: step 1

Côte d'Ivoire is ready to apply CHW in Sediment Balance at Step 1, which only requires to have access to Google Earth timeline application, in combination with Geological Layout classification.

In order to extend Sediment Balance classification to Step 2 and 3, local data is required. In this sense the following actions are suggested:

Action 1: It is recommended to use Google Earth images available in timeline function. Ideally, multiple shorelines should be available covering a period as long as possible, e.g., 20 years.

Action 2: build an inventory of all coastal anthropogenic actions along the coast and the past years. This should include urbanisation in coastal areas, coastal protection infrastructures, and coastal activities. This can be very useful to identify coastal stretches with erosion/accretion problems.

Parameter 6: Storm Climate

As shown in the table 30, no storm database is available. However, there is no need of local information within the 3 steps of CHW methodology, as the West African Coast is not affected by tropical cyclones (see annex 1 for more information).

Readiness level: step 3

Côte d'Ivoire is ready to apply CHW in Storm Climate at Step 3. Storm Climate classification is immediate, since the all country is classified as non-tropical cyclone affected.

There is no further recommendation to apply CHW in Storm Climate.

Conclusion

As a conclusion from the analysis of the six parameters, it is recommended Côte d'Ivoire start working with CHW at step 1. This is possible through the open access datasets provided in annex 1. Further implementation of step 2 and 3 are not possible at this level as they imply collection, quality analysis and processing of all existing data.

c) Recommendations for enabling the environment for CHW implementation

In order to enable a proper environment for the implementation of CHW, it is recommended to Côte d'Ivoire to take the following actions:

- Recommendation 1: name a national coordinator within the *Ministère de l'Environnement et du Developpement Durable*, who will be responsible for CHW implementation and interaction with the team of consultants.
- Recommendation 2: establish direct contact with the Centre de Recherche Oceanographique and other institutions with the objective of exchange information and expertise.
- Recommendation 3: establish a CHW team in within *National Observatory on Climate Change*, led by CHW coordinator, composed by technical staff with expertise in data analysis, GIS and/or oceanography.
- Recommendation 4: check the available computer resources within *National Observatory on Climate Change*. At this level, it is essential to have a Geographic Information System (GIS) software. It is advised to use Quantum-GIS[9], an open source GIS software that can be used

[9] https://qgis.org/en/site/

in a laptop or a desktop computer with any operating system. Alternatively, ArcGIS can be used, but implies purchasing a license.

c) Proposed agenda for CHW implementation (to be agreed upon with WACOM Antennas and Cameroon):

The implementation of CHW starts with the mapping of the coast for each CHW dimension. To this end, the Consultants suggests the following phases for Benin:

Phase 1: using the open access digital shoreline, define basic units segmenting it in coastal stretches in which the Geological layout (Parameter 1) is uniform. This can result in stretches from hundreds of meters to kilometres, depending on the Geological Layout spatial variability. Recent Google Earth satellite images can be used in this case as a basis, together with a geological map and a DEM.

This task is estimated to be completed **in three weeks** by a GIS specialist.

Phase 2: classify the basic units defined in phase 1 according to Wave Exposure, Tidal range and Storm Climate. Wave exposure and Storm climate can be classified according to the Global Wave Environments map (Davies 1980, modified by Masselink and Hughes 2003 and Rosendahl Appelquist) map, Wave exposure classification for the CHW system[10] and Map over global todañ environment (Davies 1980, modified by Masselink and Hughes 2003) (see annex 1).

This task is estimated to be completed **in one week** by a GIS specialist.

Phase 3: classify the basic units defined in phase 1 according to Flora/Fauna. We propose that Google Earth images should be revised in order to identify those areas where resolution is enough to describe the type of vegetation and the percentage of area with vegetation. This process should be carried out in **two weeks**.

For those areas without enough resolution, complementary information should be acquired that allows the identification of these variables. Additionally, field trips should be performed to those areas where vegetation cannot be identified and quantified otherwise.

These processes should be carried out in **two weeks**.

Phase 4: classify the basic units defined in phase 1 according to Sediment Balance by comparing multiple historical shorelines and/or historical ortophotos In the timeline function of Google Earth, satellite and ortophotos are available. Coastal deficit, balance or surplus in each basic unit has to be assessed through the identification of coastline retreat or advance across the last decades by comparing the evolution of historical coastlines. It is important to note if a dominant erosion/accretion behaviour is possible to be related with some anthropogenic action. Only ortophotos from the same month or season must be taken in consideration in order to filter inter-annual oscillation of the coast.

This task is estimated to be completed in **two weeks** by a GIS specialist.

[10] https://www.coastalhazardwheel.org/media/1217/main-manual-coastal-hazard-wheel.pdf

2.2.4. Gambia

a) Overview and analysis per CHW dimension

Table 32 provides an overview of the situation of **Gambia** in terms of availability, quality, accessibility of the required datasets for CHW application, classified by CHW dimension. according to the responses of surveys and remote meetings with *National Environment Agency*.

Table 32. Data overview in Gambia for implementing CHW

Dimension	Responsible institution	Datasets required	Availability	Quality	Accessibiliy	Readiness (steps as per CHW)
Geological Layout	Department of Water Resources	Costal geomorphology classification				1
		Shoreline database				
		Current ortophotografies				
		Geological/Lithological map				
		DEM				
		Other report/studies on geomorphology				
Wave Exposure	Department of Water Resources	Buoy datasets				1
		Wave reanalysis				
Tidal Range	Department of Water Resources	Tidal records based on harbour tidal gauges				1
		Tidal datasets based on satellite altimetry				
Flora/fauna	Department of Parks and Wildfile	Flora and fauna database cover with satellite images by Google Earth				1
		Local institution responsible for biodiversity database				1
Sediment Balance	Port Authority and Gambia Maritime Authority	Reports about coastline erosion				1
		Historical ortophotography				
		Digitalized historical shorelines				
		Inventory of anthropogenic actions influencing coastal erosion				
Storm Climate	Ports Authority and Gambia Maritime Authority	Storm database				3

In the following paragraphs an analysis per CHW parameter is proposed with the readiness level of the country and specific recommendations for the implementation of the CHW in the country.

Parameter 1: Geological Layout

As indicated in table 32, local data is available to characterize Geological Layout, but not accessible (still not provided to the Consultants). Consequently, their quality is unknown. According to the surveys and interview, digital shoreline, current ortophotos, geological map and Digital Elevation Model (DEM) are available. Digital shoreline should be available in Shapefile format and its resolution should be finer than 50 meters, but is date is unknown. Geological, lithological maps and DEM should be available in digital and georeferenced format.

Readiness level: step 1

Gambia is only ready to apply CHW in Geological Layout at Step 1, which only requires access to open access datasets (see the global datasets available in Annex 1). Local datasets are theoretically available, but their quality is not guaranteed for steps 2 or 3.

Shifting the Geological Layout classification to Step 2 and 3, would imply the following:

- Action 1: Assess the quality of the available digital shoreline and ortophotos. In order to use the CHW, the resolution and age (when the picture was taken) of both data sets are key: the resolution of the digital shoreline should be 50 meters or finer and the digital shoreline pictures be frequently updated, at least every 2-3 years.

- Action 2: Prepare and ensure the geological map and DEM are available, in digital format and georeferenced. If not, a GIS expert should work on this to make sure they are made available.

Parameter 2: Wave Exposure

As can be seen in table 32, wave datasets from buoys and reanalysis are available to characterize Wave Exposure. However, they are not accessible (they have not been provided to the Consultants). Consequently, their quality is unknown.

Readiness level: **step 1**

Gambia is only ready to apply CHW in Wave Exposure at Step 1, which requires having access to a Geological Layout classification and a global distribution of wave conditions, provided by the CHW methodology (see Annex 1).

In order to extend Wave Exposure classification to Step 2 and 3, local data is required. In this sense the following recommendations are suggested:

- Action 1: Collect datasets from wave buoy datasets and assess their quality considering the recorded variables, the length of the time series and the spatial coverage of the coast. First, significant Wave Height (H_s) must be recorded with at least an hourly time step. Timeseries must be homogeneous (not manipulated during recording) and they must contain multiannual data, ideally, 20 years or more.
- Action 2: use global wave reanalysis as an alternative if wave buoy datasets cannot be produced at this time at national level.

Parameter 3: Tidal Range

As can be seen in table 32, tidal datasets from harbours and from satellite missions are available, but they are not accessible (not provided to the Consultants). Consequently, their quality is unknown.

Readiness level: step 1

Gambia is only ready to apply CHW in Tidal Range at Step 1, which requires to have access to global tidal information and the map provided by the CHW methodology (see annex 1). Local tidal datasets are theoretically available, but their quality is not guaranteed.

In order to extend Tidal Range classification to Step 2 and 3, local data is required. In this sense the following actions are proposed:

- Action 1: collect time series from tidal gauges and check their quality. To this end, it is required they have a time-span of at least 20 years and record the sea level from a well defined reference level. With this information, tidal harmonic analysis can be performed and basic statistics can be calculated.

- Action 2: consider using global data sets from satellite altimetry (see annex 1) as an alternative to tidal gauges. Satellite altimetry provides a solution globally to measure precisely sea surface height, derived from the time taken by a radar pulse to travel from the satellite antenna to the surface and back to the satellite receiver.

Parameter 4: Flora/Fauna

Gambia has information about biodiversity in the coastal region that is useful for the analysis. Moreover, aerial images are available, which are key for the classification system proposed in CHW. On the other hand, quality of the data is not clearly defined and should be checked before implementing CHW. Port Authority and Gambia Maritime Authority are the institutions responsible of the availability of biodiversity data in Gambia, and the Department of Parks and Wildlife is responsible of checking the quality of these data.

Readiness level: step 1

Gambia is only ready to apply CHW in Flora/Fauna at Step 1, which requires having enough quality in aerial images in order to identify the type of vegetation. However it is estimated that an acceptable first approximation can be achieved with Google Earth Images.

In order to consolidate Step 1 and to extend Flora/Fauna classification to Step 2 and 3, local data is required. In this sense the following actions should be taken:

- Action 1: look for coastal photographs that can help to identifying these types of vegetation
- Action 2: perform field trips to those areas that remain unclear after applying the previous recommendations.

Parameter 5: Sediment Balance

As can be seen in Table 32, historical orthophotos, historical digitalized shorelines, local studies and an inventory of anthropogenic actions are available. Some reports about coastal erosion should also be available according to the surveys. However, none of the datasets are accessible (not provided to the Consultants). Consequently, their contents are unknown. From the surveys, the ortophotos are in digital format and georeferenced, but their date is unknown.

Readiness level: step 1

Gambia is ready to apply CHW in Sediment Balance at Step 1, which requires only to have access to Google Earth timeline application, in combination with Geological Layout classification.

In order to extend Sediment Balance classification to Step 2 and 3, local data is required. In this sense the following recommendations are suggested:

- Action 1: collect historical orthophotos and historical shorelines. Data gathered should be digitalized and georeferenced. Ideally, multiple ortophotos/digital shoreline should be available covering a period as long as possible, e.g., 20 years.
- Action 2: build an inventory of all coastal anthropogenic actions along the coast during the past years. This should include urbanisation in coastal areas, coastal protection infrastructures and other coastal activities. This is a very useful way to identify coastal stretches with erosion/accretion problems.

Parameter 6: Storm Climate

As indicated in Table 32, there is not storm database available. However, there is no need of local information within the 3 steps of CHW methodology, as the West African Coast is not affected by tropical cyclones (see annex 1 for more information).

Readiness level: step 3

Gambia is ready to apply CHW in Storm Climate at Step 3. Storm Climate classification is immediate, since all country is classified as non-tropical cyclone affected.

There is no further recommendation to apply CHW in Storm Climate.

Conclusion

Based on the analysis of the CHW coastal parameters, it is recommended to Gambia to work on CHW implementation at step 1. This allows working on open access datasets provided in annex 1. Further implementation of step 2 and 3 needs collection, quality analysis and processing of all local existing data and global datasets.

c) Recommendations for enabling the environment for CHW implementation

In order to enable a proper environment for the implementation of CHW, it is recommended to Gambia to take the following actions:

- Recommendation 1: name a national coordinator within the *National Environment Agency*, who will be responsible of CHW implementation and interaction with the consultants.
- Recommendation 2: establish direct contact with the *Department of Water Resources and the Port Authority and Gambia Maritime Authority* and other institutions with the objective of exchanging information and expertise.
- Recommendation 3: establish a CHW team in the *National Environment Agency*, led by CHW coordinator, composed by technical staff with expertise in data analysis, GIS and/or oceanography.
- Recommendation 4: check the available computer resources in *Institut de Recherche Halieutique et Océanographique*. At this level, it is essential to have a Geographic Information System (GIS) software. It is advised to use Quantum-GIS[11], an open source GIS software that can be used in a laptop or a desktop computer with any operating system. Alternatively, ArcGIS can be used, but implies purchasing a license.

c) Proposed agenda for CHW implementation (to be agreed upon with WACOM Antennas and Cameroon):

The implementation of CHW starts with the mapping of the coast for each CHW dimension. To this end, the consultants suggest the following phases for Benin:

Phase 1: using the open access digital shoreline, define basic units segmenting it in coastal stretches in which the Geological layout (Parameter 1) is uniform. This can result in stretches from hundreds of meters to kilometres, depending on the Geological Layout spatial variability. Recent Google Earth satellite images can be used in this case as a basis, together with a geological map and a DEM.

This task is estimated to be completed **in three weeks** by a GIS specialist.

Phase 2: classify the basic units defined in phase 1 according to Wave Exposure, Tidal range and Storm Climate. Wave exposure and Storm climate can be classified according to the Global Wave Environments map (Davies 1980, modified by Masselink and Hughes 2003 and Rosendahl Appelquist) map, Wave exposure classification for the CHW system[12] and Map over global todañ environment (Davies 1980, modified by Masselink and Hughes 2003) (see annex 1).

This task is estimated to be completed **in one week** by a GIS specialist.

[11] https://qgis.org/en/site/

[12] https://www.coastalhazardwheel.org/media/1217/main-manual-coastal-hazard-wheel.pdf

Phase 3: classify the basic units defined in phase 1 according to Flora/Fauna. We propose that Google Earth images should be revised in order to identify those areas where resolution is enough to describe the type of vegetation and the percentage of area with vegetation. This process should be carried out in **two weeks**.

For those areas without enough resolution, complementary information should be acquired that allows the identification of these variables. Additionally, field trips should be performed to those areas where vegetation cannot be identified and quantified otherwise.

These processes should be carried out in **two weeks**.

Phase 4: classify the basic units defined in phase 1 according to Sediment Balance by comparing multiple historical shorelines and/or historical ortophotos In the timeline function of Google Earth, satellite and ortophotos are available. Coastal deficit, balance or surplus in each basic unit has to be assessed through the identification of coastline retreat or advance across the last decades by comparing the evolution of historical coastlines. It is important to note if a dominant erosion/accretion behaviour is possible to be related with some anthropogenic action. Only ortophotos from the same month or season must be taken in consideration in order to filter inter-annual oscillation of the coast.

This task is estimated to be completed in **two weeks** by a GIS specialist.

2.2.5. Ghana

a. Overview and analysis per CHW dimension

Table 33 provides an overview of the situation of **Ghana** in terms of availability, quality, accessibility of the required datasets for CHW application, classified by CHW dimension. according to the responses of surveys and remote meetings with *University of Ghana*.

Table 33. Data overview in Ghana for implementing CHW

Parameter	Responsible institution	Datasets required	Availability	Quality	Accessibiliy	Readiness (step as per CHW)
Geological Layout	Ghana survey and mapping division, lands commission	Costal geomorphology classification				1
		Shoreline database				
		Current ortophotografies				
		Geological/Lithological map				
		DEM				
		Other report/studies on geomorphology				
Wave Exposure	University of Ghana	Buoy datasets				1
		Wave reanalysis				
Tidal Range	Survey and mapping division	Tidal records based on harbour tidal gauges				1
		Tidal datasets based on satellite altimetry				
Flora/Fauna	Unknown	Flora and fauna database cover with satellite images by Google Earth				1

		Local institution responsible for biodiversity database				
Sediment Balance	Hydrological division Research	Reports about coastline erosion				1
		Historical ortophotography				
		Digitalized historical shorelines				
		Inventory of anthropogenic actions influencing coastal erosion				
Storm Climate	Unknown	Storm database				3

In the following paragraphs an analysis per CHW parameter is proposed with the readiness level of the country and specific recommendations for the implementation of the CHW in the country.

Parameter 1: Geological Layout

As seen in table 33, local data is available to characterize Geological Layout, but was not accessible for the consultants. Therefore it was impossible to assess the quality. According to the survey and the interview conducted, digital shoreline, current ortophotos, geological map and Digital Elevation Model (DEM) are available at national level. Digital shoreline should be available in Shapefile format and its resolution should be finer than 50 meters, but the date is unknown. DEM is available in digital and georeferenced format. Geological is not available in digital and georeferenced format.

Readiness level: step 1

Ghana is only ready to apply CHW in Geological Layout at Step 1, which requires access to open access datasets (see the global datasets available in Annex 1). Local datasets are theoretically available, but their quality is not guaranteed for steps 2 or 3.

In order to extend Geological Layout classification to Step 2 and 3, local data is required. In this sense the following recommendations are suggested:

- Action 1: Assess the quality of the available digital shoreline and ortophotos. In order to use the CHW, the resolution and age (when the picture was taken) of both data sets are key: the resolution of the digital shoreline should be 50 meters or finer and the digital shoreline pictures be frequently updated, at least every 2-3 years.

Parameter 2: Wave Exposure

As can be seen in Table 33, wave datasets from buoys and reanalysis are available to characterize Wave Exposure. However, they are not accessible (they have not been provided to the Consultants). Consequently, their quality is unknown. From the answers of the survey, there is no information about the wave parameters registered, neither their location and temporal length.

Readiness level: **step 1**

Ghana is only ready to apply CHW in Wave Exposure at Step 1, which requires having access to a Geological Layout classification and a global distribution of wave conditions, provided by the CHW methodology (see Annex 1).

Shifting the Wave Exposure classification to Step 2 and 3 would imply the following:

- Action 1: Wave buoy datasets should be collected and their quality assessed. The quality must be assessed considering the recorded variables, the length of the time series and the spatial coverage of the coast. First, significant Wave Height (H_s) must be recorded with at least an hourly time step. Timeseries must be homogeneous (not manipulated during recording) and they must contain multiannual data, ideally, 20 years or more.

- Action 2: If wave buoys do not fulfil the required quality thresholds, global wave reanalysis are publicly available as an alternative (see Annex 1). It is recommended to consider using global wave reanalysis as an alternative if wave buoy datasets can not be produced at this time at national level.

Parameter 3: Tidal Range

As can be seen in Table 33, tidal datasets from harbours are available, but they are not accessible (not provided to the Consultants). Consequently, their quality is unknown. From the surveys completed, some of this information has to be purchased.

Readiness level: step 1

Ghanais only ready to apply CHW in Tidal Range at Step 1, which requires to have access to global tidal information and the map provided by the CHW methodology (see annex 1). Local tidal datasets are theoretically available, but their quality is not guaranteed.

In order to extend Tidal Range classification to Step 2 and 3, local data is required. In this sense the following actions are suggested:

- Action 1: collect time series from tidal gauges and check their quality. To this end, it is required they have a time-span of at least 20 years and record the sea level from a well defined reference level. With this information, tidal harmonic analysis can be performed and basic statistics can be calculated.
- Action 2: consider using global data sets from satellite altimetry (see annex 1) as an alternative to tidal gauges. Satellite altimetry provides a solution globally to measure precisely sea surface height, derived from the time taken by a radar pulse to travel from the satellite antenna to the surface and back to the satellite receiver.

Parameter 4: Flora/Fauna

Ghana has information about biodiversity in the coastal region that is useful for the analysis (invasive species, threatened species, latitude of the assessment area, protected areas). However, it lacks other sources of data (mainly aerial images) that are key for the classification system proposed in CHW. Moreover, accessibility of the data is not clearly defined and should be checked before implementing CHW. Research institutions have been reported to have some information on biodiversity in Ghana.

Readiness level: step 1

Ghana is ready to apply CHW in Flora/Fauna at Step 1, which requires having enough quality in aerial images in order to identify the type of vegetation. Nevertheless it is estimated that an acceptable first approximation can be achieved with Google Earth Images.

In order to consolidate Step 1 and to extend Flora/Fauna classification to Step 2 and 3, local data is required. In this sense the following actions should be taken:

- Action 1: analyse Google Earth images in order to check their quality and the feasibility of identifying the type of vegetation on the distinction between marsh and mangrove areas
- Action 2: look for complementary coastal photographs (taken from the ground) that can help identifying these types of vegetation
- Action 3: organize field trips to the areas that remain unclear.

Parameter 5: Sediment Balance

As can be seen in Table 33, historical orthophotos, historical digitalized are available. Also some reports about coastal erosion should be available according to the surveys. However, none of the datasets are accessible (not provided to the Consultants). Consequently, their contents are

unknown. From the surveys, there are 2 ortophotos corresponding to 1974 and 2005. They are available in digital format and georeferenced.

Readiness level: step 1

Ghana is ready to apply CHW in Sediment Balance at Step 1, which requires only to have access to Google Earth timeline application, in combination with Geological Layout classification.

In order to extend Sediment Balance classification to Step 2 and 3, local data is required. In this sense the following actions should be taken:

- Action 1: collect historical orthophotos and historical shorelines of 1974 and 2005 and complement it with open access sources (see annex 1 to check the existent data sources). Ideally, multiple ortophotos/digital shoreline should be available covering a period as long as possible, e.g., 20 years.
- Action 2: build an inventory of all coastal anthropogenic actions along the coast during the past years. This should include urbanisation in coastal areas, coastal protection infrastructures and other coastal activities. This is a very useful way to identify coastal stretches with erosion/accretion problems. The existing reports on coastal erosion can give valuable information on this topic.

Parameter 6: Storm Climate

As indicated in Table 33, there is not storm database available. However, there is no need of local information within the 3 steps of CHW methodology, as the West African Coast is not affected by tropical cyclones (see annex 1 for more information).

Readiness level: step 3

Ghana is ready to apply CHW in Storm Climate at Step 3. Storm Climate classification is immediate, since all country is classified as non-tropical cyclone affected.

There is no further recommendation to apply CHW in Storm Climate.

Conclusion

As a conclusion from the analysis of the CHW parameters, it is recommended to Gambia to work on CHW implementation at step 1. This would possible using the open access datasets provided in annex 1. Further implementation of step 2 and 3 implies a collection, quality analysis and a processing of all the existent data.

b) Recommendations for enabling the environment for CHW implementation

In order to enable a proper environment for the implementation of CHW, it is recommended to Ghana to take the following actions:

- Recommendation 1: name a national coordinator within *University of Ghana*, who will be responsible of CHW implementation and interaction with the consultants.
- Recommendation 2: establish direct contact with the *Ghana survey and mapping division, Ghana Ports and Harbours* and other institutions with the objective of exchange information and expertise.
- Recommendation 3: establish a CHW team in within *University of Ghana*, led by CHW coordinator, composed by technical staff with expertise in data analysis, GIS and/or oceanography.
- Recommendation 4: check the available computer resources within *National Observatory on Climate Change*. At this level, it is essential to have a Geographic Information System (GIS) software. It is advised to use Quantum-GIS[13], an open source GIS software that can be used

[13] https://qgis.org/en/site/

in a laptop or a desktop computer with any operating system. Alternatively, ArcGIS can be used, but implies purchasing a license.

c) Proposed agenda for CHW

The implementation of CHW starts with the mapping of the coast for each CHW dimension. To this end, the consultants suggest the following phases for Benin:

Phase 1: using the open access digital shoreline, define basic units segmenting it in coastal stretches in which the Geological layout (Parameter 1) is uniform. This can result in stretches from hundreds of meters to kilometres, depending on the Geological Layout spatial variability. Recent Google Earth satellite images can be used in this case as a basis, together with a geological map and a DEM.

This task is estimated to be completed **in three weeks** by a GIS specialist.

Phase 2: classify the basic units defined in phase 1 according to Wave Exposure, Tidal range and Storm Climate. Wave exposure and Storm climate can be classified according to the Global Wave Environments map (Davies 1980, modified by Masselink and Hughes 2003 and Rosendahl Appelquist) map, Wave exposure classification for the CHW system[14] and Map over global todañ environment (Davies 1980, modified by Masselink and Hughes 2003) (see annex 1).

This task is estimated to be completed **in one week** by a GIS specialist.

Phase 3: classify the basic units defined in phase 1 according to Flora/Fauna. We propose that Google Earth images should be revised in order to identify those areas where resolution is enough to describe the type of vegetation and the percentage of area with vegetation. This process should be carried out in **two weeks**.

For those areas without enough resolution, complementary information should be acquired that allows the identification of these variables. Additionally, field trips should be performed to those areas where vegetation cannot be identified and quantified otherwise.

These processes should be carried out in **two weeks**.

Phase 4: classify the basic units defined in phase 1 according to Sediment Balance by comparing multiple historical shorelines and/or historical ortophotos In the timeline function of Google Earth, satellite and ortophotos are available. Coastal deficit, balance or surplus in each basic unit has to be assessed through the identification of coastline retreat or advance across the last decades by comparing the evolution of historical coastlines. It is important to note if a dominant erosion/accretion behaviour is possible to be related with some anthropogenic action. Only ortophotos from the same month or season must be taken in consideration in order to filter inter-annual oscillation of the coast.

This task is estimated to be completed in **two weeks** by a GIS specialist.

2.2.6. Guinea

a) Overview and analysis per CHW dimension

Table 34 provides an overview of the situation of **Guinea** in terms of availability, quality, accessibility of the required datasets for CHW application, classified by CHW dimension. according to the responses of surveys and remote meetings with *Centre de Protection du Milieu Marin et des Zones Côtiéres (CPMZC) / Ministère de l'Evironnement*.

[14] https://www.coastalhazardwheel.org/media/1217/main-manual-coastal-hazard-wheel.pdf

Table 34. Data overview in Guinea for implementing CHW

Dimension	Responsible institution	Datasets required	Availability	Quality	Accessibiliy	Readiness (step as per CHW)
Geological Layout	CPMZC; CERESCOR; NSHB; CERE, COSIE, ONGR, DN Météo	Costal geomorphology classification				1
		Shoreline database				
		Current ortophotografies				
		Geological/Lithological map				
		DEM				
		Other report/studies on geomorphology				
Wave Exposure	Direction de la Météo	Buoy datasets				1
		Wave reanalysis				
Tidal Range	Direction de la Météo, Direction de l'Hydraulique, CERESCOR	Tidal records based on harbour tidal gauges				1
		Tidal datasets based on satellite altimetry				
Flora/Fauna	Unknown	Flora and fauna database cover with satellite images by Google Earth				1
		Local institution responsible for biodiversity database				
Sediment Balance	CPMZC, CERESCOR	Reports about coastline erosion				1
		Historical ortophotography				
		Digitalized historical shorelines				
		Inventory of anthropogenic actions influencing coastal erosion				
Storm Climate	Direction de la Météo	Storm database				3

In the following paragraphs an analysis per CHW dimensions is performed. Final level of readiness is provided and recommendations for further working on data are suggested.

Parameter 1: Geological Layout

As indicated in table 34, local data is available to characterize Geological Layout, but not accessible (still not provided to the Consultants). Consequently, their quality is unknown. According to the surveys and interview, digital shoreline, current ortophotos, geological map and Digital Elevation Model (DEM) are available.

Readiness level: step 1

Guinea is only ready to apply CHW in Geological Layout at Step 1, which only requires access to open access datasets (see the global datasets available in Annex 1). Local datasets are theoretically available, but their quality is not guaranteed for steps 2 or 3.

Shifting the Geological Layout classification to Step 2 and 3, would imply the following:

- Action 1: Assess the quality of the available digital shoreline and ortophotos. In order to use the CHW, the resolution and age (when the picture was taken) of both data sets are key: the resolution of the digital shoreline should be 50 meters or finer and the digital shoreline pictures be frequently updated, at least every 2-3 years.

- Action 2: Prepare and ensure the geological map and DEM are available, in digital format and georeferenced. If not, a GIS expert should work on this to make sure they are made available.

Parameter 2: Wave Exposure

As can be seen in table 34, wave datasets from neither buoys nor reanalysis are available to characterize Wave Exposure.

Readiness level: **step 1**

Guinea is only ready to apply CHW in Wave Exposure at Step 1, which requires having access to a Geological Layout classification and a global distribution of wave conditions, provided by the CHW methodology (see Annex 1).

Shifting the Wave Exposure classification to Step 2 and 3 would imply the following:

- Action 1: global wave reanalysis is publicly available and an alternative for implementing CHW in Step 2-3 (see Annex 1). It is recommended to consider using global wave reanalysis as an alternative.

Parameter 3: Tidal Range

As can be seen in table 34, tidal datasets from harbours and from satellite missions are available, but they are not accessible (not provided to the Consultants). Consequently, their quality is unknown.

Readiness level: step 1

Guinea is ready to apply CHW in Tidal Range at Step 1, which requires having access to global tidal information and the map provided by the CHW methodology (see annex 1). Local tidal datasets are theoretically available, but their quality is not guaranteed.

In order to extend Tidal Range classification to Step 2 and 3, local data is required. In this sense the following actions would be necessary:

- Action 1: collect time series from tidal gauges and check their quality. To this end, it is required they have a time-span of at least 20 years and record the sea level from a well defined reference level. With this information, tidal harmonic analysis can be performed and basic statistics can be calculated.
- Action 2: consider using global data sets from satellite altimetry (see annex 1) as an alternative to tidal gauges. Satellite altimetry provides a solution globally to measure precisely sea surface height, derived from the time taken by a radar pulse to travel from the satellite antenna to the surface and back to the satellite receiver.

Parameter 4: Biodiversity

Guinea has information about biodiversity in the coastal region that is useful for the analysis. Moreover, aerial images, which are key for the classification system proposed in CHW, are available. On the other hand, quality of the data is not clearly defined and should be checked before implementing CHW. CPMZC is the institution responsible of the availability of biodiversity data in Gambia. CPMZC, Direction de la Meteo and CERESCOR are responsible of checking the quality of these data.

Readiness: Guinea **is ready to apply CHW in Flora/Fauna at Step 1**, which requires to have enough quality in aerial images in order to identify the type of vegetation. Nevertheless it is estimated that an acceptable first approximation can be achieved with Google Earth Images.

In order to extend Flora/Fauna classification to Step 2 and 3, local data is required. In this sense the following recommendations are suggested:

- Action 1: look for complementary coastal photographs (taken from the ground) that can help identifying these types of vegetation
- Action 2: organize field trips to the areas that remain unclear.

Parameter 5: Sediment Balance

As can be seen in Table 34, historical orthophotos, historical shorelines, local studies and an inventory of anthropogenic actions are not available. Some reports about coastal erosion should be available according to the surveys, but they are not accessible (not provided to the Consultants). Consequently, their contents are unknown.

Readiness level: step 1

Guinea is ready to apply CHW in Sediment Balance at Step 1, which requires only to have access to Google Earth timeline application, in combination with Geological Layout classification.

In order to extend Sediment Balance classification to Step 2 and 3, local data is required. In this sense the following recommendations are suggested:

- Action 1: collect historical orthophotos and historical shorelines. Data gathered should be digitalized and georeferenced. Ideally, multiple ortophotos/digital shoreline should be available covering a period as long as possible, e.g., 20 years.
- Action 2: build an inventory of all coastal anthropogenic actions along the coast during the past years. This should include urbanisation in coastal areas, coastal protection infrastructures and other coastal activities. This is a very useful way to identify coastal stretches with erosion/accretion problems.The existing reports on coastal erosion can give valuable information on this topic.

Parameter 6: Storm Climate

As indicated in Table 29, there is not storm database available. However, there is no need of local information within the 3 steps of CHW methodology, as the West African Coast is not affected by tropical cyclones (see annex 1 for more information).

Readiness level: step 3

Guinea is ready to apply CHW in Storm Climate at Step 3. Storm Climate classification is immediate, since all country is classified as non-tropical cyclone affected.

There is no further recommendation to apply CHW in Storm Climate.

Conclusion

After analysing the different parameters of CHW, it is recommended to Guinea to implement CHW at step 1. This is possible using open access datasets provided in annex 1. Further implementation of step 2 and 3 implies the collection, quality analysis and processing of all the existiing data.

b) Recommendations for enabling the environment for CHW implementation

In order to enable a proper environment for the implementation of CHW, it is recommended to take the following actions in Guinea:

- Recommendation 1: name a national coordinator within CPMZC, who will be responsible of CHW implementation and interaction with the consultants.
- Recommendation 2: establish direct contact with CERESCOR, NSHB, CERE, COSIE, ONGR and DN Météo and other relevant institutions with the objective of exchanging information and expertise.

- Recommendation 3: establish a CHW team in *CPMZC*, led by CHW coordinator, composed by technical staff with expertise in data analysis, GIS and/or oceanography.
- Recommendation 4: check the available computer resources in *Institut de Recherche Halieutique et Océanographique*. At this level, it is essential to have a Geographic Information System (GIS) software. It is advised to use Quantum-GIS[15], an open source GIS software that can be used in a laptop or a desktop computer with any operating system. Alternatively, ArcGIS can be used, but implies purchasing a license.

c) Proposed agenda for CHW implementation (to be agreed upon with WACOM Antennas and Cameroon):

The implementation of CHW starts with the mapping of the coast for each CHW dimension. To this end, the consultants suggest the following phases for Benin:

Phase 1: using the open access digital shoreline, define basic units segmenting it in coastal stretches in which the Geological layout (Parameter 1) is uniform. This can result in stretches from hundreds of meters to kilometres, depending on the Geological Layout spatial variability. Recent Google Earth satellite images can be used in this case as a basis, together with a geological map and a DEM.

This task is estimated to be completed **in three weeks** by a GIS specialist.

Phase 2: classify the basic units defined in phase 1 according to Wave Exposure, Tidal range and Storm Climate. Wave exposure and Storm climate can be classified according to the Global Wave Environments map (Davies 1980, modified by Masselink and Hughes 2003 and Rosendahl Appelquist) map, Wave exposure classification for the CHW system[16] and Map over global todañ environment (Davies 1980, modified by Masselink and Hughes 2003) (see annex 1).

This task is estimated to be completed **in one week** by a GIS specialist.

Phase 3: classify the basic units defined in phase 1 according to Flora/Fauna. We propose that Google Earth images should be revised in order to identify those areas where resolution is enough to describe the type of vegetation and the percentage of area with vegetation. This process should be carried out in **two weeks**.

For those areas without enough resolution, complementary information should be acquired that allows the identification of these variables. Additionally, field trips should be performed to those areas where vegetation cannot be identified and quantified otherwise.

These processes should be carried out in **two weeks**.

Phase 4: classify the basic units defined in phase 1 according to Sediment Balance by comparing multiple historical shorelines and/or historical ortophotos In the timeline function of Google Earth, satellite and ortophotos are available. Coastal deficit, balance or surplus in each basic unit has to be assessed through the identification of coastline retreat or advance across the last decades by comparing the evolution of historical coastlines. It is important to note if a dominant erosion/accretion behaviour is possible to be related with some anthropogenic action. Only ortophotos from the same month or season must be taken in consideration in order to filter inter-annual oscillation of the coast.

This task is estimated to be completed in **two weeks** by a GIS specialist.

[15] https://qgis.org/en/site/

[16] https://www.coastalhazardwheel.org/media/1217/main-manual-coastal-hazard-wheel.pdf

2.2.7. Senegal

a) Overview and analysis per CHW dimension

Table 35 provides an overview of the situation of **Senegal** in terms of availability, quality, accessibility of the required datasets for CHW application, classified by CHW dimension. according to the responses of surveys and remote meetings with *Direction de l'Environnement et des etablissements classes – Ministere de l'Environnement et du Developpement Durable (DEEC-MEDD)*.

Table 35. Data overview in Senegal for implementing CHW

Dimension	Responsible institution	Datasets required	Availability	Quality	Accessibiliy	Readiness (steps as per CHW)
Geological Layout	DPM, ANACIM, UCAD, UGB CRODT, CSE	Costal geomorphology classification				2
		Shoreline database				
		Current ortophotografies				
		Geological/Lithological map				
		DEM				
		Other report/studies on geomorphology				
Wave Exposure	Phares et Valises, CRODT, ANACIM	Buoy datasets				1
		Wave reanalysis				
Tidal Range	Phares et Valises, CRODT, ANACIM	Tidal records based on harbour tidal gauges				1
		Tidal datasets based on satellite altimetry				
Flora/fauna		Flora and fauna database cover with satellite images by Google Earth				1
		Local institution responsible for biodiversity database				
Sediment Balance	DEEC	Reports about coastline erosion				1
		Historical ortophotography				
		Digitalized historical shorelines				
		Inventory of anthropogenical actions regarding erosion				
Storm Climate	ANACIM, DEEC, DPM, CSE, DPC	Storm database				3

In the following paragraphs an analysis per CHW parameter is proposed with the readiness level of the country and specific recommendations for the implementation of the CHW in the country.

Parameter 1: Geological Layout

As seen in Table 35, local data are available to characterize Geological Layout properly. Some of them are accessible and their quality has been assessed. First, a digital shoreline is available. It is correctly projected and was taken is 2019. Secondly, current orthophotos has been also reviewed. They have good quality, but only PDF versions have been provided to the Consultants.

Third, a geological map is also available at very high detail in spatial resolution, but only PDF format was provided. Finally, DEM should be available according to the survey, although it has not been provided to the Consultants

Readiness level: **Step 2**

Senegal is ready to apply CHW in Geological Layout at Step 2-3, which requires access to open access and local datasets (see the global datasets available in annex 1). Local datasets are theoretically available, but their quality is not guaranteed.

In order to further work in Geological Layout classification in Step 2 and 3, the following action is suggested:

Action 1: Ensure that geological map, ortophotos and DEM are in digital format and georeferenced. If not available, a GIS expert should work on this.

Parameter 2: Wave Exposure

As can be seen in table 35, neither wave datasets from buoys neither reanalysis are available to characterize Wave Exposure. Global wave reanalysis are available instead.

Readiness level: step 1

Senegal is ready to apply CHW in Wave Exposure at Step 1, , which requires having access to a Geological Layout classification and a global distribution of wave conditions, provided by the CHW methodology (see Annex 1).

Shifting the Wave Exposure classification to Step 2 and 3 would imply the following:

- Action 1: global wave reanalysis is publicly available and an alternative for implementing CHW in Step 2-3 (see Annex 1). It is recommended to consider using global wave reanalysis as an alternative.

Parameter 3: Tidal Range

As indicated in table 35, tidal datasets from harbours and from satellite missions are not available.

Readiness level: step 1

Senegal is only ready to apply CHW in Tidal Range at Step 1, which requires to have access to global tidal information and the map provided by the CHW methodology (see annex 1).

In order to extend Tidal Range classification to Step 2 and 3, local data is required. In this sense the following actions would be necessary:

- Action 1: consider using global data sets from satellite altimetry (see annex 1) as an alternative to tidal gauges, not available in Senegal. Satellite altimetry provides a solution globally to measure precisely sea surface height, derived from the time taken by a radar pulse to travel from the satellite antenna to the surface and back to the satellite receiver.

Parameter 4: Flora/Fauna

Senegal has little information about biodiversity in the coastal region that is useful for the analysis. Moreover, it lacks other sources of data (mainly aerial images) that are key for the classification system proposed in CHW. Also, quality and accessibility of the data is not clearly defined and should be checked before implementing CHW. DEEC, CSE, DPN, ANACIM and DAMPC are the institutions responsible of the availability of biodiversity data in Gambia. DAMPC and DPM are responsible of checking the quality of these data.

Readiness level: step 1

It is unclear if **Senegal is ready to apply CHW in Flora/Fauna at Step 1**, which requires having enough quality in aerial images in order to identify the type of vegetation. Nevertheless it is estimated that an acceptable first approximation can be achieved with Google Earth Images.

In order to consolidate Step 1 and to extend Flora/Fauna classification to Step 2 and 3, local data is required. In this sense the following actions are suggested:

- Action 1: analyse Google Earth images in order to check their quality and the feasibility of identifying the type of vegetation on the distinction between marsh and mangrove areas
- Action 2: look for complementary coastal photographs (taken from the ground) that can help identifying these types of vegetation
- Action 3: organize field trips to the areas that remain unclear.

Parameter 5: Sediment Balance

As can be seen in table 35, historical orthophotos, historical shorelines, local studies and an inventory of anthropogenic actions are available, but they are not accessible (not provided to the Consultants). Consequently, their quality is unknown. Some past studies about coastal erosion has been provided an analysed. They are a valuable source of information, since coastal hazard are well idenfied and in depth-analized at national level

Readiness level: step 1

Senegal is ready to apply CHW in Sediment Balance at Step 2-3, which requires to have access to local field data, in combination with Geological Layout classification.

to local field data, in combination with Geological Layout classification.

In order to go further in the Sediment Balance classification in Step 2 and 3, local data has to be digested. In this sense the following recommendations are suggested:

- Action 1: collect historical orthophotos and historical shorelines in georeferenced format. If they are not georeferenced, a GIS expert can work in this. From the georeferenced shorelines in the past, erosion or accretion taxes can be derived from a reference (invariant) line. Ideally, multiple ortophotos/digital shoreline should be available covering a period as long as possible, e.g., 20 years.
- Action 2: build an inventory of all coastal anthropogenic actions along the coast during the past years. This should include urbanisation in coastal areas, coastal protection infrastructures and other coastal activities. This is a very useful way to identify coastal stretches with erosion/accretion problems.

Parameter 6: Storm Climate

As indicated in Table 35, there is not storm database available. However, there is no need of local information within the 3 steps of CHW methodology, as the West African Coast is not affected by tropical cyclones (see annex 1 for more information).

Readiness level: step 3

Senegal is ready to apply CHW in Storm Climate at Step 3. Storm Climate classification is immediate, since all country is classified as non-tropical cyclone affected.

There is no further recommendation to apply CHW in Storm Climate.

Conclusion

Based on the analysis of the 6 parameters of CHW, Senegal appears to be able to work on CHW implementation at step 2-3. This is possible through the open access datasets provided in Table 35, together with the local datasets available in the country. Special attention must be paid to the

reports about coastal hazards, which contains key information about coastal erosion from local sources.

b) Recommendations for enabling the environment for CHW implementation

In order to enable a proper environment for the implementation of CHW, it is recommended to take the following actions in Senega:

- Recommendation 1: name a national coordinator within DEEC/MEED, who will be responsible of CHW implementation and interaction with the consultants.
- Recommendation 2: establish direct contact and cooperation with the other institutions with expertise in geography, oceanography and coastal vegetation, such as DPM, ANACIM, UCAD, UGB CRODT, Phares et Valises, CRODT, ANACIM, CSE and DPC.
- Recommendation 3: establish a CHW team in DEEC/MEED, led by CHW coordinator, composed by technical staff with expertise in data analysis, GIS and/or oceanography.
- Recommendation 4: check the available computer resources in *Institut de Recherche Halieutique et Océanographique*. At this level, it is essential to have a Geographic Information System (GIS) software. It is advised to use Quantum-GIS[17], an open source GIS software that can be used in a laptop or a desktop computer with any operating system. Alternatively, ArcGIS can be used, but implies purchasing a license.

c) Proposed agenda for CHW implementation:

The implementation of CHW starts with the mapping of the coast for each CHW dimension. To this end, the consultants suggest the following phases for Senegal:

Phase 1: using the open access digital shoreline, define basic units segmenting it in coastal stretches in which the Geological layout (Parameter 1) is uniform. This can result in stretches from hundreds of meters to kilometres, depending on the Geological Layout spatial variability. Recent Google Earth satellite images can be used in this case as a basis, together with a geological map and a DEM.

This task is estimated to be completed **in three weeks** by a GIS specialist.

Phase 2: classify the basic units defined in phase 1 according to Wave Exposure, Tidal range and Storm Climate. Wave exposure and Storm climate can be classified according to the Global Wave Environments map (Davies 1980, modified by Masselink and Hughes 2003 and Rosendahl Appelquist) map, Wave exposure classification for the CHW system[18] and Map over global todañ environment (Davies 1980, modified by Masselink and Hughes 2003) (see annex 1).

This task is estimated to be completed **in one week** by a GIS specialist.

Phase 3: classify the basic units defined in phase 1 according to Flora/Fauna. We propose that Google Earth images should be revised in order to identify those areas where resolution is enough to describe the type of vegetation and the percentage of area with vegetation. This process should be carried out in **two weeks**.

For those areas without enough resolution, complementary information should be acquired that allows the identification of these variables. Additionally, field trips should be performed to those areas where vegetation cannot be identified and quantified otherwise.

These processes should be carried out in **two weeks**.

Phase 4: classify the basic units defined in phase 1 according to Sediment Balance by comparing multiple historical shorelines and/or historical ortophotos In the timeline function of Google Earth, satellite and ortophotos are available. Coastal deficit, balance or surplus in each

[17] https://qgis.org/en/site/

[18] https://www.coastalhazardwheel.org/media/1217/main-manual-coastal-hazard-wheel.pdf

basic unit has to be assessed through the identification of coastline retreat or advance across the last decades by comparing the evolution of historical coastlines. It is important to note if a dominant erosion/accretion behaviour is possible to be related with some anthropogenic action. Only ortophotos from the same month or season must be taken in consideration in order to filter inter-annual oscillation of the coast.

This task is estimated to be completed in **two weeks** by a GIS specialist.

2.2.8. Togo

a) Overview and analysis per CHW dimension

Table 36 provides an overview of the situation of **Togo** in terms of availability, quality, and accessibility of the required datasets for CHW application, classified by CHW parameters according to the responses of surveys and remote meetings with the *Direction de l'Environnement*.

Table 36. Data overview in Togo for implementing CHW

Dimension	Responsible institution	Datasets required	Availability	Quality	Accessibiliy	Readiness (step as per CHW)
Geological Layout	Unkown	Costal geomorphology classification				1
		Shoreline database				
		Current ortophotografies				
		Geological/Lithological map				
		DEM				
		Other report/studies on geomorphology				
Wave Exposure	Unkown	Buoy datasets				1
		Wave reanalysis				
Tidal Range	Unkown	Tidal records based on harbour tidal gauges				1
		Tidal datasets based on satellite altimetry				
Flora/Fauna		Flora and fauna database cover with satellite images by Google Earth				1
		Local institution responsible for biodiversity database				
Sediment Balance	Unkown	Reports about coastline erosion				1
		Historical ortophotography				
		Digitalized historical shorelines				
		Inventory of anthropogenical actions regarding erosion				
Storm Climate	Unkown	Storm database				3

In the following paragraphs an analysis per CHW parameter is proposed with the readiness level of the country and specific recommendations for the implementation of the CHW in the country.

Parameter 1: Geological Layout

As seen in Table 36, no local data is available to characterize Geological Layout.

Readiness level: step 1

Togo is only ready to apply CHW in Geological Layout at Step 1, which only requires access to open access datasets (see the global datasets available in Annex 1

Extension of Geological Layout classification to Step 2 and 3 is not possible at this moment. We suggest starting working on:

Action 1: the digitalization of the most updated satellite image, which can be found in Google Earth.

Action 2: familiarizing with global databases: geological maps and DEM (see Annex 1 for the existing global databases).

Parameter 2: Wave Exposure

As can be seen in table 36, wave datasets from buoys or reanalysis are not available to characterize Wave Exposure. Publicly datasets can be used instead (see annex 1 for the existing global databases).

Readiness level: **step 1**

Togo is only ready to apply CHW in Wave Exposure at Step 1, which requires having access to a Geological Layout classification and a global distribution of wave conditions, provided by the CHW methodology (see Annex 1)

Shifting the Wave Exposure classification to Step 2 and 3 would imply the following:

- Action 1: use global wave reanalysis as an alternative as wave buoys datasets are not available. The teams should start familiarizing with these data sets.

Parameter 3: Tidal Range

As can be seen in Table 36, tidal datasets from harbours and from satellite missions are not available.

Readiness level: step 1

Togo is only ready to apply CHW in Tidal Range at Step 1, which requires to have access to global tidal information and the map provided by the CHW methodology (see annex 1).

In order to extend Tidal Range classification to Step 2 and 3, local data is required. In this sense the following actions should be taken:

- Action 1: As local tidal gauges are not available in Cameroon, use global data sets from satellite altimetry (see annex 1) as an alternative to tidal gauges. Satellite altimetry provides a solution globally to measure precisely sea surface height, derived from the time taken by a radar pulse to travel from the satellite antenna to the surface and back to the satellite receiver.

Parameter 4: Biodiversity

Togo has little information about biodiversity in the coastal region that is useful for the analysis. Moreover, it lacks other sources of data (mainly aerial images) that are key for the classification system proposed in CHW. Also, quality and accessibility of the data is not clearly defined and should be checked before implementing CHW. No institution has been identified in Ivory Togo as responsible of data availability, quality and accessibility.

Readiness level: **step 1**

It is **unclear if Togo is ready to apply CHW in Flora/Fauna at Step 1**, which requires to have enough quality in aerial images in order to identify the type of vegetation. However, it is estimated that an acceptable first approximation can be achieved with Google Earth Images.

In order to consolidate Step 1 and to extend Flora/Fauna classification to Step 2 and 3, local data is required. In this sense the following actions are suggested:

- Action 1: analyse Google Earth images in order to check their quality and the feasibility of identifying the type of vegetation on the distinction between marsh and mangrove areas
- Action 2: look for complementary coastal photographs (taken from the ground) that can help to identifying these types of vegetation
- Action 3: perform field trips to those areas that remain unclear after applying the previous recommendations.

Parameter 5: Sediment Balance

As can be seen in Table 36, no information about Sediment Balance is available.

Readiness level: step 1

Togo is ready to apply CHW in Sediment Balance at Step 1, which only requires to have access to Google Earth timeline application, in combination with Geological Layout classification.

In order to extend Sediment Balance classification to Step 2 and 3, local data is required. In this sense the following actions are suggested:

- Action 1: assess the historical orthophotos. They must be correctly georeferenced and projected. As 2005 and 1980 are very distant in time, it is recommended to complete the database with Google Earth images. Ideally, multiple shorelines should be available covering a period as long as possible, e.g., 20 years.
- Action 2: build an inventory of all coastal anthropogenic actions along the coast during the past years. This should include urbanisation in coastal areas, coastal protection infrastructures and other coastal activities. This is a very useful way to identify coastal stretches with erosion/accretion problems.

Parameter 6: Storm Climate

As shown in the table 30, no storm database is available. However, there is no need of local information within the 3 steps of CHW methodology, as the West African Coast is not affected by tropical cyclones (see annex 1 for more information).

Readiness level: step 3

Cameroon is ready to apply CHW in Storm Climate at Step 3. Storm Climate classification is immediate, since all country is classified as non-tropical cyclone affected.

There is no further recommendation to apply CHW in Storm Climate.

Conclusion

Togo is only ready to implement the CHW at step 1 using open access datasets provided in Annex 1. Further implementation of step 2 and 3 will imply further data collection, quality analysis and a processing of all the existing data.

b) Recommendations for enabling the environment for CHW implementation

In order to enable a proper environment for the implementation of CHW, it is recommended to take the following actions in Togo:

- Recommendation 1: name a national coordinator within *Direction de l'Environnement*, who will be responsible of CHW implementation and interaction with the consultants.
- Recommendation 2: establish direct contact with the Research Centers of the country on oceanography and other institutions with the objective of exchange information and expertise.

- Recommendation 3: establish a CHW team in within *National Observatory on Climate Change*, led by CHW coordinator, composed by technical staff with expertise in data analysis, GIS and/or oceanography.
- Recommendation 4: check the available computer resources in *Institut de Recherche Halieutique et Océanographique*. At this level, it is essential to have a Geographic Information System (GIS) software. It is advised to use Quantum-GIS[19], an open source GIS software that can be used in a laptop or a desktop computer with any operating system. Alternatively, ArcGIS can be used, but implies purchasing a license.

c) Proposed agenda for CHW implementation:

The implementation of CHW starts with the mapping of the coast for each CHW dimension. To this end, the consultants suggest the following phases for Togo:

Phase 1: using the open access digital shoreline, define basic units segmenting it in coastal stretches in which the Geological layout (Parameter 1) is uniform. This can result in stretches from hundreds of meters to kilometres, depending on the Geological Layout spatial variability. Recent Google Earth satellite images can be used in this case as a basis, together with a geological map and a DEM.

This task is estimated to be completed **in three weeks** by a GIS specialist.

Phase 2: classify the basic units defined in phase 1 according to Wave Exposure, Tidal range and Storm Climate. Wave exposure and Storm climate can be classified according to the Global Wave Environments map (Davies 1980, modified by Masselink and Hughes 2003 and Rosendahl Appelquist) map, Wave exposure classification for the CHW system[20] and Map over global todañ environment (Davies 1980, modified by Masselink and Hughes 2003) (see annex 1).

This task is estimated to be completed **in one week** by a GIS specialist.

Phase 3: classify the basic units defined in phase 1 according to Flora/Fauna. We propose that Google Earth images should be revised in order to identify those areas where resolution is enough to describe the type of vegetation and the percentage of area with vegetation. This process should be carried out in **two weeks**.

For those areas without enough resolution, complementary information should be acquired that allows the identification of these variables. Additionally, field trips should be performed to those areas where vegetation cannot be identified and quantified otherwise.

These processes should be carried out in **two weeks**.

Phase 4: classify the basic units defined in phase 1 according to Sediment Balance by comparing multiple historical shorelines and/or historical ortophotos In the timeline function of Google Earth, satellite and ortophotos are available. Coastal deficit, balance or surplus in each basic unit has to be assessed through the identification of coastline retreat or advance across the last decades by comparing the evolution of historical coastlines. It is important to note if a dominant erosion/accretion behaviour is possible to be related with some anthropogenic action. Only ortophotos from the same month or season must be taken in consideration in order to filter inter-annual oscillation of the coast

This task is estimated to be completed in **two weeks** by a GIS specialist.

[19] https://qgis.org/en/site/

[20] https://www.coastalhazardwheel.org/media/1217/main-manual-coastal-hazard-wheel.pdf

2.3. Conclusion and next steps

Based on the analysis performed and the country profile roadmap, a series of general conclusions and recommendations can be proposed in order to improve and manage properly the data management process for the CHW.

The following conclusions can be drawn:

- **Conclusion One:** All countries are ready to implement the CHW at Step 1 of the analysis, with support from global databases. However, none of them are completely ready to move to the methodological framework of Step 2 and/or Step 3
- **Conclusion Two:** In general, countries have significant information in order to classify relevant parameters of the CHW, such as the geological layout, tidal range and sediment balance, although the quality and accessibility per country is uneven
- **Conclusion Three:** The three CHW dimensions where countries have more shortages of access to data and quality challenges are wave exposure, flora/fauna and storm climate.
- **Conclusion Four:** In terms of capacities, it is worth noting that WACOM National Antennas are not familiarized with the methodology nor the counterpart representation, and therefore, it is needed to strengthen their outreach on this behalf in the region.
- **Conclusion Five:** Institutions directly responsible for managing and processing data are not as aware as they probably should on the virtues of CHW for risk management of the coasts.
- **Conclusion Six:** The level of alignment and awareness between the different institutions in all countries is not very cohesive and thus, it would be recommended to establish a national strategy to develop the data gathering process in a more integral way.

Based on these conclusions, the following steps are recommended in order to develop a proper CHW analysis at both levels (national and regional):

- **Step One:** Encourage countries to assign a national coordinator per country in order to manage and develop a proper data process analysis
- **Step Two:** Encourage country counterparts to propose a list of country representatives to participate in the national training that will be provided by GlobalCAD during the month of July
- **Step Three:** Create a joint CHW national Steering Committee with key representatives in order to manage and coordinate the CHW data analysis process
- **Step Four:** Liaise between the consultant consortium and the country representatives in order to complete the first mapping of CHW framework of each country.
- **Step Five:** Ensure the CHW National Steering Committee commits to a regular review and process meeting (at least once every six months) to ensure the sustainability of the process

3. Evaluation study on the management of gender issues in coastal risk planning and management in West Africa and Cameroon (D.2.2.)

3.1. Findings

3.1.1. To what extent is vulnerability gender-specific in the West African and Cameroonian coastal area?

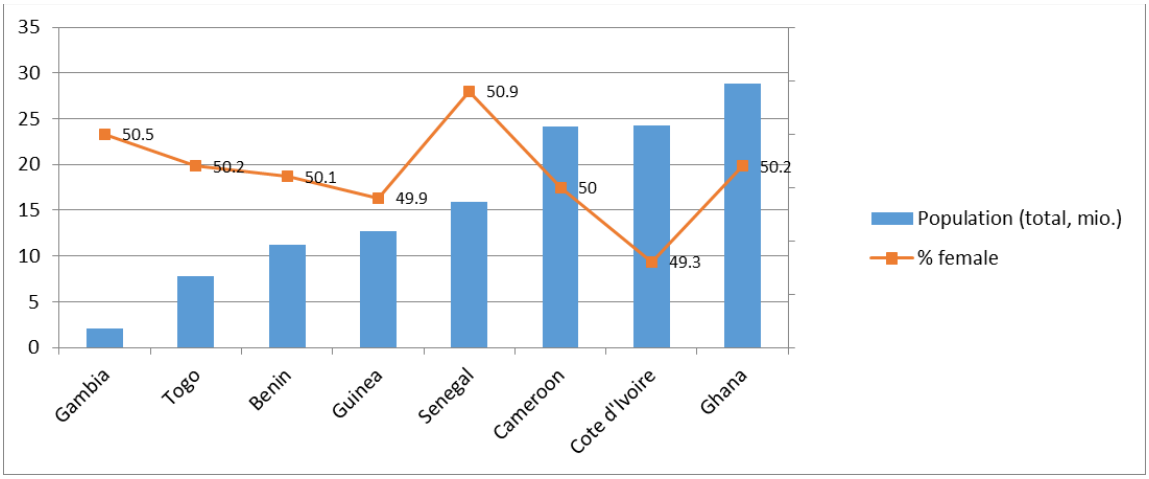
How do coastal risks affect communities in coastal areas in West Africa?

The West African and Cameroonian coastal areas are among the most vulnerable to the impacts of climate change, but also of human activity. The effects of coastal hazards include ecosystem disruption, gradual inundation, salt water intrusion, erosion and increased coastal flooding.

The eight countries included in this study – Benin, Cote d'Ivoire, the Gambia, Ghana, Guinea, Senegal, Togo and Cameroon - have a population of about 127 million people, of which approximately 50% (63.4 million) are women.[21]

[21] Based on World Bank population data from 2017 available at https://data.worldbank.org/indicator/SP.POP.TOTL?view=chart

Figure 1: Total population and share of female population



Source: Own elaboration based on World Bank data (2017)

Secondary literature shows that about one third of West Africa's population lives in coastal areas (31% of the total population and 51% of urban population), with a growing trend, and about 42% of the region's GDP is generated in these areas.[22] Some differences exist between countries: while in Ghana for example about 25% of the population lives in coastal areas, in Togo it is 36% and in Benin even 60%.[23]

All administrative and/or economic capitals of the countries included in this study lie in the coastal areas, and due to rapid urbanization and population growth it is predicted that by 2050, the region's urban population could increase from 36 million to about 80 million people.[24] They are thus an important driver of socio-economic development, and many people's livelihoods depend on the ecosystem services and natural resources available at land and at sea.

Coastal hazards result in natural environment changes that consequently affect people's livelihood and well-being. In different contexts, coastal hazards impact people differently, but they affect more intensively most vulnerable populations. The countries covered in this study are among those with lowest human development and thus the population's vulnerability to coastal risks and disasters is aggravated by high poverty rates and other factors such as low education levels, lack of access to basic services, political instability, poor governance, and generally weak economies.[25]

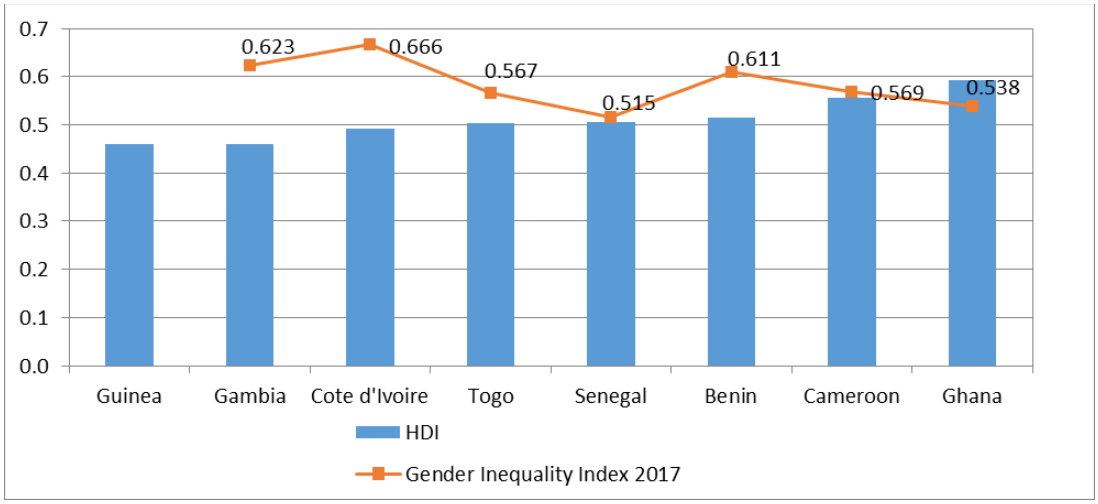
[22] http://www.worldbank.org/en/programs/west-africa-coastal-areas-management-program

[23] Percentage for Ghana is mentioned in the National Climate Change Policy of Ghana, for Togo in the Plan d'actions pour le développement et l'adaptation aux changements climatiques du littoral togolais, and for Benin in the Plan d'investissement multisectoriel pour l'adaptation aux risques côtiers face aux changements climatiques

[24] Goussard et. al., Regional Study for Shoreline Monitoring and Drawing Up a Management Scheme for the West African Coastal Area. Towards a Regional Coastal Risk Reduction Plan. UEMOA, 2010. Numbers are for the whole region, individual country data are not available.
https://www.iucn.org/sites/dev/files/content/documents/communication_doc_sdlao_pr_en_0.pdf

[25] Disaster Risk Management Strategy in West Africa and the Sahel FAO 2011-2013

Figure 2: Human Development Index (HDI) and Gender Inequality Index (GII)



Source: Own elaboration based on UNDP HDI data (2018) and GII 2017[26]

Likewise, all countries are among those with the highest gender inequalities if compared at the international level.[27] This means that in the overall context of low human development, women and girls face disproportionately more hardships and discrimination than men and boys in terms of their rights and opportunities in the political and economic sphere, as well as regarding other social areas such as education and health.

Regarding livelihoods, the population of the countries included in the study is still highly dependent on agriculture, both for income generation and subsistence. Typical socio-economic activities and division of labour in coastal communities in West Africa and Cameroon include:

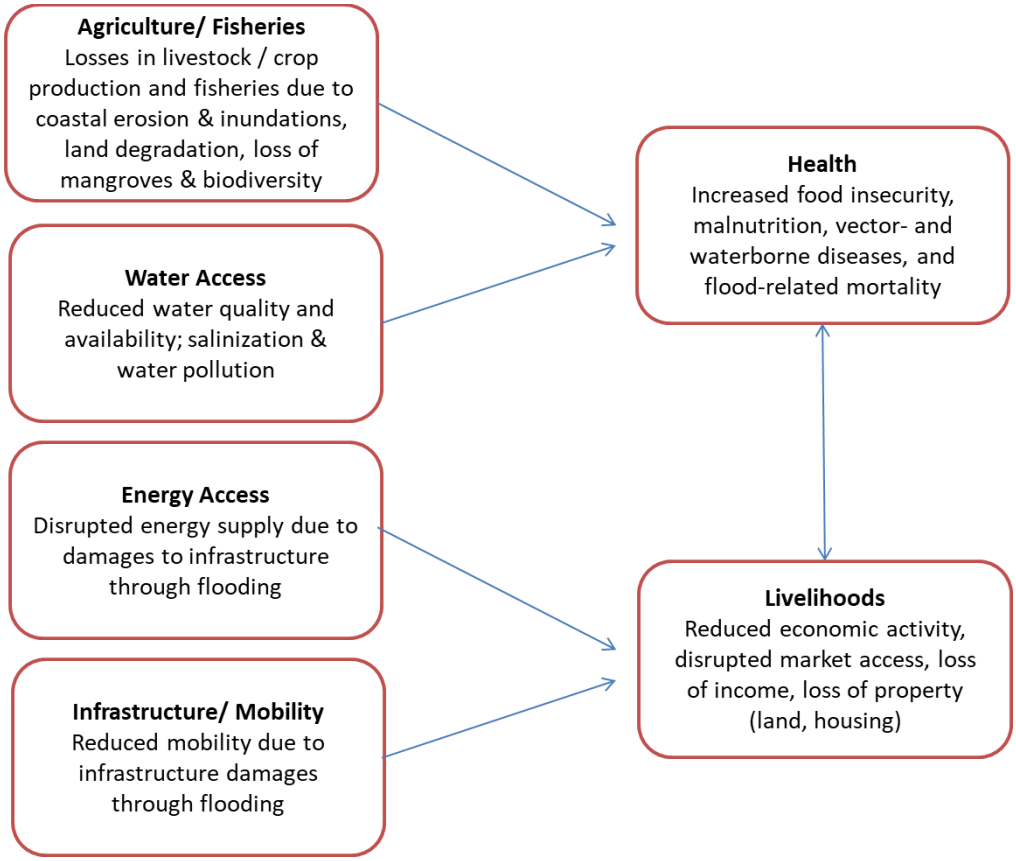
Women:	**Men:**
• Rice cultivation along the coast • Small-scale agriculture (vegetables) and small animal farming (chicken etc.) • Small-scale fishing activities • Fish smoking and drying • Selling of fish and other sea products	• Fishing • Shrimp farming • Livestock production • Cash crop production

In addition, women are usually responsible for collecting water and firewood, cooking and taking care of the household.

Coastal risks and hazards have a number of negative consequences for the population, which in turn has an overall impact on the national economies.

[26] HDI country profiles are available at http://hdr.undp.org/en/countries, the GII at http://hdr.undp.org/en/data. The GII for Guinea is not available, the GII for Cote d'Ivoire is from 2015 as it is not available for 2017.
27 The GII, like the HDI, has a scale from 0 to 1 where 0 would mean perfect equality and 1 complete inequality. For 2017, Yemen has the highest GII with 0.835, and Switzerland has the lowest, 0.039.

Figure 3: Impacts of coastal risks and hazards



Source: Own elaboration, adapted from USAID[28]

A recent study on the Cost of Environmental Degradation (COED) in the coastal areas of Benin, Côte d'Ivoire, Senegal, and Togo shows that the COED of the four countries is estimated at about US$3.8 billion, or 5.3 per-cent of the countries' GDP in 2017. Numbers vary between 2.5 % of GDP in Benin to 7.6 % in Senegal. In addition, coastal degradation causes over 13,000 deaths a year, primarily due to air and water pollution and to floods.[29]

In how far are women and men in the communities affected differently?

Women are amongst the most vulnerable to the impacts of coastal hazards due to cultural and social rules, norms, structures and other social arrangements that shape and regulate their status in society, and that affect their access to and control over resources and decision making. They thus often suffer more from the above described impacts than men.

Women do not form a homogeneous group defined by their gender alone. Gender intersects with other social aspects that define who is privileged and who is not, for example, age, education, ethnicity, etc. The importance of these aspects differs among countries and also among different communities within a country. However, in the context of West Africa and Cameroon, a number of common characteristics can be highlighted:

[28] USAID, Climate Risk Profile West Africa. https://www.climatelinks.org/resources/climate-risk-profile-west-africa
[29] Lelia Croitoru, Juan José Miranda and Maria Sarraf, The Cost of Coastal Zone Degradation in West Africa: Benin, Cote d'Ivoire, Senegal and Togo (2019). Available at http://documents.worldbank.org/curated/en/822421552504665834/pdf/135269-Cost-of-Coastal-Degradation-in-West-Africa-March-2019.pdf

Box 1: Factors that increase girls' and women's vulnerability to coastal risks and disasters in West Africa and Cameroon

- **Patriarchal family structures** determine the role of women; especially in rural settings women are defined through their reproductive role. Girls often marry early, and many girls and women live in polygamist families[30]. Their role is to take care of the household and to provide food for the family, fetch water and firewood, take care of the children and the elderly. Men usually control household assets, finances, and take the decisions regarding their use. This limits women's access to resources and decision-making processes.
- **Lack of education**: priority is given to boys; thus, girls and women have lower education levels[31], limiting their access to information and their ability to make decisions. This also often drives them into informal employment – or they work without any remuneration, for example in agriculture, in addition to their household tasks.
- **Restricted access to property**: Women often don't have the right to own land (or if they do have the right by law, it is still not enforced properly), which limits their access to assets/ financing for developing their economic activities.
- **Violence against women** is prevalent and in some countries, even increasing. This limits women's freedom to move and make self-determined decisions.

Gender roles are generally more traditional in rural than in urban settings, but inequalities prevail also in bigger cities and especially among the poorer population groups with lower education levels. As Ghana's National Climate Policy states: "Particularly at risk are poor urban and rural women who live in densely populated coastal and low-lying areas…"[32]

These gender inequalities in the distribution of assets and opportunities mean that women's choices are much more constrained than men's. For example, restrictions around land ownership for rural women can mean that they may not have access to productive land to farm, and a lack of financial capital means they cannot easily diversify their livelihoods or get access to new technologies. In the end, this means that gender inequality increases the negative effects of coastal hazards on women because they do not have the proper resources, information and power to cope with the consequences. Moreover, women often face restriction and discrimination in access to support and recovery services in the event of a disaster happening, and mortality rates are often higher for women.[33]

Additionally, when coastal hazards occur, they can aggravate gender inequalities – for example, studies have shown that violence against women can increase in crisis situations.

Women are also often solely seen as victims and not recognized as actors that can contribute to a more sustainable development although it is often the women who more directly depend on and work with natural resources, and who have traditional knowledge on sustainable management of these resources.

3.1.2. How does WACOM countries and Cameroon perceive and deal with vulnerability and resilience to

[30] For example, in Ivory Coast, around 30%. JICA Country Gender Profile: Côte d'Ivoire (2013)
[31] Although in primary education countries have made progress in reaching equity between girls and boys, gender disparities persist in secondary and higher education.
[32] National Climate Policy of Ghana (2013), p. 77
[33] For example, women accounted for 61% of deaths caused by Cyclone Nargis in Myanmar in May 2008, 70 to 80% of deaths in the 2004 Indian Ocean tsunami and 91% of deaths in the 1991 cyclone in Bangladesh. UNDP, Gender and Adaptation (2013). https://www.undp.org/content/dam/undp/library/gender/Gender%20and%20Environment/PB2-AP-Gender-and-Adaptation.pdf

Regarding this question, coastal risks have been defined as an aspect of climate change – although not all coastal risks necessarily are a consequence of a changing climate. However, the link between gender and coastal risks is most often made in the context of climate change adaptation, and literature suggests that coastal risks and disasters are aggravated by climate change impacts.

The way that countries perceive and deal with gender and coastal risks has thus been analysed through a more general analysis of policies and strategies adopted related to climate change adaptation and gender, as well as disaster risk management. The international, regional and national levels have been taken into account.

International Level

At the international level, all countries covered in this study are signatories to the UN General Assembly Convention for the Elimination of All forms of Discrimination Against Women (CEDAW), which was adopted in 1979. Likewise, they are signatories of different conventions and frameworks that establish a link between gender and climate change, environment and risk reduction. These include:

The Sendai Framework on Disaster Risk Reduction (2015-2030), which emphasizes that "women and their participation are critical to effectively managing disaster risk and designing, resourcing and implementing gender-sensitive disaster risk reduction policies, plans and programmes; and adequate capacity-building measures need to be taken to empower women for preparedness as well as build their capacity for alternative livelihood means in post-disaster situations".[34]

The SDGs, which include gender equality and women's empowerment as a stand-alone goal (SDG5). In addition, SDG13 on Climate Action calls for the promotion of mechanisms for raising capacity for effective climate change-related planning and management, including focusing on women, youth and local and marginalised communities.

By signing and ratifying the Conventions on biodiversity (CBD), climate change (UNFCCC), and desertification (UNCCD), governments officially committed to implement these agreements, and monitor and report on their progress. All three of the Rio Conventions include multilateral agreements on gender equality and women's empowerment.

Most recently, the Gender Action Plan (2017) of the UNFCCC seeks to advance women's full, equal and meaningful participation and promote gender-responsive climate policy. It also recognizes that women play a critical role on climate change due to their local knowledge of and leadership in sustainable resource management and/or leading sustainable practices at the household and community level.

These legal and normative instruments can be considered as fundamental frameworks for policymakers and development practitioners to mainstream gender across environmental sectors.

Regional Level

At the regional level, all countries included in this study are members of the African Union (AU), which has put gender equality on the agenda through its Agenda 2063[35], its strategy for Gender Equality and Women's Empowerment (GEWE, 2019), its Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa (2003), and the Solemn Declaration on Gender Equality in Africa (SDGEA, 2004)[36]. The AU's Women, Gender and

[34] https://www.unisdr.org/we/advocate/gender
[35] https://au.int/sites/default/files/documents/36204-doc-agenda2063_popular_version_en.pdf
[36] https://www.un.org/en/africa/osaa/pdf/au/declaration_gender_equality_2004.pdf

Development Directorate (WGDD) aims to ensure that member states implement the respective policies and strategies, and provides guidance to the country level in this respect. Environment or climate change related topics are integrated into GEWE under the pillar of economic justice and sustainable development, where the strategy document states that "Women are key managers of the environment; bear the brunt of natural disasters and climate change yet are not meaningfully engaged in climate justice initiatives."[37]

In 2010 the AU declared the Decade for Women 2010-2020. Among its objectives is to "identify Women's role in mitigating climate change, as custodians of the environment, making sure they benefit from the new global packages to fight climate change". Adaptation to climate change however is not specifically included.

In addition, all countries except Cameroon are members of ECOWAS. The Supplementary Act on Equality of Rights between Women and Men for Sustainable Development in the ECOWAS Region[38] from 2015 commits all ECOWAS Member states to the promotion of gender equality and equity in all sectors through appropriate policy and legislative formulation and reviews as well as strategy alignment. It includes Article 37 on Environmental Management and Article 38 on Protection against the Negative Impacts of Climate Change.

National Level

The translation of international/ regional frameworks to the national and sub-national level is quite different from country to country, and a lot of gaps still exist in the effective implementation of global agreements as well as national policies and plans. Countries make use of various frameworks to mainstream gender: from national development plans to specific national gender policies, to the integration of a gender dimension into National Adaptation Plans (NAPs) or other specific instruments for climate change adaptation and/or coastal risk management.

The different levels of advancement regarding gender equality are reflected in different indexes that aim to measure evidence on gender equality at country level. While a number of different indexes exist, two have been selected as particularly interesting for this study: The African Gender Equality Index of the AfDB[39] and the Environment and Gender Index (EGI)[40], which is an initiative of the IUCN. While the AGEI takes into account indicators regarding three dimensions – equality in economic opportunities, human development and laws and institutions, the EGI integrates indicators related to gender equality and environmental sustainability.

Box 2: The Environment and Gender Index

The EGI is the first index that assesses the conditions for gender equality and women's empowerment in the environmental arena in 72 countries, with 20 from Sub-Saharan Africa. It has been piloted in 2013 and includes 27 indicators from six categories: Livelihood, Ecosystem, Gender-based Rights and Participation, Governance, Gender-based Education and Assets, and Country-Reported Activities (a country's inclusion of gender in Conference of Parties (COPs) reports as well as a country's inclusion of environmental sustainability in CEDAW reports).

The indexes have a scale from 0 to 100 and 0 to 1, respectively, where 100 or 1 would mean perfect equality and 0 no equality at all.

[37] African Union Gender Strategy, available at https://au.int/en/gender-equality-development
[38] http://www.ccdg.ecowas.int/wp-content/uploads/Supplementary-Act-on-Gender-Equality.pdf
[39] The African Gender Equality Index covers 52 African countries and can be downloaded at https://www.afdb.org/en/topics-and-sectors/topics/quality-assurance-results/gender-equality-index/
[40] The EGI is the first index that assesses the conditions for gender equality and women's empowerment in the environmental arena in 72 countries. Four of the eight countries of this study are included: Benin, Cameroon, Gambia and Ghana. http://genderandenvironment.org/resource/the-environment-gender-index/

Table 1: AGEI (2015) and EGI (2013) scores and ranking

	African Gender Equality Index (AfDB) 2015	AGEI rank (out of 52 countries)	EGI 2013	EGI rank (out of 72 countries)
Ghana	62.3	15	0.51	41
Gambia	54.7	24	0.42	61
Benin	52.0	29	0.44	57
Senegal	51.9	30	n/a	n/a
Togo	49.5	33	n/a	n/a
Cameroon	46.7	41	0.4	63
Cote d'Ivoire	43.7	43	n/a	n/a
Guinea	39.5	48	n/a	n/a

Source: Own elaboration based on AGEI 2015 and EGI 2013 reports

Ghana ranks highest in both indexes, while Cameroon ranks lowest when both indexes are considered. Nevertheless overall, no country is in a top position – rather the opposite, most are positioned towards the rear end in the rankings.

Regarding the EGI, the report states that the African countries rank highest in the ecosystem category of the index, which includes data on biodiversity preservation, critical habitat protection and higher quality forests. However, no sex-disaggregated data was available for this category and it rather provides insights into a country's commitment to environmental sustainability and conservation only. Within the region, Benin ranks highest in the ecosystem category in Africa, but lowest in the gender-based education and assets category worldwide.

The overall impression transmitted by the two indexes on where countries stand regarding gender equality and the environment is also partly reflected in the range of policies and plans that countries have adopted regarding gender and climate change adaptation, or coastal risk management specifically. Despite the various policy and strategy documents that exist at national level, a specific link to gender and coastal risk management is usually not made and thus, it remains vague how gender mainstreaming in coastal risk management should be implemented.

It can be observed from the document analysis that currently, Ghana has most comprehensively integrated gender in its National Climate Policy, while some countries at the moment have not yet made the link between gender and climate change adaptation at all.

Moreover, only four out of the eight countries included in this study – Benin, Cote d'Ivoire, Ghana and Togo - have assigned a UNFCCC gender focal point so far, and there seems to be a certain correlation between the level of integration of gender into relevant policies and the existence of a gender focal point.

However, it also needs to be said that the topic is relatively new, as reflected by the recent Lima Work Programme and the finalization of the UNFCCC Gender Action Plan in 2017. Looking at several countries, there seems to be a recent trend to increasingly mainstream gender in climate change adaptation policies, and to identify coastal management as a priority. In this regard, several countries are in the process of developing new policies and plans that will include gender mainstreaming related to climate change adaptation as well as coastal management in the near future. Developments in Cote d'Ivoire, Senegal and Gambia can be highlighted in this regard. This can also be an indication that the provision of guidance at the international level is indeed an effective way to support country level implementation, although this can take some time.

Benin, Cote d'Ivoire, Senegal and Togo are also currently participating in the investment component of WACA, a World Bank Programme on West Africa Coastal Areas Management. The Programme is now in the initial stages of developing a gender action plan and thus it can be assumed that in the coming years, gender will be mainstreamed into WACA's investment plans at the country levels.

Table 2: Overview on national level strategies/ plans on gender equality, climate change adaptation and coastal risk management

	National Development Plan	National Gender Equality Policy	Climate Change Adaptation/ DDR Policies/ Plans	Coastal Development Plans or other related documents	UNFCCC Gender Focal Point?
Benin	**National Development Plan 2018-2025** Resilience to climate change on the one hand, and gender equality on the other are priorities stated in the policy. However, no linkage is made between the two topics.	**Politique Nationale de promotion du Genre 2009-2025** - Doesn't refer to environment directly, but considers every sectorial ministry to implement the gender policy.	**Programme d'Action National d'Adaptation aux Changements Climatiques** du Benin (PANA-Benin) 2008 Cadre d'Action de Hyogo 2013-2015 - Benin doesn't take into account gender in risk prevention (only 2 local women associations are included in the definition of the plan). **First NDC** (2017) Includes as one need for capacity building: Promotion du renforcement et du partage de connaissance sur les changements climatiques, par des activités de sensibilisation, de gestion des risques et d'élaboration de politiques sensibles au genre Otherwise, gender is not included in sector specific areas (such as biodiveristy, water, etc. It is only generally stated that the NDC should be implemented with the participation of different state and non-state actors, and taking into account gender and social inclusion.	Plan d'investissement multisectoriel pour l'adaptation aux risques cotiers face aux changements climatiques au Benin (2017) Gender is not mentioned in the document. However, this plan has been developed in the context of WACA and it will be a requirement to integrate gender into specific initiatives and to contract a gender specialist for this purpose.	Yes
Cameroun	**Vision 2035**: Poursuivre la lutte contre l'exclusion sociale et renforcer l'égalité de genre (but not considering environment)	**Politique nationale genre 2011-2020** refers to women and the environment "...climate change, which affects the entire population, has a stronger impact on women who are compelled to travel over long distances to fetch household water, firewood, etc." "...although the combined action of women and men undermine the environment, …social distribution of roles between women and men still hinder its sustainable management."	**National Adaptation Plan for Climate Change (NAPCC, 2015)** The Government of Cameroon formally endorsed the NAPCC in June 2015. It became part of the Paris Agreement, and should benefit from the financial pledges with legal force under the United Nations Framework Convention on Climate Change (UNFCCC). In total, the NAPCC includes 20 program sheets; sheets 1 to 5 are inter-sectoral programs and sheets 6 to 20 are programs ascribed to thematic sectors: Project 5: Coastal protection against the effects of climate change; Project 10: Adapting the national gender policy and reducing their vulnerability to climate change **First NDC Cameroon (2016)** Summarizes the NAPCC, gender as a cross-sector aspect (but only mentioned briefly twice in the whole document)		No
Cote d'Ivoire	**Plan National de Développement 2016-2020** includes gender, but not related to environment/climate change. The main focus is	Politique nationale sur l'égalité des chances, l'équité et le genre de Côte d'Ivoire (2009) Does not include any relation between gender and climate change, rather focuses on human	**First NDC Cote d'Ivoire (2016)** Just talks about "taking gender into consideration" in the context of agriculture. **Programme d'appui du PNUD à la mise en œuvre des Contributions Déterminées au niveau national (CDN)** de la Côte d'Ivoire - Programme document states: "les stratégies, plans et	Appui a la préparation de plan d'investissement multisectoriels IDA-17 et du plan d'investissement pour la ville de Grand-Lahou, République de Cote d'Ivoire	Yes

	on economic growth that is "respectful to gender and the environment"	rights, macroeconomic development, reconstruction and basic social service (Health and Education), as well as general gender mainstreaming and M&E framework	politiques climatiques qui existent ne prennent pas suffisamment en compte les questions de genre." It defines the aim to integrate a gender dimension into the NDC and the NAP, including gender-sensitive indicators for M&E. The Programme defines the objective to elaborate a **National Gender and Climate Change Strategy and Action Plan;** and includes capacity building for national actors so that they are capable to implement. The Programme also aims at including a gender dimension in the communication strategy about the NDC	Gender is not mentioned in the document. However, this plan has been developed in the context of WACA and it will be a requirement to integrate gender into specific initiatives and to contract a gender specialist for this purpose.	
Gambia	**National Development Plan 2018-2021** states: Women's empowerment is identified as a critical enabling factor to reach the strategic objectives of the development plan. However, no reference is made to gender related to environmental aspects, natural resources management etc. Environment or climate change adaptation or mitigation are not included in the Plan at all.	**The Gambia National Gender Strategy 2010- 2020** Environment/CC not mentioned as a priority area. However, the first mission statement "**Achieve gender equity and equality at policy, programme and project levels in all institutions and levels across all sectors of the Gambian society**" is very broad and thus includes also the coastal risk management.	**National Disaster Management Programme** (2008) **Strategic Action Plan 2008 - 2011** Includes the action: Mainstreaming gender, poverty and environment in disaster issues, under the objective "Develop an efficient response mechanism to disaster management and to make available the necessary resources." It is not further detailed in which way gender should be mainstreamed, but women are mentioned among the key stakeholders of the action plan, and the plan also suggests that the key institutional bodies at regional and community level include women representatives (however at the national level it is not foreseen that an institution from the gender machinery participates) **First NDC Gambia (2016)** No specific information, states that adaptation will be dealt with in the process of elaborating a NAP. One priority area will be Enhancing Resilience of coastal and estuarine/riverine economies and livelihoods of the districts in the coastal zone. **In 2018, a large-scale Ecosystem-based Adaptation (EbA) project funded by the Green Climate Fund (GCF), and supported by UN Environment, was launched in The Gambia**, spearheading major efforts at conservation, sustainable utilisation of resources, and development of rural enterprises. No information on gender, but as the GCF has requirements on gender mainstreaming it can be assumed it is integrated.		No
Ghana		**National Gender Policy - Mainstreaming Gender Equality and Women's Empowerment into Ghana's Development Efforts (2015)** Does not make reference to climate change/environment/natural	**National Climate Change Adaptation Strategy** NCCAS (2012) Includes as a guiding principle: Gender sensitivity and reduction of vulnerability are extensively adopted. Coastal erosion is included as a major challenge, but no explicit link to gender is made. No more details are given about how gender would be integrated in adaptation **National Climate Change Policy** (2013) Comprehensively includes a gender dimension in all areas.		Yes

		resources. Only agriculture/land tenure is an aspect integrated. Under the agriculture topic, the Policy mentions to "**Engender climate change processes** and facilitate the participation of CSOs, famer-based organisations to ensure that agricultural practices and other livelihood practices comply with acceptable standards." Under Research, Monitoring and Evaluation Responsibilites, the point "**Gender inequalities in the management of natural resources and in safeguarding the environment**." is included as an indicator	**First NDC (2016)** Resilience for Gender and the Vulnerable is one of the adaptation policy actions mentioned. The reference document is the National Climate Change Policy. Implementation of community led adaptation and livelihood diversification for vulnerable groups is the Programme of Action proposed. No further details are included regarding specific approaches or M&E, and no link with coastal management is made.		
Guinea	**Plan National de Développement Economique et Social 2016-2020** Includes gender equality in all main dimensions of the plan (economic, political, social development). Climate change and disaster risk reduction are also part of the plan, but no link to gender is made there. However, under biodiversity preservation, the specific role of women is mentioned.	**Politique Nationale Genre (2011)** Natural disasters and climate variability is stated as a risk factor for the country's development in general and for the effective implementation of the gender policy, and women's role in environmental management is highlighted. Women's access to and control over resources, including environmental, is one strategic objective of the strategy.	From the **Rapport national de suivi sur la mise en œuvre du Cadre d'action de Hyogo (2013-2015)** - Interim: Regarding the aim “La prise en compte de la question du genre et de la réduction du risque est adoptée et institutionnalisée”; the report states: Totale reconnaissance du problème, de la stratégie/ du cadre d'action à développer pour répondre au problème, peu d'application dans les politiques et les pratiques, manque d'adhésion des acteurs. No more information is given. **First NDC (2016)** Gender is only mentioned once, stating that it should be considered in all programme and project planning. Coastal zone management is a priority area, but it is not linked with gender. In its **Second National Communication on Climate Change to the UNFCCC (2018)**, it states that coastal management has become a national priority. Gender aspects are not mentioned in this regard.		No
Senegal	**Plan Sénegal Émergent 2019-2023** Identifies gender inequality as a hindrance to socio-economic development, especially in rural areas. Equality is a	**Stratégie Nationale pour l'Équité et l'Égalité de genre 2016-2026** In the introductory part, makes reference to international frameworks (especially SDGs) and the issue of women's access	**NAPA (2006)** Generically states that a gender approach will be applied, without any further details. **No NDC** apparently (not available at https://www4.unfccc.int/sites/NDCStaging/pages/All.aspx) In its **Third National Communication on Climate Change to the UNFCCC (2015)**, gender is mentioned regarding forest management		No

	guiding principle of the strategy, including gender equality but also social inclusion in broader terms. Adaptation to climate change is also mentioned as a challenge, but no link is made with gender there. Just "poverty and inequalities". Fighting coastal erosion, land degradation and loss of biodiversity is another priority, but again, no link to gender is made.	to and participation in environmental management and protection against negative impacts of climate change. Under the strategic area of "human capital", environment and sustainable development are integrated into the strategy. However, the focus of the strategy lies on economic, governance and social topics. In general, it aims at ensuring gender equality in all sectors and in line with the Plan Sénegal Émergent.	at the community level, but no comprehensive gender approach is integrated. **No NAP** Senegal is currently collaborating with UNDP to develop a National Adaptation Plan (project launched in 2017) . As this project is financed by GEF it can be assumed that gender will be integrated. In the absence of a comprehensive framework for adaptation, Senegal currently bases its adaptation measures on a range of policies and strategies related to environmental management, forest management, protection of biodiversity, sustainable land management, coastal erosion.		
Togo	**Togo National Development Plan 2018-2022:** Under the aspect of social development and inclusion, one area is equity and gender equality. However, it is not further explained what the specific goals are and how they would be achieved. Also, only the English version includes this, the French version does not mention gender at all.	**Politique Nationale pour l'Equité et l'Egalité de Genre du Togo (2011)** Women's low participation in environmental management, their lack of access to environmental education and to conservation technologies is stated as a challenge. However, this issue is not addressed in the strategic objectives of the policy.	**First NDC (2017)** Gender is not mentioned at all. Coastal erosion is a priority sector. **Plan National d'Adaption aux Changements Climatiques du Togo** (PNACC, 2018) Integrates a gender dimension and establishes coastal protection as one priority area, but it does not become clear how gender will really be integrated into coastal risk management.	Plan d'actions pour le développement et l'adaptation aux changements climatiques du littoral togolais (2017) Gender is not mentioned in the document. However, this plan has been developed in the context of WACA and it will be a requirement to integrate gender into specific initiatives and to contract a gender specialist for this purpose.	Yes

Source: Own elaboration based on document review and expert interviews

Box 3: Ghana's National Climate Change Policy

The National Climate Change Policy of Ghana integrates gender in a comprehensive way. It includes gender as a guiding principle and states that policies that support gender equality in access, use and control over science and technology, formal and informal education and training will enhance the nation's capability in disaster reduction, mitigation and adaptation to climate change. The Policy also understands women as important change agents for climate change adaptation: "Women are not just helpless victims of climate change, however; they are also powerful agents of change and their knowledge and leadership is critical. There is a need, therefore, to ensure that climate change and disaster risk reduction measures are gender responsive, sensitive to local knowledge systems and respect human rights. Women's right to participate at all levels of decision-making must also be guaranteed in climate change policies and programmes."

Regarding challenges that currently inhibit the integration of gender issues into climate change responses, the Policy identifies:

- ✘ Overdependence on natural resources due to insufficient access to alternative livelihood opportunities
- ✘ Low female literacy rates
- ✘ Unfavourable land tenure systems
- ✘ Lack of useful methodologies to measure climate change impacts by gender at local, national and international levels
- ✘ Knowledge gaps, particularly in areas where the specific impacts of climate change on women and men are not immediately obvious, such as transport and infrastructure, energy access, housing, formal or informal employment
- ✘ Lack of access to resources such as finance and technology-based solutions for climate change adaptation and mitigation
- ✘ Unequal participation in climate change decision-making processes.

In the light of these challenges, specific objectives of the policy related to gender are:

- ✓ Promote equal opportunities and affirmative action for women and vulnerable groups in climate change adaptation and mitigation through mainstreaming gender issues into national and sub-national climate-change-related policies
- ✓ Increase knowledge and strengthen capacity at all levels on gender-responsive climate change policies, strategies and programmes.

Key interventions for achieving these objectives are to:

- ✓ Ensure the integration of gender equality principles in all social policies such as education, health, water and sanitation
- ✓ Generate gender-specific information including sex-disaggregated data for determining the gender impacts of climate change
- ✓ Develop effective gender and climate change goals and gender-sensitive indicators
- ✓ Collaborate with CSOs, especially women's rights organisations and coalitions, in climate change discussions and processes
- ✓ Build the capacity of the relevant institutions to mainstream gender issues into climate change policy formulation, planning, monitoring and evaluation
- ✓ Prepare and implement gender and climate change mainstreaming strategic plans by institutions, which would provide a sound basis for evaluating the extent of gender mainstreaming
- ✓ Identify and analyse gender-specific needs, impacts, protection and support measures related to climate change and variability such as floods, droughts and diseases
- ✓ Promote gender equitable financing as a means of responding to the differential impacts of climate change by gender. This will require establishing clear mechanisms for integrating a gender dimension into the design, implementation and monitoring of all climate funds
- ✓ Increase the resilience of vulnerable groups, including women and children, through the development of community-led adaptation, livelihood diversification, better access to basic services and social protection (safety nets, insurance)
- ✓ Integrated biomass strategies for food, fuel, fodder, and other basic needs including income generation
- ✓ Promote effective and equal participation of men and women in climate change policy and decision-

making processes
- ✓ Strengthen the implementation of gender responsiveness in disaster risk management.

Some countries in Sub-Saharan Africa have also developed specific climate change Gender Action Plans (ccGAP) – for example, Tanzania, Mozambique, Zambia or Liberia[41], however none of the countries included in this study have done so (yet).

Although Liberia is not covered by this study, it is worthwhile mentioning as it is part of the West African region and thus shares similar characteristics with the eight countries included in the research. Coasts are included as a priority area in Liberia's ccGAP.[42] A number of objectives and specific action steps have been defined to integrate gender in coastal planning and management. Indicators of success and responsible institutions have also been defined.

Box 4: Objectives of the Liberian ccGAP related to coasts:

- ✓ To develop and implement gender climate change sensitive policies for aquaculture and integrated coastal management
- ✓ To conduct gender-sensitive vulnerability studies on coasts to be used in planning and available in public domain
- ✓ To put in place a robust gender-balanced monitoring system in coastal zones
- ✓ To implement coastal forest regeneration program in the hands of women
- ✓ To offer coastal management course at University levels (Specific action: Develop a special quota and scholarship scheme for women)
- ✓ County Development Agenda captures climate change (Specific action: Recruit and train female county coordinators on coastal management)

Interestingly, while Ivory Coast ranks comparatively low regarding the African Gender Equality Index, and data are not available for the EGI, the country is now looking to integrate gender into its climate change adaptation agenda. Currently, the Ministry of Environment works with UNDP to develop its Nationally Determined Contribution (NDC). This also includes the development of a National Gender and Climate Change Strategy and Action Plan, which is expected to be finalized in 2019. The project also includes capacity building for national actors so that they are capable to implement the Action Plan, and aims at including a gender dimension in the communication strategy about the NDC. However, no information is available yet in how far coastal management will be integrated in this Plan.

Likewise, in 2018 The Gambia launched a large-scale Ecosystem-based Adaptation (EbA) project funded by the Green Climate Fund (GCF) in collaboration with UNIDO, and Senegal is currently collaborating with UNDP to develop a National Adaptation Plan (launched in 2017), with financial support from GEF. As both the GCF and GEF include requirements for gender mainstreaming, it can be assumed that this aspect will be integrated in the resulting policies and implementation plans.

[41] These countries have been supported by the IUCN in the development of their ccGAPs.
[42] The ccGAP can be downloaded here: http://genderandenvironment.org/resource/liberia-climate-change-gender-action-plan-ccgap-report/

3.1.3. How do WACOM countries and Cameroon intend to change the gender roles in coastal risk planning and management?

At the level below national policies, it is much more difficult to systematize how countries address gender mainstreaming concretely in coastal risk management and planning. As literature or other documents on this aspect have not been found by this research, the information in this chapter is mostly based on survey results and interviews conducted with different subject matter experts and key informants.

Survey results with the CTCN national antennas indicate that five countries (Cameroon, Gambia, Guinea, Senegal and Togo) do currently consider gender aspects in coastal risk management, one does not (Ghana), and for another two survey respondents did not know (Benin, Cote d'Ivoire).

However, when those who answered "yes" were asked for more details, respondents did usually not have information on how exactly gender issues are addressed and integrated.

In interviews and document review it became clear that although policies for gender mainstreaming exist at the national level, they are not yet systematically implemented, for the following main reasons:

- **Weak inter-institutional communication and collaboration.** As gender mainstreaming is a cross-cutting issue, it is necessary to work across ministries and other institutions responsible for coastal risk management, down to the sub-national and community levels. This is a major challenge in West African countries and Cameroon.
- **Lack of capacities and expertise.** In addition to the above, there is also a lack of resources in the respective institutions to ensure that gender mainstreaming can be addressed in a coherent way. This means that even though institutional arrangements are in place (for example, gender focal points in different ministries or special agencies for gender equality), their implementation power is reduced. High staff turnover often exacerbates this situation.
- **Lack of financing.** Often, financial resources allocated to measures and activities that address gender are insufficient, which hampers proper implementation. A lack of expertise on gender-sensitive budgeting in the different institutions adds to this situation.
- **Lack of data.** Countries do not have sufficient information on women's situation related to climate change, environment and coastal risks. National statistics are often not sufficiently sex-disaggregated (or not disaggregated at all), and data at the sub-national level are mostly unavailable.
- **Low prestige.** Although gender equality and women's empowerment have become more prominent at the policy level, within the respective institutions it is often not yet seen as a priority and staff that is assigned with gender mainstreaming might not be taken seriously by superiors.[43]

In addition, the specific link between gender and coastal risk management or more broadly speaking climate change adaptation is still a new topic in the countries included in this study. That is, countries focus more on initiatives related to the "traditional" sectors for gender mainstreaming: education and health, political and economic participation, as well as the fight against violence against women. As also reflected in the previous chapter on the policy level,

[43] This is an issue mentioned specifically in the Gender Profile Report of Cote d'Ivoire by the African Development Bank (2015), but it can be assumed that it is the case in other countries as well.

climate change adaptation has only recently started to pay more attention to gender mainstreaming, and this translates to still very low implementation at the country level.

This is even more true for coastal risk management, which very few countries have identified as a priority sector for gender mainstreaming.

In addition, coastal risk management is a somewhat decentralized or fragmented sector. There is often not one single institution responsible for this topic, and it rather depends on the specific aspects related to coastal risks – e.g. erosion, deforestation, flooding, agriculture, fishery, energy, etc. which organizations implement specific initiatives. This fragmentation makes it more difficult to mainstream gender in a coherent way.

Another point is that gender mainstreaming is a highly localized issue in the end, as realities change from community to community and thus tailor-made responses need to be given to each situation. This involves the need to conduct vulnerability assessments and gender analysis at the local level, for which resources and expertise are often not available.

Given this situation, it is often still either international organizations that support countries to advance with policy planning for gender mainstreaming in coastal risk management or that plan and implement specific initiatives. However, some interviewees reported that even in projects or programmes from the international level, a proper integration of a gender dimension is sometimes missing.

In addition, national, local and regional NGOs also play an important role for promoting gender equality and women's empowerment.

Two regional initiatives can be especially interesting for WACOM countries and Cameroon:

REFACOF

The African Women's Network for Community Management of Forests (REFACOF, for its French name Réseau des Femmes Africaines pour la Gestion Communautaire des Forêts) was founded in 2009 as a network of women involved in sustainable forest resource management in Africa. With headquarters in Cameroon, the organization currently has 18 member countries mostly in West and Central Africa. The network engages in policy dialogue at the international and regional levels regarding women's rights and land tenure. At country level, REFACOF implements projects related to coastal management that address women-led reforestation and sustainable management of mangroves along coastlines. The organization also collaborates with government institutions and international organizations and provides technical assistance and advice for integrating a gender dimension into projects on climate change adaptation. Some successful strategies applied by REFACOF include[44]:

- ✓ Involving men at the local and national level, especially traditional leaders; ensuring culturally appropriate understanding of 'gender';
- ✓ Building capacity of actors, partners, stakeholders, women and indigenous peoples through information-sharing, sensitization, education, and communication;
- ✓ Creating alliances and networks of gender-sensitive people working on projects; building strong networks of women's organizations, with technical know-how;
- ✓ Developing gender-sensitive criteria and indicators, and identifying baselines prior to trainings and awareness activities;
- ✓ Participating in forest and land reform processes and advocating for more gender-sensitive reform processes; and
- ✓ Ensuring gender monitoring and evaluation of the activities, projects, and programs.

[44] From USAID/IUCN, The African Network for Community Management of Forests, available at http://genderandenvironment.org/resource/the-african-womens-network-for-community-management-of-forests-refacof-empowering-african-women-to-influence-redd/

WACA

The West Africa Coastal Areas Management Program (WACA) is a convening platform that aims to assist West African countries to sustainably manage their coastal areas and enhance socio-economic resilience to the effects of climate change. The program also seeks to facilitate access to technical expertise and financial resources for participating countries.

Under the investment component of WACA, a Gender Action Plan (GAP) is currently being developed. Furthermore, it is a requirement for participating countries to recruit gender experts that assist with planning for coastal areas management.

As the programme started only recently, no results on gender mainstreaming can be reported yet, but this programme can be an opportunity for WACOM countries and Cameroon to learn and exchange knowledge. Benin, Cote d'Ivoire, Senegal and Togo participate in the investment component.

3.1.4. How do WACOM countries and Cameroon measure changes in gender roles in coastal risk management?

No evidence could be found through this research on existing statistics or monitoring and evaluation (M&E) systems that would measure the changes in gender roles in coastal risk management in the eight countries included in the study. Usually, those indicators included in policy or strategy documents are purely quantitative and give information about the number or percentages of beneficiaries for example disaggregated by sex, but do not provide more insights into changing gender roles. Furthermore, there is in general a lack of sex-disaggregated data in sectors that are relevant for coastal risk management, such as forestry, agriculture, water, energy, marine, disasters, infrastructure, etc.[45]

Therefore, the analysis in this section provides information on a more general level regarding types of indicators that can be used to monitor and evaluate a change in gender roles, which are also applicable to coastal risk management.

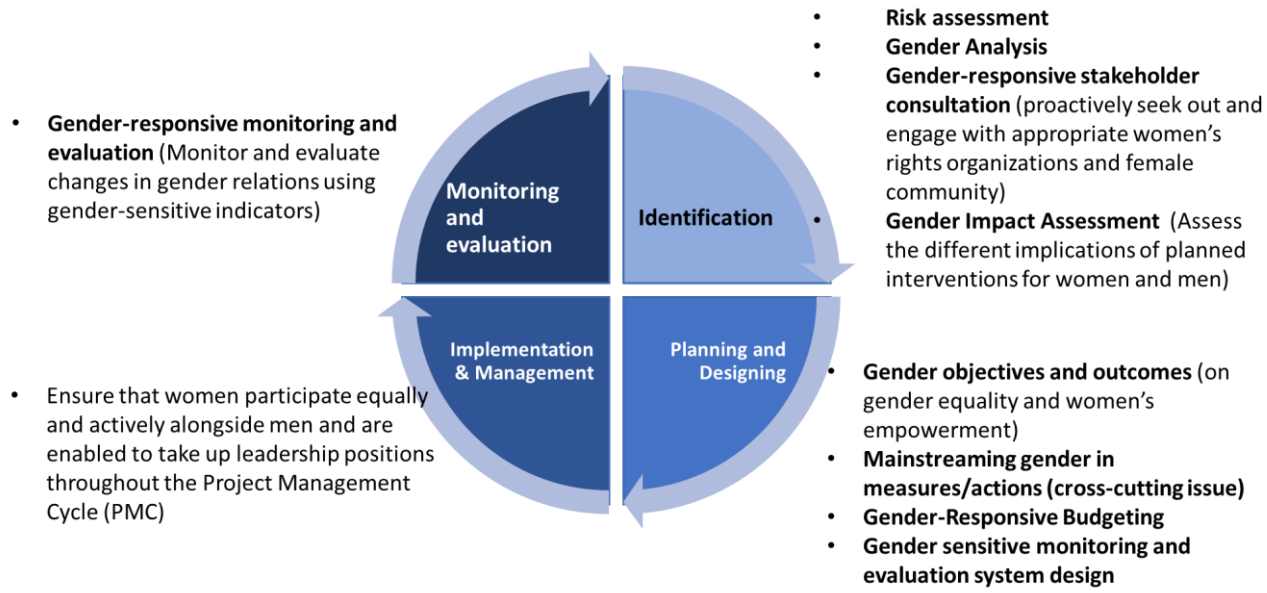
First of all, in order to determine any changes in gender roles, data needs to be collected at different points in time. This includes, as a minimum, the definition of a baseline at project or programme start and an end-of-project data collection. Depending on the duration of the intervention, a mid-term data collection is also a good option. Given that gender roles are culturally determined and changes take time, if possible, it is also advisable to conduct an impact evaluation sometime after the intervention ended, for example after six months or a year.

The best results in terms of data and information on gender roles can be achieved if gender is integrated at all stages of the project management cycle. That way, it can be ensured that gender-sensitive information will be integrated from the beginning, that planning is made based on this data, and that gender-sensitive monitoring and evaluation activities are adequately planned for – not only regarding the definition of indicators and data collection mechanisms, but also regarding the allocation of the necessary financial and human resources.

This is especially important in the context of West Africa and Cameroon where gender-sensitive data is generally scarce and will need to be produced through each intervention related to coastal risk management.

Figure 4 Project Management Cycle from a gender perspective

[45] This has also been confirmed in the IUCN The Environment and Gender Index (EGI) 2013 Pilot report.



As mentioned before, quantitative gender-sensitive indicators at national level related to climate change adaptation or coastal risk management are scarce in the West African and Cameroonian context, so that the data will have to be collected through the specific interventions.

Indicators to measure changes in the relations between women and men can be quantitative or qualitative. Furthermore, within these two categories, different types of indicators can be used:

Output level indicators

Outputs are direct results of specific activities in the context of an intervention. They would usually not be used to measure changes in gender roles; however it is important to include gender-sensitive output indicators so that a causal relationship can be established between intervention activities, outputs and outcomes/ impact. In this regard, output indicators usually measure the extent to which women have been included in the intervention's activities.

Box 5: Examples of output level indicators to measure changes in gender roles in coastal risk management[46]

- ✓ Evidence that national / local development policies, programmes and plans require participatory approaches and the targeting of both women and men to use and manage low-carbon and climate-resilient solutions and technologies
- ✓ Budget allocated to gender equality supporting measures in sectoral planning and programming – gender-responsive budgeting
- ✓ Number and percentage of women and men who attend / are actively involved in sectoral planning and consultation meetings
- ✓ Number and percentage of women and men trained in sustainable technologies (e.g. adaptations to land management practices in fragile lands, adaptations related to flooding and erosion)

Outcome level indicators

[46] Selected sample indicators taken from UN Women, Leveraging Co-Benefits between Gender Equality and Climate Action for Sustainable Development. Mainstreaming Gender Considerations in Climate Change Projects (2016). Available at: https://unfccc.int/files/gender_and_climate_change/application/pdf/leveraging_cobenefits.pdf. Some indicators have been adapted to make them more relevant to coastal risk management.

At the outcome level, indicators measure in how far long-term objectives of an initiative have been achieved. At this level, changes in gender roles can be observed over time.

Box 6: Examples of outcome level indicators to measure changes in gender roles in coastal risk management[47]

- ✓ Level of women's and men's awareness on women rights and rules for access to financial, natural and energy resources
- ✓ Number and percentage of women adopting low-carbon and climate-resilient solutions
- ✓ Number and percentage of women with new / improved income-generating opportunities due to access to low-carbon and climate-resilient solutions
- ✓ Number and percentage of women involved in the design, distribution, management and utilization of low-carbon and climate-resilient solutions
- ✓ Number / proportion of women with improved access to financial mechanisms (equity investment, affordable loans, etc.) for low-carbon / climate-resilient products and services
- ✓ Number and percentage of poor women and men with increased resilience to deal with coastal risks (e.g. improved land management, clean technologies, increased knowledge and strengthened networks on coastal risk issues, number / percentage of women-headed households provided with resilient home)

The indicators to be used of course depend on the overall objectives of each specific intervention. For example, Liberia's ccGAP includes a number of gender-sensitive indicators related to coastal risk management:

Box 7: Examples of indicators from Liberia's ccGAP related to coastal management

- ✓ No. of gender sensitive policies, plans and programs
- ✓ Amount budget allocated and spent to support gender and climate change adaptation in coastal zones
- ✓ Gender disaggregated vulnerability study concluded
- ✓ Improved early warning meteorological information for coastal zones management
- ✓ No. of women participating in mini weather stations along the coast
- ✓ Women participation in the building of coastal infrastructure
- ✓ No. of women trained in coastal monitoring
- ✓ No. of women using alternative energy
- ✓ No. of reforested hectares in hands of the women
- ✓ No. of trained climate managers/specialist by sex
- ✓ Percentage of coastal coordinators trained disaggregated by sex

Finally, the CTCN also provides a number of sample gender-sensitive indicators as part of its Gender Mainstreaming Tool for Response Plan Development:

Box 8: Sample indicators from the CTCN Gender Mainstreaming Tool for Response Plan Development[48]

- ✓ Number and percentage of women and men who attend participatory planning and consultation meetings
- ✓ Number of men and women in decision making and or leadership positions in project planning process

[47] Taken from UN Women, Leveraging Co-Benefits between Gender Equality and Climate Action for Sustainable Development. Mainstreaming Gender Considerations in Climate Change Projects (2016). Available at: https://unfccc.int/files/gender_and_climate_change/application/pdf/leveraging_cobenefits.pdf. Some indicators have been adapted to make them more relevant to coastal risk management.

[48] https://www.ctc-n.org/technologies/ctcn-gender-mainstreaming-tool-response-plan-development

- ✓ Number and percentage of men and women in climate technology user groups, cooperatives, committees, utilities etc.
- ✓ Number and percentage of women and men who receive some form of leadership or technical training from the program.
- ✓ Number and type of training sessions targeted specifically at women or men.
- ✓ Number of women's organisations benefitting from training.
- ✓ Perception/value placed on training received by women & by men.

The above shows that there is a wide range of possible indicators that can be used in climate change adaptation and coastal risk management interventions to measure a change in gender roles.

In addition to these examples of mostly quantitative indicators, it is advisable to include a qualitative level into the evaluation of initiatives that will help to know which specific aspects of an intervention have worked best to promote a change of gender roles and why, or what have been limiting factors that hinder the achievement of results. This type of information is usually collected through focus group discussions or semi-structured interviews with the beneficiary population of an intervention and requires the participation of experts that are knowledgeable in both qualitative research and gender issues.

3.1.5. What are the factors that encourage changes in gender roles (drivers of change) and what are the limitations and challenges?

Like the previous section, due to the lack of information and evidence regarding this question in the eight countries included in the study, the following analysis is drawn mostly from (more generic) secondary literature and expert interviews.

First of all, it needs to be highlighted that changes in gender roles do not happen quickly, and probably also not through one single intervention. As gender roles are shaped by cultural and social norms that are deeply rooted in people's attitudes and behaviour, it will take time and patience until changes can be observed. They also do not happen in a linear way as usually depicted in an intervention's theory of change. Furthermore, there is not "the" single factor that can guarantee that an initiative works, as each community is different. Multiple initiatives in different sectors and at different levels from national policies to grassroots implementation are needed to promote real change in the long term.

The following limitations and best practices could be extracted from interviews and documentation of a variety of projects and programmes, as well as fact sheets, practical guides and handbooks on gender and climate change adaptation[49]:

Limitations:

- ✘ Persisting social cultural and religious norms and rules

  Gender roles are diverse and dynamic, and gender inequality does not mean that all women are disempowered everywhere, in every way, or all of the time. Inequality also depends on other factors such as age, wealth, (dis)ability, ethnicity, etc. However, religious and cultural beliefs and traditions often have a conservative effect on the relation between women and men and their roles in society, limiting women's participation in decision making, access to and control over resources, or education. These beliefs are very hard to change,

[49] See literature list in the annex for further information.

- ✘ Misperceptions regarding gender equality

Gender equality is often misperceived as a “women’s issue” or the attempt to change gender roles in a way that women gain more power or control to the disadvantage of men. This can cause reluctance towards interventions that aim to address gender inequality and lead to conflicts in a beneficiary community.

- ✘ Lack of information, expertise & resources

A lack of specific data and information on the linkage between gender and costal risks and disasters as well as missing expertise/ institutional capacity at national and sub-national level leads to insufficient resource allocation to gender aspects in interventions, as well as uninformed planning (or no planning at all) regarding this issue.

Best practices/ drivers:

- ✓ Engagement of men in the process is a necessity.

Initiatives should encourage collaborative approaches between women and men, and seek the active engagement and support of male community members for gender equality, especially those in power positions. This can be done on the one hand through education and capacity building on gender equality, but also through specific activities that men and women implement together, fostering mutual learning and understanding. These types of interventions can lead to more respectful gender relations.

- ✓ Education and awareness raising need to accompany any technical implementation.

Both women and men need to become more aware of gender inequalities and women’s rights. Any intervention should plan for education activities around this topic, choosing materials and methodologies that are adequate in the local context (e.g. depending on the community members’ literacy, existing gender roles, etc.).

- ✓ Highlight the benefits of women’s empowerment for the whole community.

Interventions should address gender quality and women’s empowerment in a way that it becomes obvious for all community members what benefits it can bring for everyone. If community members perceive it just to be a “women’s issue”, it is likely that the intervention will not work. In the specific context of coastal risk management, women’s knowledge and skills for natural resource management and adaptation to climate change should be capitalized.

- ✓ Be careful not to add to the triple burden that women are already facing

Gender-responsive or transformative initiatives usually aim at the equal participation of women and men in a programme’s activities, among other objectives. However, if not properly planned in a culturally sensitive way, more participation does not always have only positive effects on the women. They are usually already under pressure due to the different roles they are expected to fulfil – reproductive, productive and as caretakers of the household and family. Interventions can increase women’s workloads, but without a real shift in control or influence, which needs to be avoided.

- ✓ Context-specific participatory planning and budgeting

Gender roles are context specific and although there are common social norms and rules in countries, dynamics can be different from community to community. Gender analysis and planning at the local level is critical to adequately address change in gender roles. This includes the allocation of resources for data gathering and analysis, as well as for targeted activities that address gender relations. Participatory planning in collaboration with the communities (including women) is a way to ensure that the initiative will be accepted by the beneficiary population.

3.2. Conclusions and Recommendations

The following main conclusions can be drawn from the analysis:

In West African countries and Cameroon, coastal risks and disasters affect men and women differently

Although specific statistics at the country level are unavailable, numerous studies and reports have shown that gender inequalities aggravate the consequences of environmental risks and disasters for (poor) women regarding their livelihoods and personal well-being, and that at the same time, environmental risks and disasters can also exacerbate gender inequalities. However, gender roles vary from community to community and specific coastal risk related gender-specific vulnerabilities need to be assessed at the local level.

International guidance has a certain influence on the uptake of gender mainstreaming in national policies

Especially in recent years, gender has been increasingly integrated into national policies and strategies for climate change adaptation and disaster risk reduction, coinciding with strengthened international frameworks, e.g. the SDGs and the UNFCCC GAP. It can be thus assumed that international guidance is an effective way to support countries in advancing in gender mainstreaming.

Nevertheless, concrete implementation on the ground is still in an infant stage

The main bottleneck for the actual implementation of gender mainstreaming is the translation of national level policies, strategies and plans into concrete actions on the ground. Major challenges in this regard are a lack of institutional capacities and resources.

A specific approach for gender mainstreaming in coastal risk management is still missing

The previous analysis has shown that while at the policy level important steps have been made to integrate a gender dimension in relevant strategies and plans related to climate change adaptation, a specific approach for gender mainstreaming in coastal risk management is still missing in all countries included in this research.

Likewise, there is a lack of data and information on how gender roles change in coastal risk management

Related to the above is a lack of sex-disaggregated data and a general lack of knowledge about gender roles in sectors relevant to coastal management. A lack of resources and/or expertise also hampers adequate planning for effective monitoring and evaluation of how gender roles can be changed in this area.

For these reasons, the following recommendations are given to ensure an effective mainstreaming of gender into coastal risk management:

Recommendation 1: Address knowledge gaps

Countries should invest in research on gender and climate change adaptation/ coastal risk management and allocate resources into conducting gender analysis in affected coastal areas to know more about gender-related vulnerabilities to coastal risks. While local data collection will be necessary to adequately address community-specific issues, national statistics institutes should work towards sex-disaggregated data collection in sectors relevant to climate change adaptation and coastal management.

In addition, more capacity building is needed to enhance knowledge of relevant actors at national, subnational and local level to integrate gender mainstreaming into planning and implementation, as well as monitoring and evaluation of programmes and projects.

Recommendation 2: Assign a specific gender focal point for coastal risk management

While some countries already have assigned UNFCCC gender focal points, there seems to be a lack of expertise regarding the specific topic of gender and coastal risk management. It is advisable that this gap will be addressed by countries by establishing gender focal points in institutions in charge of coastal risk management. This focal point should aim at bridging the gap in inter-ministerial / inter-institutional collaboration and create a real linkage between gender and coastal risk management.

Recommendation 3: Encourage exchange of experiences at the regional level and take advantage of existing knowledge in the region

It is advisable that countries engage in knowledge exchange at the regional level to share practical examples and experiences regarding the integration of a gender dimension in coastal risk management. In this regard, in the near future the four countries currently engaged in the WACA investment component can take a leading role and share with other countries how the future WACA Gender Action Plan translates into concrete implementation of programmes and projects. Furthermore, other international organizations (e.g. UNIDO, UNDP, UN Women) and NGOs with experience in the topic should be included in this regional exchange.

Recommendation 4: Promote the development of specific action plans on coastal risk management and gender

The link between coastal risk management and gender is currently not effectively made in most policies and strategies, and guidance for implementation remains vague. It is therefore advisable to develop specific coastal risk gender action plans with concrete objectives and indicators that will help practitioners to implement and achieve results. Some existing initiatives, such as the ccGAPs developed by the IUCN, or the future WACA GAP can give orientation to other countries that do not yet have those plans.

Recommendation 5: Ensure proper allocation of resources to data gathering for vulnerability assessments and gender analysis, as well as for M&E activities

When planning for coastal risk management initiatives, countries should adopt a gender-sensitive project management cycle and integrate a gender dimension in all main stages from identification and planning to monitoring and evaluation. This includes gender-sensitive budgeting so that sufficient resources are made available for necessary data gathering, an effective implementation as well as gender-sensitive M&E. It is also advisable to include gender experts into the programme or project team.

Recommendation 6: Tap into existing international financing mechanisms (e.g. GEF, GCF) that require gender-responsive approaches

A variety of financial instruments exist that have built in a gender dimension into their selection criteria. Among them, GEF and GCF also provide specific guidelines that help applicant countries with a step-by-step approach to integrate a gender dimension into all stages of programme management.

Recommendation 7: Include reporting on gender mainstreaming into the national communications to the UNFCCC

Countries should aim to keep track of what is being done to integrate a gender dimension into climate change adaptation and coastal risk management, and include this aspect into their national communications to the UNFCCC to contribute to knowledge generation on this topic, keep track on results achieved and be able to make informed decisions regarding further strategic improvements.

Annex I. Inventory of available data, pre-processing and preliminary analysis (D.2.3)

A.1.1. Regional inventory Data Matrix

Inventory Criteria						Country considerations sources								Comments
Dimension	Indicator framework required	Data source basis	Specific objectives of data analysed	Open access Datasets	Segment measure analysis	Benin	Cameroon	Côte D'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo	
1. Coastal geomorphology data	Sedimentary plain	1. Geological/Lithological map 2. Satellite images	To assess whether the coastline is composed of soft or hard rock material To get an overview of the coastal geomorphology and identify	GLIM- Global Lithological Map https://www.geo.uni-hamburg.de/de/geologie/forschung/geochemie/glim.html Google Earth	300 meters - 1 km	Step 1	Step 1	Step 1	Step 1	Step 1	Step 1	Step 2-3. Local sources: - Aerial ortophotos (national level) - Geological map (national level)	Step 1	Cameroon has provided a shoreline dataset, but still some of its properties are unknown (projection and age). So, Step 1 is finally recommended also for Cameroon. Most of the countries say they have information, but I have seen it. So I've decided to keep Step 1 for them too. Senegal has provided some ortophotos and geological map (PDF format, but it looks like it is should be in georeferenced format), so I think it is feasibly to develop
	Barrier													
	Delta/ low estuary island													
	Tidal inlet/ sand spit/ River mouth													

			form-features											Step 2-3 (but even not sure completely)
	Sloping soft rock coast	3. Terrain-elevation model	To assess whether the coastline has a flat or sloping character	Google Earth (terrain elevation function)										
	Flat hard rock coast			Google Earth (terrain elevation function)										
	%Slopping hard rock coast													
	Coral island													
2. Wave exposure	Coast exposed	1. Wave global map and location	To locate the area of interest with respect to global wave map (steps 1-2)	Rosendahl Appelquist L and Halsnæs K (2015). The Coastal Hazard Wheel system for coastal multi-hazard assessment & management in a changing climate. Journal of Coastal Conservation 19, 2, 157-179.	300 meters - 1 km	Step 1	Step 1	Step 1	Step 1	Step 1	Step 1	Step 1	Step 1	No wave time series provided for any country. Step 1 is recommended for all countries
	Coast moderately exposed	2. Wave data (reanalysis)	To determine the wave exposure based on the Hs 12h/yr along (step 3).	ERA5 (ECMWF): https://www.ecmwf.int/en/forecasts/datasets/reanalysis-datasets/era5										
	Coast Protected													

3. Tidal range	Micro-tidal environment	1. Tidal range global map and location	To locate the area of interest with respect to tidal range global map (steps 1-2)	Rosendahl Appelquist L and Halsnæs K (2015). The Coastal Hazard Wheel system for coastal multi-hazard assessment & management in a changing climate. Journal of Coastal Conservation 19, 2, 157-179.	300 meters - 1 km	Step 1	Step 1	Step 1	Step 1	Step 1	Step 1	Step 1	Step 1	No local tidal gauges has been provided from any country
	Meso-tidal environment	2. Tidal data	To determine the tidal range along the coast (step 3).	AVISO+ (CNES) https://www.aviso.altimetry.fr/en/data/products/auxiliary-products/global-tide-fes.html OTIS Regional Tide solutions http://volkov.oce.orst.edu/tides/region.html										
	Macro-tidal environment													
4. Biodiversity (flora and marine and coastal fauna),	Intermittent marsh		To determine the dominant vegetation cover (mangrove, marsh)	Google Earth	300 meters - 1 km	Step 1	Step 1	Step 1	Inst. available by ortophotos	Step 1	Inst. available by ortophotos	Step 1	Step1	Question: Even if Gambia and Guinea have responded to have ortophotos, if they are not available at this moment, maybe we should keep Step 1 also here for all countries
	Vegetated													
	Non vegetated													

	Coral	1. Satellite images to determine % of vegetation cover & the typology of vegetation	From satellite images (Goggle Earth) also supported by already vegetation-classified areas	OceanDataViewer (UNEP): http://data.unep-wcmc.org/ GlobeCover (ESA): http://due.esrin.esa.int/page_globcover.php										
	Intermittent mangrove													
	Marsh/tidal flat													
	Mangrove/ tidal flat													
	Marsh/mangrove													
5. Sediment ology (sediment balance)	Land with sediment balance/deficit	1. Satellite images	To assess coastal evolution by comparing images at different dates (steps 1-2)	Google Earth Shoreline monitor (Deltares) http://shorelinemonitor.deltares.nl/	300 meters - 1 km	Step 1	Step 1	Step 1	Step 1	Step 1	Step 1	Step 1	Step 1	No local information available for any country. Some countries have provided some report, but still not much to shit to Step 2-3
	Land with sediment surplus	2. Historical shorelines analysis	To assess coastal evolution by detailed shoreline analysis (step 3).											
	Beach land													
	Not beach land													
6. Storms	Tropical cyclone influence area	Cyclone global distribution map	To locate the area of interest with respect to	Rosendahl Appelquist L and Halsnæs K (2015).	300 meters - 1 km	Step 1-2-3	Step 1-2-3	Step 1-2-3	Step 1-2-3	Step 1-2-3	Step 1-2-3	Step 1-2-3	Step 1-2-3	No further information other than the cyclon global distribution map are required for all three steps of

	Not tropical cyclone influence area		global storm/cyclone map	The Coastal Hazard Wheel system for coastal multi-hazard assessment & management in a changing climate. Journal of Coastal Conservation 19, 2, 157-179.										CHW

A1.2. Country Process Analysis

Segment	Coastal Classification						Inherent Hazard Level					CHW Codification Management options
	1. Coastal geomorphology data	2. Wave exposure	3. Tidal range	4. Biodiversity (flora and marine and coastal fauna),	5. Sedimentology (sediment balance)	6. Storms	Ecosystem Disruption	Gradual inundation	Salt Water intrusion	Erosion	Flooding	
300												
600												
900												
1200												
1500												
1800												
2100												
2400												
2700												
3000												

3300												
3600												
3900												
4200												
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8700												
9000												
9300												
9600												
9900												
10200												

Annex II. Report of the regional training (D.2.4)

1) Main objectives and methodology

The main objective of the workshop was to improve capacities specifically related to the CHW tool, and more specifically to evaluate, validate and harmonize the approach and the procedures for collecting, processing and disseminating data. In order to do so, 4 specific objectives were determined:

- Assure all participants are familiarized with the different parameters and steps to be considered for implementing the CHW methodology
- Introduce the gender approach and how and why integrating it into coastal risk management
- Present the status of data in the region and countries and assess the procedures used to collect and process it for its integration in the CHW methodology
- Facilitate the identification of gaps at national and regional level and propose possible solutions.

The online training event was prepared and implemented through a three steps approach

- **Step 1: Preparation -** Firstly, the consultants drew-up a training framework document which included all the relevant information from phases 2.1. The focus was put on the CHW tool use and the gender mainstreaming. It was decided to divide the training workshop in two workshops: one for the English-speaking countries and another one for the French-speaking countries. Following the content drew on the training framework, a Power Point presentation was design as support material to support the understanding of the process.
- **Step 2: training workshop -** The participants were introduced to i) the CHW classification system, and the tool's application options, ii) the gender approach to integrate in coastal risk management; iii) the results obtained through data gathering process presented by parameter at national and regional level iv) the consultants recommendations to implement CHW. The workshop allowed an harmonized approach and the procedures for collecting, processing and disseminating data of the CHW. The CHW and GIS expert together with the workshop and gender experts implemented the training and provided support in order to ensure appropriate understanding and assimilation of the training modules. All the materials prepared for the training were shared with the participants (Power Point Presentation, recording of the workshops).
- **Step 3: Follow-up -** One of the most important aspect of the training workshop is to ensure that the focal points of the national antennas and the regional coordination unit fully grasp the ins and outs of the CHW. Therefore, the consultants plan to organize a follow-up with each workshop attendee. The objective of the follow-up will be to see if there are any remaining questions or doubts with regards to the training that they undertook. The consultants will thus be available to ensure that all participants are fully comfortable with the CHW tool.

2) Participants

The workshop included the focal points of the national antennas and the regional coordination unit of MOLOA as well as the technical counterpart in Cameroon.

English training workshop participants

Country	Organization	Name
Cameroon	Technical Counterpart	Zouhtem Isabella
Gambia	MOLOA	Fafanding Katiir Kinteh
Ghana	MOLOA	Kwasi Appeaning Addo

French-speaking training workshop participants

Country	Organization	Name
Benin	CTCN	Raphiou Adissa Aminou
Benin	MOLOA	Moussa Biodjara
Cote d'Ivoire	CTCN	Kumasi Phillipe Kouadio
Guinea	MOLOA	Mohammed Lamine Sidibé
Senegal	MOLOA	Luc Mathurin Malou
Togo	CTCN NDE	Mery Yaou
Togo	MOLOA/WACOM	Tchabinni Bakatimbé
Regional	MOLOA	Moussa Sall
Regional	MOLOA	Marième Soda Diallo

3) Agenda

Two workshop trainings were held due to language requirements from the different country units and country situations:

1) For English-speaking countries and Cameroon (who requested to participate during all the project as an English-speaking country), the workshop was held on Thursday 2nd of May from 9:30 to 12:00 GMT Time.

2) For French-speaking countries and the WACOM regional coordination unit, the workshop was held on Monday 6th of May from 9:30 to 12:00 GMT Time.

Agenda of workshop trainings

Managing the Climate Change Hazards in Coastal areas – The Coastal Hazard Wheel Decision-Support System
Module 1 The Project & the Consortium (9:30 – 9:45)
▪ **The Context of West Africa and Cameroon** ▪ **Proposed Project and main objective** ▪ **The Consortium** ▪ **Methodological Phases**
Module 2 The Coastal Hazard Wheel Tool – An Introduction (9:45 – 10:45)
▪ **Introduction of the CHW tool – system of coastal classification** ▪ **The CHW universal classification system** ▪ **The CHW Hazard Valuation Component** ▪ **Application for local, regional, and national multi-hazard assessments** ▪ **Application for identification of hazards management options**

Module 3 The Gender Dimension (10:45 – 11:00)
▪ **Introduction to gender approach** ▪ **Why is important to introduce the gender approach on coastal risk management** ▪ **Gender approach on policies, programmes and projects and how to implemented**
Module 4 In-depth regional analysis (11:00 – 11:45)
▪ **Data gathering process results**
Module 5 The path-forward (11:45 – 12:00)
▪ **CHW application recommendations**

4) Implementation of the workshop

As underlined on the Agenda section both trainings were 2h30 long. The workshop was presented through the platform Gotowebinar, put on the group of consultants disposal by the CTCN to allow a fluid conversation with national antennas and to easily record both workshops. A PowerPoint presentation was used as support material to facilitate the understanding of the content.

Overview

The workshop was subdivided in 5 modules:

Module 1 – The project and the Consortium (15 minutes)

Overview information – Key information presented

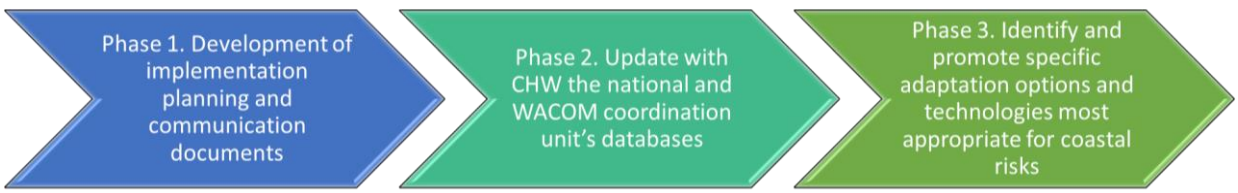
The consultants briefly presented the west African coastal background explaining the need for harmonization to support decision making. Overall the West African coast has been suffering from:

- Increased urbanization of coastal areas
- Climatic uncertainties
- Amplification of the intensity and frequency of coastal risks
- Insufficient data, technical, technological, institutional and financial capacities
- Diversity of evaluation approaches and methodologies

In this context, the Coastal Hazard Wheel tool appears as a necessary tool to assess the required adaptation measures in terms of coastal hazard management. The CHW tool was presented in more detail in the Module 2.

In addition, the consortium and the general methodological approach followed in the project was presented (see figure 1)

Figure 1 General methodological approach followed by the consultants



Module 2 – The Coastal Hazard Wheel Tool: an Introduction (one hour)

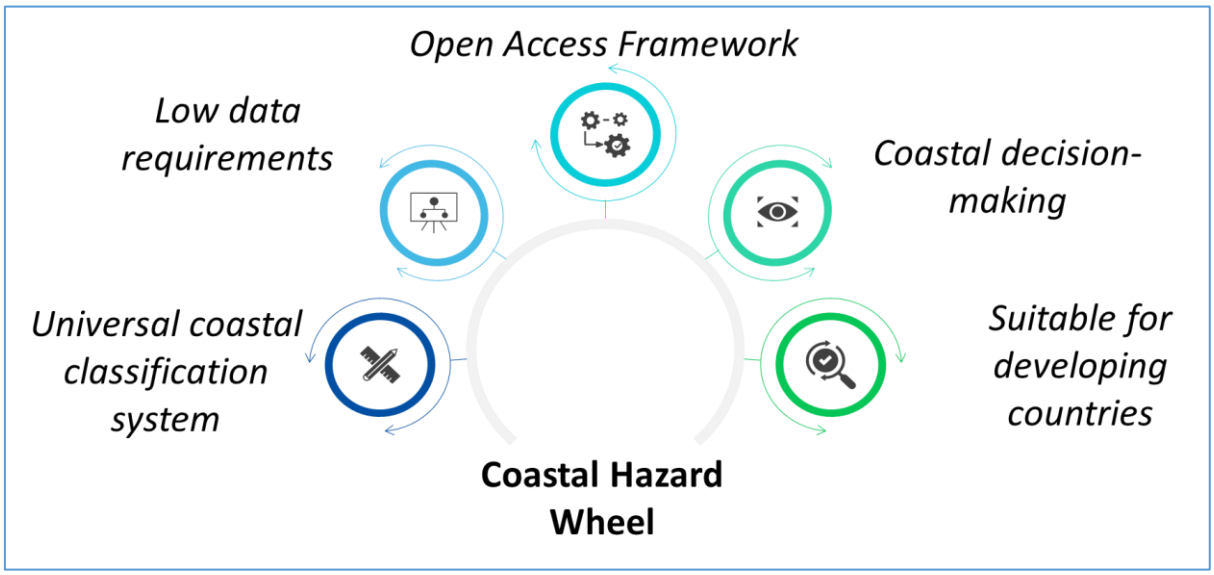
Overview information – Key information presented

Divided in 5 subsections, the Module 2 presented the CHW tool taking into consideration all the parameters and necessary actions needed to his implementation.

a) Introduction

The consultants highlighted the CHW as a relevant tool to multi-risk assessment, identify relevant management options for a specific coastline, and standardise coastal language to communicate coastal information; and the benefits CHW application has particularly in developing countries (see figure 2)

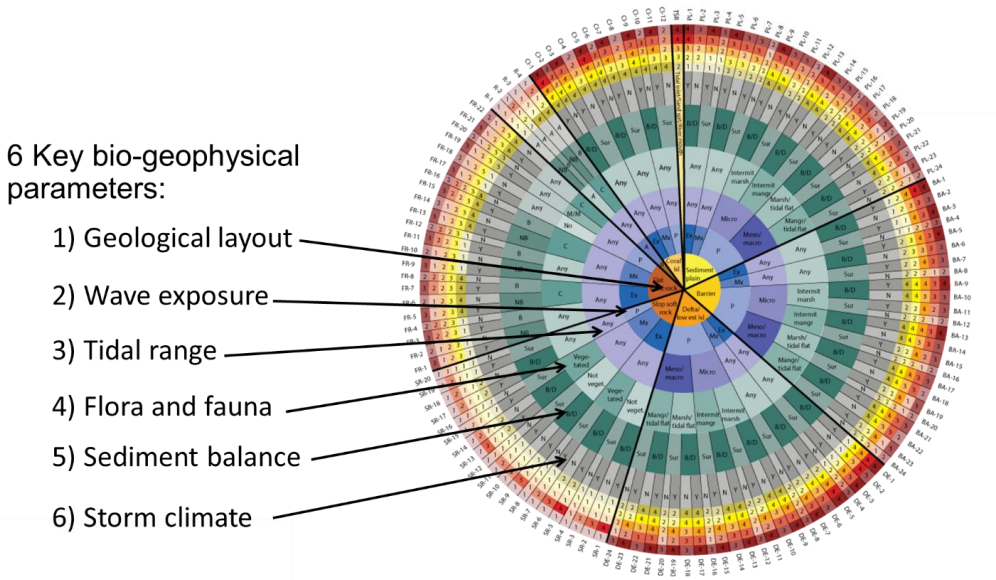
Figure 2 Benefits of the CHW methodology



b) Universal coastal classification system

The CHW classification systems was explained in detailed using the CHW 6 associate parameters: Geological Layout, Wave Exposure, Tidal Range, Biodiversity, Sediment Balance and Storm climate (see figure 3)

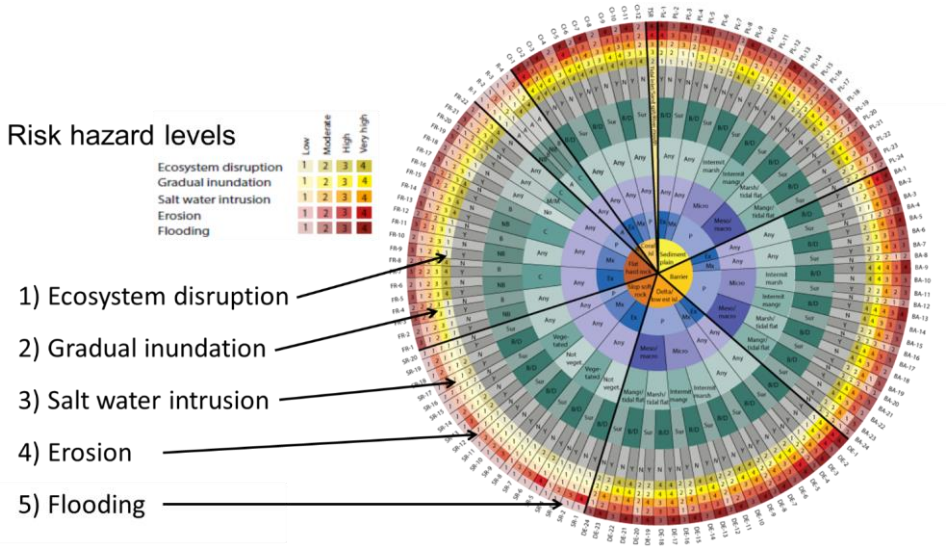
Figure 3. Bio-geophysical classification on CHW



c) The hazard valuation component

The valuation component integrated on the CHW to assess the risk hazard levels was exposed. Following the CHW classification, 5 hazards were identified: Ecosystem disruption, Gradual Inundation, Salt Water intrusion, Erosion and Flooding. In each hazard 4 levels of risk were considered: Low, Moderate, High and Very High (see figure 4)

Figure 4. Risk classification on CHW



d) Application for local, regional, and national multi-hazard assessments

The consultants described how to implement the CHW at local, national and regional level based on the data availability and the accuracy requirements based on the 3 steps procedure of the CHW tool (see table 1)

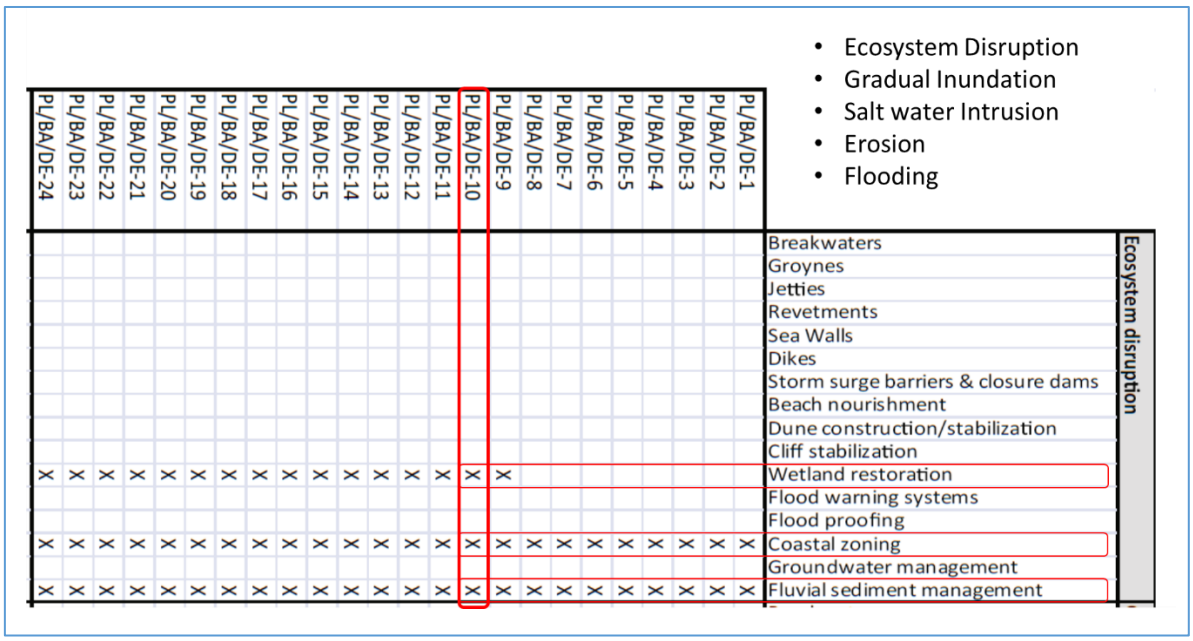
Table 1. Implementation steps for CHW application

Step	Data availability & accuracy requirements	Implementation based on	Used for
1	Low	Remote sensing and publicly available data.	Larger sub-regional, regional and national screenings, - initial picture of the hazard presence in a cost-efficient manner
2	Moderate	Additional field verification though remote sensing and public data sources.	Larger sub-regional, regional and national screenings,
3	High	Requires field verification combined with high quality datasets for key classification parameters.	used for coastlines where more comprehensive information is needed

Furthermore, a manual assessment procedure was considered and explained, as well as, some examples to illustrate the implementation of the tool.

e) **Application for identification of hazards management options**

The consultants presented then how to identify the hazard management options in the CHW tool taking into consideration the parameters, the type of hazard and the level of risk identify.



Selected comments and Questions

Moussa Sall Paramètre 4 et paramètre 6

Question 1. Moussa Sall

On Biodiversity: Why is biodiversity taken into account in terms of vulnerability if there is no change in fauna and flora?

Answer: The biodiversity parameter serves to realize a present environmental situation analysis.

Question 2. Moussa Sall

On Storm Climate: In terms of Storm areas in the CHW analysis, West Africa is not considered in general as a Storm area. However, lately West Africa has been suffering from multiple events close to tropical storms. How or why the CHW doesn't reflect this parameter?

Answer: Even if West Africa has recently suffered important storms, they remain exceptional considering the overall climate patern of the region. In this sense, the classification criteria of the CHW is simplified to include every possible region.

Question 3. Mathurin Malou

On the general CHW concept: Can we dissociate the problems caused by man and those caused by climate change directly?

Answer: The CHW doesn't analyze the causes of climate change, it classifies the environmental conditions related to climate change in order to identify the necessary and useful coastal risk management options.

Comment 1. Mery Yaou

On Wave Exposure: Didn't size how to measure and gather the availability information for the wave exposure parameter.

Question 4. Moussa Sall

On the general CHW concept: Does the CHW only takes into account coastal geomorphology? Why the occupation of the land is not considered in the analysis?

Answer: For the CHW, geology and geomorphology are very important variables. However, there are not the only criteria, the other variables have also an impact in measuring the coastal risks.

Why we do not consider the characteristics of the occupation (for example in terms of urbanization)? The classification is done this way because the occupancy assessment will come after the coastal classification during the hazard valuation component. Once the coast is classified, we will be able to measure the vulnerability of the coast and then land use problematics will be arisen.

Question 5. Moussa Sall

On the CHW tool in general: The coastal segmentation done by the CHW is very interesting, however it could be useful to add other classification systems which include other interesting variables?

Answer: In fact, after the classification through the CHW tool, supplementing with other criteria and types of data would be an important asset.

Module 3 – The gender dimension (15 min)

Overview information – Key information presented

The gender concept and the gender approaches to be integrated on coastal risk management were presented. The module was organized in 3 phases:

a) Introduction to gender

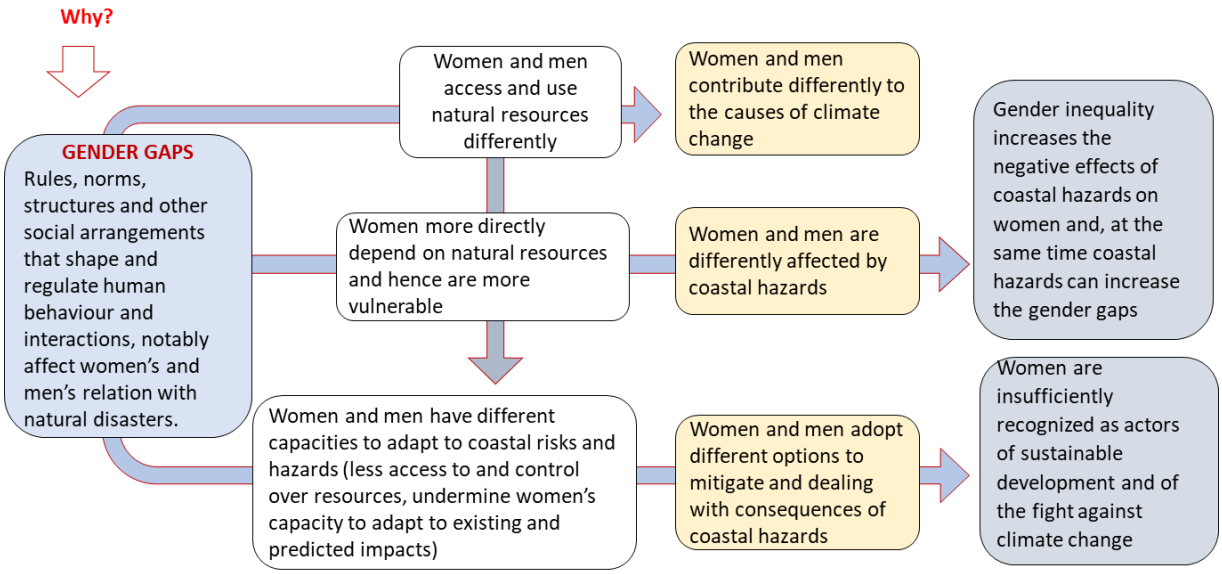
Gender was defined as "the **socially determined roles and responsibilities of men and women and the relationship between them** in any given society". In addition, the gender consultants introduced the following gender concepts to complement the mainstream definition of

gender: gender equality and intersectionality. Gender equality referring to to the equal rights, responsibilities and opportunities of women and men and girls and boys; and intersectionality referring to the fact that gender intersects with other forms of social differences (class, ethnicity, age, etc.).

b) Importance of introducing a gender approach on coastal risk management

The role gender plays on structuring the context were natural phenomena occurs was highlighted. In this sense, the gender consultants presented the different reasons how and why natural hazards affects particularly vulnerable groups, and more specifically women.

Figure 5. Scheme on why women suffer differently about natural hazards



The gender gaps identified allowed to show the importance of including a gender approach on coastal risk management and raise awareness on this matter for participants.

c) Gender approach on policies, programs and projects

Following gender mainstreaming strategy definition: "strategy for **making women's as well as men's concerns and experiences an integral dimension of the design, implementation, monitoring and evaluation of any planned action**, including legislation, policies or programs in all political, economic and societal spheres and at all levels, so that women and men benefit equally and inequality is not perpetrated to not harm or exclude women, and help to redress existing gender imbalances". Gender consultants presented the main normative and conceptual frameworks related to gender approach on policies, programs and projects (see table 2)

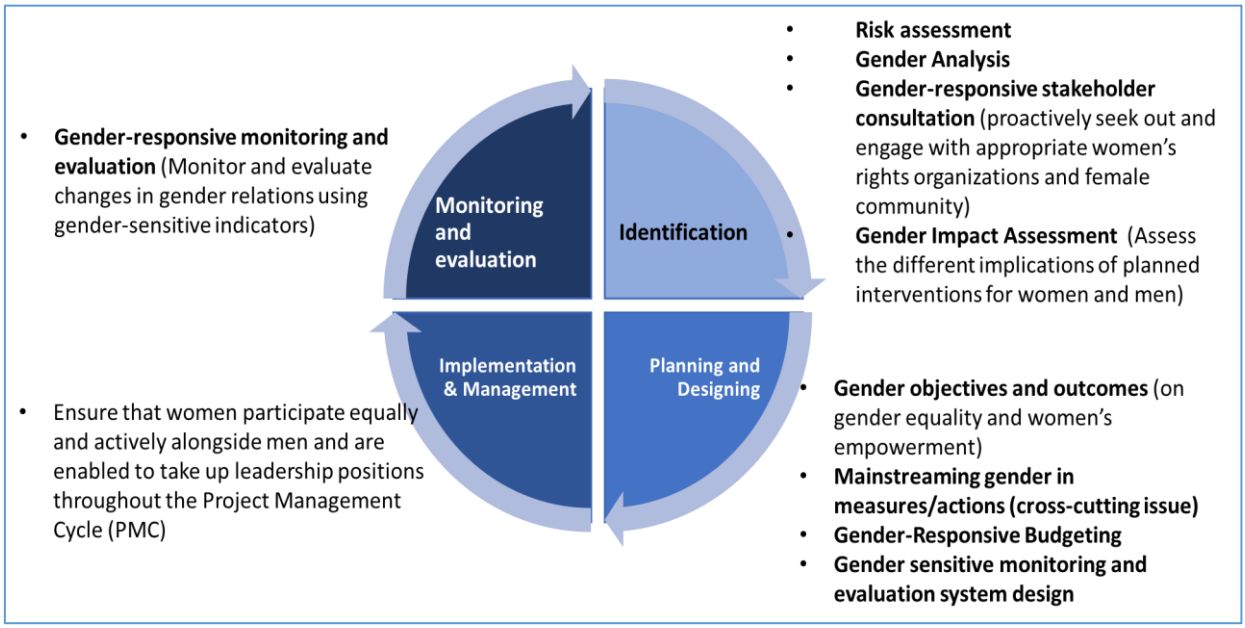
Table 2. Main International Normative Frameworks for gender equality

	2017	***UNFCCC Gender Action Plan***
	2017	UNCCD Gender Action Plan
	2016	Paris Agreement - Lima work program on gender extended to 2019
Beijing +10	2015	***2030 Agenda on Sustainable Development (SDGs)***

		CDB Gender Plan of Action (2015-2020)
	2015	Sendai Framework for Disaster Risk Reduction 2015-2030
	2014	Lima Work Program on Gender
	2012/2013	Commission on the Status of Women (CSW) resolutions 56/2 and 58/2 on gender equality and the empowerment of women in natural disasters
	2008	CDB Gender Plan of Action
	2005	UN World Conference on Disaster Reduction
		Kyoto Protocol (1997) entered into force
	2002	World Summit on Sustainable Development (WSSD)
	2000	Millennium Development Goals (MDGs)
UN Fourth World Conference on Women in Beijing. ***Beijing Declaration and Platform for Action***	1995	
	1992	UN Conference on Environment and Development *"Earth Summit"* (UNCED): - Rio Declaration - Agenda 21
		- United Nations Framework Convention on Climate Change (UNCCC)
		- Convention on Biological Diversity (CBD)
		- Convention to Combat Desertification (UNCCD)
Convention on the Elimination of All Forms of Discrimination against Women (CEDAW)	1979	

Moreover, an approach on how to integrate gender in the project management cycle was presented (see figure 6).

Figure 6. Project Management Cycle from a gender perspective



Main Comments and Questions

Comment 1. Mery Yaou

On planification and project design using a gender approach**:** In terms of planification and project design there are different sensitivities between men and women, this is why it is very important to consider the financial aspect and to budget in advance when implementing projects to include a gender approach.

In fact, the roots of the problem are at the formulation team; if at the conception level there is no woman to conceptualize the project, gender inequality will remain because women will not speak and express their opinion.

Comment 2. Mery Yaou

On project implementation: Women rarely speak with men going to the field as they are afraid of other men threatening them or making negative comments about their behavior. For this reason, we propose to send to the field gender mixed national and regional teams.

Module 4 – In-depth regional analysis (45 min)

Overview information – Key information presented

Module 4 presented the methodological approach followed on the phase 2 to implement the activities 2.1 and 2.2 and the results gathered through the survey and the different interviews to CTCN NDEs and WACOM focal points by country groups.

The data collection results were presented following the survey structure. As an introductory phase results on general awareness on coastal hazards impacts on economy, the environment, local communities and women and on the Coastal Hazard Wheel awareness were exposed

Moreover, the results obtained from the data analysis on the 6 CHW parameters were classified in terms of availability, quality and accessibility on a traffic light system table (see table 3).

Table 3. Traffic light system table for geological layout parameter

	Benin	Cameroun	Cote d'Ivoire	Gambia	Ghana	Guinea	Senegal	Togo
Coastal geomorphological classification of the coast								
Shoreline database								
At national level								
At regional level								
At global level								
Geological map								
At national level								
At regional level								
At global level								
Lithological map								
At national level								
At regional level								
At global level								
Digital Elevation Model covering the emerged coastal strip								
Report or study in relation to coastal geomorphology for your country or region								
Orthophotos or a composition of orthophotos taken by plane								

For each parameter, by area (availability, quality and accessibility), the main findings and weaknesses in terms of information gaps were identified and highlighted to settle the ground for the recommendations presented on the next module.

Main comments and Questions

Comment 1. Luc Mathurin

On the lack of information in their country: They will try to complete missing data.

Comment 2. Moussa Sall

On missing data: The institutions which have the relevant data should communicated to the consultants. It would be necessary to create a roadmap for each country, where they indicate if they have the necessary information. The challenge will be to harmonize all the information at regional level.

Module 5 – The path forward (15 min)

Overview information – Key information presented

To conclude the training, a series of action points and recommendations were highlighted by each parameter from the Coastal Hazard Wheel tool at country and regional level.

Annex III. Support documents for the analysis of national and regional data

A.3.1. On-line survey

1) Your Organization

2) General Awareness and expertise on coastal Management

1. How relevant you think are the coastal hazard impacts to your country (social, economic and environmental)? (please value from 1 to 5 being 5 the highest value)	**1** ☐	**2** ☐	**3** ☐	**4** ☐	**5** ☐

2. Are you aware of the impact the coastal hazards have in your country on the following areas? (please answer the degree you agree with the following sentences, being 5 the maximum agreement)	**1**	**2**	**3**	**4**	**5**
In the national economy					
Coastal hazards reduce investment in coastal zones	☐	☐	☐	☐	☐
Coastal hazards reduces the economic activity of relevant sectors such as fisheries, tourism & recreation, agroindustry and construction, among others	☐	☐	☐	☐	☐
Increases unemployment due to the lack of economic stagnation	☐	☐	☐	☐	☐
In the environment and natural resources of coastal zones					
Reduces the biodiversity of coastal areas	☐	☐	☐	☐	☐
Generates erosion and enhances deforestation	☐	☐	☐	☐	☐
Deteriorates flora and fauna of the ecosystem	☐	☐	☐	☐	☐
With local coastal communities					
Increases flows of internally displaced people and environmental migrants	☐	☐	☐	☐	☐
Reduces the capacity of communities to become self-sufficient due to their ecosystem conditions	☐	☐	☐	☐	☐
Jeopardizes the capacity of public institutions to deliver public goods (water, energy, waste management)	☐	☐	☐	☐	☐

3. Do you think Climate Change and coastal hazards have the same impact on men and women?	☐Yes ☐No

4. If so, why do you think it affects differently?	**1**	**2**	**3**	**4**	**5**

They have less access to and control over resources	☐	☐	☐	☐	☐
They have less capacity to adapt to existing and predicted impacts of climate change	☐	☐	☐	☐	☐
They have less access to income and are less independent	☐	☐	☐	☐	☐
They have less access to participatory frameworks and decision making processes in the community	☐	☐	☐	☐	☐

5. Have you heard about the Coastal Hazard Wheel (CHW)?	☐Yes ☐No

6. To what degree are you knowledgeable about the CHW

I never heard about it 1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	I use it regularly 8 ☐

1. Are you aware if they have produced a CHW in your country?	☐Yes ☐No

3) Geological layout

Availability of data

Do you already have a coastal geomorphological classification of your coast?	☐Yes ☐No
Do you have a shoreline database?	☐Yes ☐No
If yes, at what level has the shoreline database been produced?	☐Nationally ☐Regionally ☐Globally
Do you have a geological map?	☐Yes ☐No
If yes, at what level is the geological map available?	☐Nationally ☐Regionally ☐Globally
Do you have a lithological map?	☐Yes ☐No
If yes, at what level is the lithological map available?	☐Nationally ☐Regionally ☐Globally
Do you have a Digital Elevation Model covering the emerged coastal strip?	☐Yes ☐No
Do you have any report or study in relation to coastal geomorphology for your country or region?	☐Yes ☐No
Do you have orthophotos or a composition of orthophotos taken by plane?	☐Yes ☐No

Quality of data

Is the shoreline database available in digital format?	☐Yes ☐No
In which file format is the shoreline database available?	☐CSV ☐Shapefile Other:

What is the date of the last update of the shoreline database?	☐Yes ☐No
What is the frequency of update currently been used for the shoreline database?	☐Yes ☐No
What is the resolution of the shoreline database (in meters)? Is that finer than 50 m?	☐Yes ☐No
Is the geological map available in a digital and georeferenced format?	☐Yes ☐No
Is the lithological map available in a digital and georeferenced format?	☐Yes ☐No
Is the Digital Elevation Model available in a digital and georeferenced format?	☐Yes ☐No
What is the date of the last orthophotos taken by plane?	☐Yes ☐No
Are the orthophotos available in a digital and georeferenced format?	☐Yes ☐No
Are the studies/reports about coastal geomorphology available in digital format (PDF)?	☐Yes ☐No

Accessibility of data

Is the shoreline database publicly available to everyone?	☐Yes ☐No
Is the shoreline database available in electronic or printed version? Please choose all options that apply:	
Electronic open version	☐
Electronic version upon request	☐
Printed version on public information centres	☐
Printed copies upon request	☐
Not publicly available	☐
Other:	
Do you know the local institution/s responsible for the production and management of the shoreline database or any other information in relation to coastal geomorphology? If yes, could you please provide the name of the responsible institution/s:	☐Yes ☐No

4) Wave exposure

Availability of data

Do you have wave time series measured from buoys?	☐Yes ☐No
Do you have a wave hindcast or wave reanalysis available?	☐Yes ☐No

Quality of data

How many buoys do you manage and where are they located? Do you know their exact geographical coordinates?	
Are the buoys measuring Significant Wave Height, Wave Period and Wave Direction?	
How long have the buoys been recording without gaps?	
If a wave hindcast is available, which is their horizontal resolution in km?	
What is the time step of wave time series?	

Accessibility of data

Are the wave time series available to everyone?	☐Yes ☐No
Are the wave time series in electronic or printed format?	
Electronic open version	☐
Electronic version upon request	☐
Printed version on public information centres	☐
Printed copies upon request	☐
Not publicly available	☐
Other:	
Is there a local institution responsible for the production and management of wave time series? *If yes, could you please provide the name of the responsible institution/s:*	☐Yes ☐No

5) Tidal range

Availability of data

Do you have tidal records from harbours available?	☐Yes ☐No
Do you work with tidal data from satellite missions?	☐Yes ☐No

Quality of data

In how many harbours do you have tidal records?	
Is there an entity responsible for reviewing and analyzing the quality of the tidal records?	☐Yes ☐No
If yes, could you please provide the name of the responsible institution/s:	

Accessibility of data

Is there a local institution responsible for the production and management of	☐Yes ☐No

the tidal data?	
If yes, could you please provide the name of the responsible institution/s:	
Is the database publicly available to everyone in digital format?	☐Yes ☐No
Is the tidal data available in electronic or printed format?	
Electronic open version	☐
Electronic version upon request	☐
Printed version on public information centres	☐
Printed copies upon request	☐
Not publicly available	☐
Other:	

6) Flora/Fauna

Availability of data

Do you have flora and fauna database cover with satellite images by Google Earth?	☐Yes ☐No	
If yes, please indicate if the following data is included in the database (additional):	***Yes***	***No***
Phytoplankton population dynamics + chlorophyll-a (water quality)	☐	☐
Invasive species (land and marine)	☐	☐
Species (threatened/ endangered/ protected)	☐	☐
Total catch by species and quota	☐	☐
Do you have a source to measure the latitude of the assessment area?	☐	☐
Do you have a database specifying the marine and coastal protected areas? (additional)	☐	☐
Do you have a database updated with other sources (as UNEP coral reef database, or field studies)? (	☐	☐
If yes, please specify the source/s used:		
Has the database been produced?	☐Nationally ☐Regionally ☐Globally	
Is there a local institution responsible for the production and management of the shoreline database?	☐Yes ☐No	
If yes, could you please provide the name of the responsible institution/s:		

Quality of data

What is the date of the last update of the biodiversity database?	
Frequency of update currently been used for the database?	
Is there an entity responsible for reviewing and supervising the quality of the database updates?	☐Yes ☐No
If yes, could you please provide the name of the responsible institution/s:	

Accessibility of data

Is the database publicly available to everyone?	☐Yes ☐No
Is the tidal data available in electronic or printed format?	
Electronic open version	☐
Electronic version upon request	☐
Printed version on public information centres	☐
Printed copies upon request	☐
Not publicly available	☐
Other:	

7) Sediment balance

Availability of data

Do you have available studies or reports about coastline erosion?	☐Yes ☐No
Do you have historical orthophotography available?	☐Yes ☐No
Do you have digitalized historical shorelines?	☐Yes ☐No
Do you have an inventory of anthropogenical actions against or for coastal erosion?	☐Yes ☐No
Is there a local institution responsible for the production and management of the shoreline database?	☐Yes ☐No
If yes, could you please provide the name of the responsible institution/s:	

Quality of data

Are the orthophotos available in digital and georeferenced format?	☐Yes ☐No
What are the dates with orthophotos available?	
What are the dates of the historical shorelines?	
What is the file format of the historical shorelines? Shapefile, CSV?	

Accessibility of data

Are the historical shorelines publicly available to everyone?	☐Yes ☐No

Is the tidal data available in electronic or printed format?	
Electronic open version	☐
Electronic version upon request	☐
Printed version on public information centres	☐
Printed copies upon request	☐
Not publicly available	☐
Other:	

8) Storm climate (extreme events)

Availability of data

Do you have a database reporting storms in terms of their intensity and the damage to the coast?	☐Yes ☐No
If no, do you have any other database reporting storms with other indicators?	
How has the database been produced?	☐Nationally ☐Regionally ☐Globally
Is there a local institution responsible for monitoring the storms in terms of their hydrodynamics?	☐Yes ☐No
If yes, could you please provide the name of the responsible institution/s:	

Quality of data

How many storms have been reported in the storm database?	

Accessibility of data

Is the storm database publicly available to everyone?	☐Yes ☐No
In which format is the data available?	
Electronic open version	☐
Electronic version upon request	☐
Printed version on public information centres	☐
Printed copies upon request	☐
Not publicly available	☐
Other:	

9) Gender

On coastal risk management and gender

1. Does your country already consider aspects of vulnerability and gender in coastal risk management?	☐Yes ☐No ☐I don't know
If yes, please briefly provide information:	
2. Do you know of specific policies or programmes in your country that deal with vulnerability and resilience to coastal risks, taking into account gender?	☐Yes ☐No ☐I don't know
If yes, please briefly provide information:	
3. Which are key institutions (governmental or non-governmental) in your country dealing with gender equality?	
4. Can you recommend any specific literature on the topic of gender in coastal risk management?	

10) Other

1. Do you know about specific technologies that could complement the Coastal Hazard Wheel tool?	☐Yes ☐No ☐I don't know
If yes, please briefly provide information:	
2. Do you know about other contacts or institutions that could provide further information or details about the elements discussed on this survey?	☐Yes ☐No ☐I don't know
If yes, please briefly provide information:	

Annex IV. Support documents for the evaluation study on the management of gender issues

A.4.1. List of documents reviewed

Author	Title	Publisher	Year of Publication	Weblink
International/ Regional documents				
African Union	African Union Gender Strategy	African Union	2019	https://au.int/en/gender-equality-development
Lelia Croitoru, Juan José Miranda and Maria Sarraf	The Cost of Coastal Zone Degradation in West Africa: Benin, Cote d'Ivoire, Senegal and Togo	World Bank Group	2019	http://documents.worldbank.org/curated/en/822421552504665834/pdf/135269-Cost-of-Coastal-Degradation-in-West-Africa-March-2019.pdf
Oxfam	In Practice: Gender Justice and Resilient Development. Sharing Programme Learning from Africa, South Asia and Central America	Oxfam	2018	https://policy-practice.oxfam.org.uk/publications/gender-justice-in-resilient-development-sharing-programme-learning-from-africa-620612
USAID	Climate Risk Profile West Africa	USAID	2018	https://www.climatelinks.org/resources/climate-risk-profile-west-africa
UN Women	Leveraging Co-Benefits Between Gender Equality and Climate Action for Sustainable Development. Mainstreaming Gender Considerations in Climate Change Projects.	UN Women	2016	https://unfccc.int/files/gender_and_climate_change/application/pdf/leveraging_cobenefits.pdf
ECOWAS	Supplementary Act on Equality of Rights between Women and Men for Sustainable Development	ECOWAS	2015	http://www.ccdg.ecowas.int/wp-content/uploads/Supplementary-Act-on-Gender-Equality.pdf

Markus, Rachel	Changing gender norms: monitoring and evaluating programmes and projects	ODI	2015	https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9815.pdf
Pereznieto, Paola	What can internationally comparable quantitative data tell us about how gender norms are changing?	ODI	2015	https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9816.pdf
Markus, Rachel, et. al.	How do gender norms change?	ODI	2015	https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9817.pdf
Webb, Julie	Gender dynamics in a changing climate: how gender and adaptive capacity affect resilience	CARE International	2015	http://careclimatechange.org/wp-content/uploads/2015/11/Gender-and-Adaptation-Learning-Brief.pdf
Coulier, Miguel, et.al.	Making It Count: Integrating Gender into Climate Change and Disaster Risk Reduction: A Practical How-To Guide	CARE International	2015	https://careclimatechange.org/wp-content/uploads/2015/09/Making-It-Count-EN.pdf
IUCN	The Environment and Gender Index (EGI) 2013 Pilot	IUCN	2013	https://www.iucn.org/content/environment-and-gender-index-egi-2013-pilot
Habtezion, Senay	Gender and Adaptation	UNDP	2013	https://www.undp.org/content/dam/undp/library/gender/Gender%20and%20Environment/PB2-AP-Gender-and-Adaptation.pdf
FAO	Disaster Risk Management Strategy in West Africa and the Sahel FAO 2011-2013	FAO	2011	http://www.fao.org/fileadmin/templates/tc/tce/pdf/DRM_Strategy_Sahel_2011-2013_web.pdf
UNDP	Gender, Climate Change and Community-Based Adaptation - A Guidebook	UNDP	2010	https://www.undp.org/content/dam/aplaws/publication/en/publications/environment-energy/www-ee-library/climate-change/gender-climate-change-and-community-based-adaptation-guidebook-/Gender%20Climate%20Change%20and%20Community%20Based%20Adaptation%20(2).pdf
Goussard et. al.	Regional Study for Shoreline Monitoring and Drawing Up a Management Scheme for the West African Coastal Area. Towards a Regional Coastal Risk Reduction Plan.	UEMOA	2010	https://www.iucn.org/sites/dev/files/content/documents/communication_doc_sdlao_pr_en_0.pdf

African Union	The African Women's Decade.	African Union	2010	https://au.int/en/documents-43
UNDP	Resource Guide - Mainstreaming Gender in Water Management	UNDP	2006	https://www.undp.org/content/dam/aplaws/publication/en/publications/environment-energy/www-ee-library/water-governance/resource-guide-mainstreaming-gender-in-water-management/IWRMGenderResourceGuide-English-200610.pdf
CTCN	CTCN Gender Mainstreaming Tool for Response Plan Development	CTCN	n/a	https://www.ctc-n.org/technologies/ctcn-gender-mainstreaming-tool-response-plan-development
Country-specific documents				
Benin				
Government of Benin	Plan National de Développement 2018-2025	Government of Benin	2018	https://plan.gouv.bj/wp-content/uploads/2019/01/MPD_Plan-National-D%C3%A9veloppement_2018-2025_version-edite-.pdf
World Bank Group	Plan d'investissement multisectoriel pour l'adaptation aux risques cotiers face aux changements climatiques au Benin	World Bank Group	2017	http://documents.worldbank.org/curated/en/799851527676178019/Plan-d-investissement-multisectoriel-pour-l-adaptation-aux-risques-cotiers-face-aux-changements-climatiques-au-Benin
Ministère du Cardre de Vie et du Développement Durable	Première Contribution Determinée au Niveau National du Bénin au Titre de l'Accord de Paris	Ministère du Cardre de Vie et du Développement Durable	2017	https://www4.unfccc.int/sites/NDCStaging/pages/Party.aspx?party=BEN
Ministère de la Famille et de la Solidarité Nationale	Politique Nationale de Promotion du Genre au Benin	Ministère de la Famille et de la Solidarité Nationale	2009	http://ilo.org/dyn/natlex/natlex4.detail?p_lang=en&p_isn=99954&p_country=BEN&p_count=232&p_classification=05&p_classcount=13
Japan International Cooperation Agency (JICA)	Country Gender Profile: Benin	JICA	2009	https://www.jica.go.jp/english/our_work/thematic_issues/gender/background/pdf/e09ben.pdf
Cote d'Ivoire				
Ministère de la Salubrité, de l'Environnement et du	Programme d'appui du PNUD à la mise en oeuvre des Contributions Déterminées au niveau	MINSED D	2018	https://www.undp.org/content/dam/LECB/events/2018/20181119-cote-divioire-ndc-validation-ws/undp-ndcsp-cotedivioire-prodoc-

Développement Durable (MINSEDD)	national (CDN) de la Côte d'Ivoire			summary.pdf
Ministère de la Salubrité, de l'Environnement et du Développement Durable (MINSEDD)	Rapport de la Troisième Communication Nationale (TCN) de la Cote d'Ivoire dans de Cadre de la Convention Cadre des Nations Unies sur les Changements Climatiques (CCNUCC)	MINSEDD	2017	http://www.un-gsp.org/sites/default/files/documents/3069145_cite_divoire-nc3-1-cote_divoire_-_third_national_communication.pdf
BeDevelopment/ WACA	Appui a la Préparation de Plan d'Investissement Multisectoriel IDA-17 et du Plan d'Investissement pour la Ville de Grand-Lahou, République de Cote d'Ivoire	BeDevelopment/ WACA	2017	http://documents.banquemondiale.org/curated/fr/553861520966891386/pdf/124254-FRENCH-WP-PUBLIC-WACA-Lot-01-Livrable-E-F-PIM-Final.pdf
Government of Cote d'Ivoire	Contributions Prévues Déterminées au Niveau National de la Cote d'Ivoire	Government of Cote d'Ivoire	2016	
Government of Cote d'Ivoire	Plan National de Développement 2016-2020	Government of Cote d'Ivoire	2016	http://www.gcpnd.gouv.ci/fichier/doc/ResumePND2016-2020_def.pdf
African Development Bank (AfDB)	Profil Genre Pays République de la Cote d'Ivoire	AfDB	2015	https://www.afdb.org/en/documents/document/cote-divoire-profil-genre-pays-2015-92686/
Japan International Cooperation Agency (JICA)	Country Gender Profile: Côte d'Ivoire	JICA	2013	http://open_jicareport.jica.go.jp/pdf/12121877.pdf
UNDP	Egalité des sexes en Cote d'Ivoire - Role du PNUD 2010-2017	UNDP	n/a	https://www.undp.org/content/dam/cote_divoire/docs/BROCHURE_PNUD_EGALITE_SEXES.pdf
Cameroon				
Banseka, Hycinth, et.al.	Cameroon: Preparing the National Adaptation Plan for Climate Change (NAPCC) and its Investment Strategy	Global Water Partnerhsip (GWP)	2018	https://www.gwp.org/globalassets/global/toolbox/case-studies/africa/cameroon-naps-full-case-study-492.pdf
Government of Cameroon	Intended Nationally Determined Contribution (INDC)	Government of Cameroon	2016	https://www4.unfccc.int/sites/NDCStaging/pages/Party.aspx?party=CMR

Ministry of Environment, Protection of Nature and Sustainable Development	Second National Communication on Climate Change	Ministry of Environment, Protection of Nature and Sustainable Development	2015	https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-convention/national-communications-and-biennial-reports-annex-i-parties/seventh-national-communications-annex-i
Ministry of Environment, Protection of Nature and Sustainable Development	Plan National d'Adaptation aux Changements Climatiques du Cameroun	Ministry of Environment, Protection of Nature and Sustainable Development	2015	https://www4.unfccc.int/sites/NAPC/Documents/Parties/PNACC_Cameroun_VF_Valid%C3%A9e_24062015%20-%20FINAL.pdf
Japan International Cooperation Agency (JICA), TAC International Inc.	2015 Country Report of Gender Profile (Cameroon)	JICA	2015	n/a
Government of Cameroon	Document de politique nationale genre 2011-2020	Government of Cameroon	2011	https://www.docdroid.net/10eyk/cameroon039s-gender-policy-document-2011-2020.pdf
Government of Cameroon	Cameroun Vision 2035	Government of Cameroon	2009	http://cm.one.un.org/content/unct/cameroon/en/home/about/vision-2035.html
Gambia				
Government of The Gambia	The Gambia National Develpment Plan (2018-2021)	Government of The Gambia	2018	http://www.thegambiatimes.com/wp-content/uploads/2018/02/1.-The-Gambia-National-Development-Plan-2018-2021-Full-Version.pdf
Ministry of Environment, Climate Change, Forestry, Water and Wildlife	Intended Nationally Determined Contribution of The Gambia	Ministry of Environment, Climate Change, Forestry, Water and Wildlife	2016	https://www4.unfccc.int/sites/NDCStaging/pages/Party.aspx?party=GMB

NAP-GSP	Gambia National Adaptation Plan Process - Stocktaking report and a road map for advancing Gambia's NAP process	UNDP/UNEP	2015	https://www.adaptation-undp.org/sites/default/files/downloads/gambia_stocktaking_report_for_nap_and_road-map_for_cambodia_nap_gsp_and_giz_31.pdf
African Development Bank (AfDB)	The Gambia: Country Gender Profile	African Development Bank (AfDB)	2011	https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/GAMBIA%20Gender%20Profil%20final%20%282%29.pdf
Ministry of Women's Affairs	The Gambia National Gender Policy 2010- 2020	Ministry of Women's Affairs	2010	http://www.ilo.org/dyn/travail/docs/1958/Gambia%20national%20gender%20policy.pdf
Government of The Gambia	National Disaster Management Programme - Strategic Action Plan 2008-2011	Government of The Gambia	2008	https://www.preventionweb.net/english/professional/policies/v.php?id=10880
Government of The Gambia	National Disaster Management Policy	Government of The Gambia	2007	https://www.preventionweb.net/english/professional/policies/v.php?id=10881
Ghana				
Owusu, Mensah	Gender Vulnerability to Climate Change and Livelihood Security in Urban Slum Communities in Accra, Ghana	The University of Adelaide	2017	https://www.researchgate.net/publication/317299413_Gender_Vulnerability_to_Climate_Change_and_Livelihood_Security_in_Urban_Slum_Communities_in_Accra_Ghana
Government of Ghana	Ghana's Third National Communication Report to the UNFCCC	Government of Ghana	2015	https://unfccc.int/resource/docs/natc/ghanc3.pdf
Ministry of Gender, Children and Social Protection	National Gender Policy	Ministry of Gender, Children and Social Protection	2015	http://www.ilo.org/dyn/natlex/natlex4.detail?p_lang=en&p_isn=103987&p_country=GHA&p_count=2
Government of Ghana	Ghana's intended nationally determined contribution (INDC) and accompanying explanatory note	Government of Ghana	2015	https://www4.unfccc.int/sites/NDCStaging/pages/Party.aspx?party=GHA
Ministry of Environment, Science, Technology and Innovation	Ghana National Climate Change Policy	Ministry of Environment, Science, Technology and Innovation	2013	http://www.un-page.org/files/public/ghanaclimatechangepolicy.pdf

Government of Ghana	Ghana: National climate change adaptation strategy	Government of Ghana	2013	https://www.adaptation-undp.org/sites/default/files/downloads/ghana_national_climate_change_adaptation_strategy_nccas.pdf
African Development Fund	Ghana Country Gender Profile	African Development Fund	2008	https://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/ADF-BD-IF-2008-237-EN-GHANA-COUNTRY-GENDER-PROFILE.PDF
Guinea				
Ministère de l'Environnement, des Eaux et des Forets	Seconde Communication Nationale a la Convention Cadre des Nations Unies sur les Changements Climatiques	Ministère de l'Environnement, des Eaux et des Forets	2018	https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-convention/national-communications-and-biennial-reports-annex-i-parties/seventh-national-communications-annex-i
Ministère du Plan et de la Coopération Internationale	Plan National de Développement Economique et Social 2016-2020	Ministère du Plan et de la Coopération Internationale	2017	http://www.gouvernement.gov.gn/images/PNDES/Plan%20National%20du%20Developpement%20Economique%20et%20Sociale.pdf
Government of Guinea	Contributions Prévues Déterminées au Niveau National (CPDN) au Titre de la Convention des Nations Unies sur le Changement Climatique (CCNUCC)	Government of Guinea	2016	https://www4.unfccc.int/sites/NDCStaging/pages/Party.aspx?party=GIN
Niang, Prof. Djibril Kamara	Rapport national de suivi sur la mise en œuvre duCadre d'action de Hyogo (2013-2015) - Interim	Centre National de Gestion des Catastrophes et Urgences Environnementales	2015	https://www.preventionweb.net/files/42379_GIN_NationalHFAprogress_2013-15.pdf
Ministère d'Etat des Affaires Sociales, de la PromotionFéminine et de l'Enfance	Politique National Genre	Ministère d'Etat des Affaires Sociales, de la Promotion Féminine et de l'Enfance	2011	https://www.undp.org/content/dam/guinea/docs/whatwedo/women-empowerment/politique-nationale-genre-2011.pdf

Senegal				
Government of Senegal	Plan Sénegal Émergent 2019-2023	Government of Senegal	2018	http://www.senegal-emergent.com/sites/default/files/documents/pap2_pse.pdf
Ministère de Femme, de la Famille et de l'Enfance	Stratégie Nationale pour l'Équité et l'Égalité de genre 2016-2026	Ministère de Femme, de la Famille et de l'Enfance	2016	http://www.directiongenre.com/docs/SNEEG%202.pdf
Agence Nationale de la Statistique et de la Démographie	Analyse Genre des Bases de Donnés Existantes	Agence Nationale de la Statistique et de la Demographie	2016	http://www.ansd.sn/ressources/publications/Rapport%20genre%20analyses%20bases.pdf
Ministère du l'Environnement et du Développement Durable	Troisième Communication du Sénegal a la Convention Cadre des Nations Unies sur les Changements Climatiques	Ministère du l'Environnement et du Développement Durable	2015	https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-convention/national-communications-and-biennial-reports-annex-i-parties/seventh-national-communications-annex-i
Diagne Gueye, Yacine	Genre, changements climatiques et sécurité humaine. Le cas du Sénégal.	Enda	2008	http://base.afrique-gouvernance.net/docs/genre-changement_climatique_et_securite_humaine_au_senegal.pdf
Togo				
Government of Togo	Togo National Development Plan 2018-2022	Government of Togo	2018	https://togoembassylondon.com/pnd-togo/
Government of Togo/ GIZ	Plan National d'Adaption aux Changements Climatiques du Togo (PNACC)	Government of Togo/ GIZ	2018	https://www4.unfccc.int/sites/NAPC/News/Pages/national_adaptation_plans.aspx
Government of Togo/ World Bank Group	West Africa Coastal Areas Management Program (WACA): Plan d'actions pour le développement et l'adaptation aux changements climatiques du littoral togolais	Government of Togo/ World Bank Group	2017	http://documents.banquemondiale.org/curated/fr/158851512725647857/Gestion-des-zones-c%C3%B4ti%C3%A8res-dAfrique-de-louest-plan-d-actions-pour-le-developpement-et-l-adaptation-aux-changements-climatiques-du-littoral-Togolais
Government of Togo	Troisième Communication Nationale sur les Changements	Government of Togo	2015	https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-

	Climatiques			under-the-convention/national-communications-and-biennial-reports-annex-i-parties/seventh-national-communications-annex-i
Government of Togo	Contribution Prévue Déterminée au Niveau National (CPDN) dans de Cadre des Nations Unies sur les Changements Climatiques (CCNUCC)	Government of Togo	2015	https://www4.unfccc.int/sites/NDCStaging/pages/Party.aspx?party=TGO
Ministére de l'Action Sociale, de la Promotion de la Femme et de l'Alphabétisation	Politique Nationale pour l'Equité et l'Egalité de Genre du Togo	Ministére de l'Action Sociale, de la Promotion de la Femme et de l'Alphabétisation	2011	http://www.ilo.org/dyn/natlex/natlex4.detail?p_lang=en&p_isn=95069

A.4.2. List of interviews conducted

Type of stakeholder	Organization	Interviewee	Position	Date of interview
International/ Regional level				
NGO	REFACOF - African Women's Network for Community Management of Forests	Cécile Ndjebet	Regional director	May 18, 2019
International Organization	World Bank	Margaret Arnold	Senior Social Development Specialist Social, Urban, Rural and Resilience	May 22, 2019
Cameroun				
Government	National Observatory on Climate Change	Patrick Mbomba	Deputy Managing Director	April 9, 2019
Government	National Observatory on Climate Change	Isabella Zouthem	Environmentalist/GIS Specialist	April 9, 2019
Cote d'Ivoire				
NGO	Actions en Faveur de l'Homme et de la Nature (AFHON)	Davy Wohary Coulibaly	Director	May 15, 2019
Government	Ministère de l'Environnement	Jean-Yves Anduve	Officer, NDC Support Programme / Private sector Relations	May 20, 2019
Academic	Université Félix Ouphouet Boigny	Célestin Hauhout		April 16, 2019
Ghana				
Government	Environmental Protection Agency	Mr. Joseph Amankwa Baffoe	Senior Programme Officer	April 9, 2019
Academic	Department of Marine and Fishries Sciences Lecturer, University of Ghana	Kwasi Appeaning ADDO	Associate Professor and head of Marine and Fisheries Sciences Department	April 9, 2019
Guinea				
Government	Ministry of Energy and Hydraulics	Dioubate Hawa	Energy Engineer	May 14, 2019
Senegal				
Government	Ministry of Petrol and Energy	Mor Ndiaye	Chief of Staff to the Minister	April 25, 2019

Specialized agency	Centre d'Etudes et de Recherches sur les Energies Renouvelables	Mr. Issakha Youm	Professor	April 23, 2019
Government	Direction de l'Environnement et du Développement Durable/Division gestion du littoral	Luc Mathurin Malou	Marine and coastal geologist	April 23, 2019
Togo				
Government	Ministère de l'Environnement et des Ressources Forestières	Méry Yaou	UNFCCC Gender Focal Point	May 10, 2019
International Organization	FAO	Djiwa Oyétoundé	Programme Officer	May 13, 2019

A.4.3. Evaluation matrix

Evaluation questions	Evaluation sub questions	Indicators	Means of verification
Q1: To what extent is vulnerability gender-specific in the West African and Cameroonian coastal area?	How do coastal risks affect communities in coastal areas in West Africa?	* Number and type of risks/disasters in coastal areas * Type of effects of risks/disasters on the local communities	Statistics Literature/ reports
	In how far are women and men in the communities affected differently?	* Number of women and men affected by coastal risks/disasters * Extent to which women and men suffer different consequences from coastal risks/disasters * Evidence on causes for different effects of coastal risks/disasters on women and men (e.g. socio-economic, cultural norms, etc.)	Statistics Literature/ reports Semi-structured interviews with experts
	Are there any population groups that can be identified as the most vulnerable to coastal risks? Within these groups, how are women and men affected differently?	* Number and type of population living in areas with most coastal risks/disasters * Extent to which women and men in these groups suffer different consequences from risks/disasters * Evidence on causes for different effects of coastal risks/disasters on women and men (e.g. socio-economic, cultural norms, etc.)	Statistics Literature/ reports Semi-structured interviews with experts
Q2: How does WACOM countries and Cameroon perceive and deal with vulnerability and resilience to coastal risks, taking into account gender?	What are current policies, measures and initiatives to protect communities from coastal risks?	* Number and type of policies/measures/initiatives for dealing with vulnerability and resilience to coastal risks	Literature/ reports Semi-structured interviews with experts
	Do these policies, measures and initiatives currently integrate a gender-sensitive approach?	* Share of policies/measures/initiatives that include a gender-sensitive approach	Literature/ reports Semi-structured interviews with experts
Q3: How do WACOM countries and Cameroon intend to change the gender roles in coastal risk planning and management?	Which specific approaches (if any) exist in the countries to integrate a gender-transformative approach into coastal risk management and planning?	* Number and type of coastal risk management plans and implementation mechanisms that include a gender-transformative approach	Literature/ reports Semi-structured interviews with experts
Q4: How do WACOM countries and Cameroon measure changes in gender roles in coastal risk management?	Which M&E systems are currently used to measure changes in gender roles in coastal risk management?	* Type and quality of M&E systems for coastal risk management that include measurement of changes in gender roles	Literature/ reports Semi-structured interviews with experts
	Which specific indicators are collected by whom? What is the quality and reliability of these indicators?		
Q5: What are the factors that encourage changes in gender roles (drivers of change) and what are the limitations and challenges?	Wich results have been produced so far (if any) through the different policies/measures/initiatives that integrate gender-sensitive or gender-transformative approaches in coastal risk management?	* Evidence on change in gender roles as a result of different initiatives * Evidence on lessons learned and best practices	Literature/ reports Case studies Semi-structured interviews with experts
	Which approaches have worked best and why? Which approaches have not worked and why not?		

A.4.4. Semi-structured interview guide

Date/ time of interview	
Interviewer	
Name of interviewee	
Position	
Organization	
Contact information	

Introduction

The Climate Technology Centre & Network (CTCN) has awarded a services contract for the "Assessment of Coastal Hazards and Climate Change Adaptation Technologies for the Coastal Region of West Africa and Cameroon Using the Coastal Hazard Wheel (CHW)" to a consortium led by the company GlobalCAD. As part of this assignment, the consultants are conducting an "Evaluation study on management of gender issues in coastal risk planning and management in West Africa and Cameroon".
The purpose of the study is to analyze to what extent vulnerability to coastal risks is gender-specific in the West African an Cameroonian coastal areas, the extent to which vulnerability and gender aspects are currently integrated in coastal risk management and planning, or how countries intend to address gender aspects in coastal risk management and planning the future, how results can be measured and which best practices exist for changing gender roles in coastal risk management.
This assessment will identify specific vulnerabilities and needs related to gender in particular in terms of access to resilience actions, funding mechanisms and proposed capacity building programs, with the aim of providing differentiated responses.
The information collected through semi-structured interviews will be treated in a confidential manner according to the EU General Data Protection Regulation (GDPR, 2018). No personal information will be disclosed to third parties. For any doubts or questions, you can contact the consultants Nina Retzlaff, nretzlaff@globalcad.org, and Oscar Martínez, omartinez@globalcad.org.

1. Please briefly introduce yourself and the organization that you work for.

2. Can you briefly describe in the specific context of country, how women and men are affected differently by coastal risks/disasters? What are main challenges for women?

3. What are the main underlying causes for these differences? *(e.g. socio-economic structures, cultural norms, etc.)*

4. Are there specific geographic areas in the country where communities are more vulnerable than others?

   ☐Yes ☐No ☐I don't know

   If yes, why/how? *(e.g. differences between rural/urban)*

5. Are there any policies/ initiatives at country level to address gender aspects related to coastal risk management?

   ☐Yes ☐No ☐I don't know

   If yes, please describe the nature of these. Who are the responsible institutions?

6. Can you give examples of how policies/ initiatives/ projects include a specific gender aspect? Which challenges are they trying to address and with which approaches?

7. Are there M&E systems in place to measure changes in gender roles in coastal risk management?

   ☐Yes ☐No ☐I don't know

   If yes, how do they measure the results and at which level? Which specific indicators are collected by whom? What is the quality and reliability of these indicators?

8. Do you have knowledge of any specific results that have been produced so far through different policies/measures/initiatives that integrate gender-sensitive or gender-responsive approaches in coastal risk management?

   ☐Yes ☐No ☐I don't know

If yes, please describe

9. What would you highlight as best practices for changing gender roles in coastal risk management in country? What would you say did not work well/ where do you see challenges?

Best practices:

Challenges:

10. Do you have any other comments/ suggestions for integrating gender aspects in coastal risk management?

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