THE CHALLENGE OF COASTAL EROSION IN WEST AFRICA

Dr Isabelle NIANG, Regional Coordinator of ACCC project,
Coordinating lead author of chapter 9 (Africa) of IPCC Working Group II

i.niang@unesco.org

Climate Adaptation Futures, Gold Coast (Australia), 29 June-1 July 2010
AN ACTUAL VULNERABILITY
COASTAL EROSION IS A MAJOR THREAT IN WEST AFRICA
Mauritania sandy coast

Photo Hellio Van Ingen/FIBA

Climate Adaptation Futures, Gold Coast (Australia), 29 June-1 July 2010
The Nouakchott harbour (Mauritania)

Between 1980 and 1998, a retreat of 25 m per year (Ould Elmoustapha, 2000)

Photo: Ould Elmoustapha, 2000

Climate Adaptation Futures, Gold Coast (Australia), 29 June-1 July 2010
Natural/human erosion

Who is responsible for what?

Photos Niang I

Climate Adaptation Futures, Gold Coast (Australia), 29 June-1 July 2010
## Variable evolution rates (Sénégal)

<table>
<thead>
<tr>
<th>Location</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saint-Louis</td>
<td>-3.3 to +0.6 m/year</td>
</tr>
<tr>
<td>Yoff</td>
<td>-3.7 to +0.9 m/year</td>
</tr>
<tr>
<td>Dakar cliffs</td>
<td>-0.4 to -1.4 m/year</td>
</tr>
<tr>
<td>Rufisque</td>
<td>-3.8 to +1.3 m/year</td>
</tr>
<tr>
<td>Joal</td>
<td>-9.1 to +8.5 m/year</td>
</tr>
<tr>
<td>Sangomar</td>
<td>-137 m/year</td>
</tr>
</tbody>
</table>
A slow but destructive erosion

Mbao

Rufisque

Climate Adaptation Futures, Gold Coast (Australia), 29 June-1 July 2010
Zones with contrasted evolution: Joal

Eroded and accreted compartments

Climate Adaptation Futures, Gold Coast (Australia), 29 June-1 July 2010
The Joal quay

April 2005

June 2002

Climate Adaptation Futures, Gold Coast (Australia), 29 June - 1 July 2010
Djiffere and the Lagoba breach

A natural phenomenon

Climate Adaptation Futures, Gold Coast (Australia), 29 June-1 July 2010
Human induced erosion: the « breach » in the langue de Barbarie
Saint Louis, 2 March 2010
Observations of sea level variations
Tide gauges have registered a 1.5 to 2 mm per year sea level rise during the 20th century (1.7 mm/year against 1.8 mm/year for the 1961-2003 period), 10 times more important than before.

A slight acceleration of the rate of sea level rise is observed actually.
Recent acceleration of sea level rise: $+3.1 \pm 0.4$ mm/year between 1993 and 2005

Red points are Topex/Poseidon data
Green points are Jason data
In blue curves obtained by doing the mean each 60 days

IPCC, 2007
Climate change and sea level rise
3 periods: a relative stability before 1870; a 1 to 2 mm/year sea level rise during the 20th century and an acceleration in sea level rise after
Climate change and sea level rise

- Climate change = atmospheric warming (between 1 and 6.4°C by the end of the 21st century as compared to 1990)
- The third IPCC report predicts a sea level rise (only due to climate warming) comprised between 9 and 88 cm by 2100 (5 to 32 cm by 2050), a rate of 0.09 to 8.8 mm/year and a mean value of 48 cm
- Two main processes responsible for sea level rise
  - Ice melting (mountain glaciers and ice sheets)
  - Warming of oceanic waters → thermal expansion
Figure 6C.5: Projected sea-level rise for the 21st century. The projected range of global averaged sea-level rise from the IPCC 2001 Assessment Report for the period 1990 to 2100 is shown by the lines and shading. The updated AR4 IPCC projections made are shown by the bars plotted at 2095, the dark blue bar is the range of model projections (90% confidence limits) and the light blue bar has the upper range extended to allow for the potential but poorly quantified additional contribution from a dynamic response of the Greenland and Antarctic ice sheets to global warming. Note that the IPCC AR4 states that “larger values cannot be excluded, but understanding of these effects is too limited to assess their likelihood or provide a best estimate or an upper bound for sea-level rise.” The inset shows the observed sea levels from tide gauges (orange) and satellites (red) are tracking along the upper bound of the IPCC 2001 projections since the start of the projections in 1990.

Source: Based on Church and others 2007; information added from IPCC 200711 and Rahmstorf and others.
MAIN IMPACTS OF CLIMATE CHANGE ON COASTAL ZONES
**Biophysical impacts**

- Acceleration of coastal erosion
- Inundation of low lying areas
- Salinization of waters and soils
- Modification in piezometric levels
- Degradation/modification of ecosystems (mangroves, coral reefs)
- Extreme events more frequent (cyclones)
- Modifications of swells and currents
Any change in one of these components of the coastal equilibrium induces a desequilibrium either positive (accretion), or negative (erosion)
Coastal erosion due to SLR
The Bruun rule (1962)

- A simple law but based on a number of hypothesis (equilibrium beach profile, no longitudinal transport)

\[ R = G \frac{L}{s} (B + d) \]

R is coastal retreat, L the width of active profile, B the height of the beach, d the depth of closure, s the sea level rise and G an overfill ratio.
The Bruun rule (1962)
- Changes in the main climatic parameters
  - Temperature
  - Precipitations
  - Evaporation
  - Winds
  - Changes in upwellings
- Other changes
Inundation of low lying areas: Banjul

Photo Hellio et Van Ingen

INC, 2003
Vulnerable zones with a minimum inundation level by 2100 (2 m)

3.5% of all the studied zone

Cap Vert peninsula

Climate Adaptation Futures, Gold Coast (Australia), 29 June-1 July 2010
Vulnerable zones with a minimum inundation level of 2 m

52% of the studied zone

Saloum estuary
Impacts of sea level rise on a coastal aquifer at the head of the Cap Vert peninsula

FEFLOW Model

Dissolved salts isovalue curves (mg.l\(^{-1}\))

A: now

B: with a 0.5 m sea level rise

Values > 15,000 mg.l\(^{-1}\)

Isovalue of 1,000 mg.l\(^{-1}\)
**Socio-economic impacts**

- Population at risk: which should be displaced (erosion, inundation); which will be affected indirectly (water supply, access to resources)
- Economic losses (infrastructure, production)
  - Lands
  - Infrastructures (roads, airports, fishing, health, education infrastructure, etc.)
  - Towns
  - Affected activities: agriculture, fisheries, tourism, industries, transport, etc.
- Health
- Limited land losses but
- Important populations at risk
- Economic value at risk (5 to 600% of GDP)
- Very high economic vulnerability

<table>
<thead>
<tr>
<th></th>
<th>Ben</th>
<th>Cam</th>
<th>Com</th>
<th>Cong</th>
<th>C. Ivo</th>
<th>Djib</th>
<th>Guin</th>
<th>Maur</th>
<th>Sén</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land (km²)</td>
<td>230</td>
<td>330</td>
<td>n.d.</td>
<td>2146</td>
<td>1495</td>
<td>14,4</td>
<td>132-234</td>
<td>874,5</td>
<td>6050</td>
</tr>
<tr>
<td>Pop (x1000)</td>
<td>880</td>
<td>460*</td>
<td>1030</td>
<td>1176</td>
<td>2500</td>
<td>68,6</td>
<td>500</td>
<td>n.d.</td>
<td>150</td>
</tr>
<tr>
<td>Eco Val. Million$</td>
<td>251,6</td>
<td>1909</td>
<td>400</td>
<td>n.d.</td>
<td>9240*</td>
<td>n.d.</td>
<td>n.d.</td>
<td>6330</td>
<td>603</td>
</tr>
<tr>
<td>Actual GDP</td>
<td>2650</td>
<td>10181</td>
<td>218</td>
<td>3544</td>
<td>10225</td>
<td>553</td>
<td>3407</td>
<td>1064</td>
<td>4971</td>
</tr>
</tbody>
</table>
ADAPTATION TO CLIMATE CHANGE IN COASTAL ZONES
Traditional adaptation options to sea level rise (IPCC/CZMS, 1990)
Available adaptation options

- Structural solutions
- Non structural solutions
- Planning, management (ICZM)
- Information, communication, education

The institutional, legislative, policies context
Accepted principles (caution, participation, etc.)
Options for a sustainable development
Structural options

Planning, management options

Erosion project

LAND USE STRATEGY

BUFFER MECHANISMS
  Restrictive Zoning
  Reserves and Public Access Strategy
  Setback

PLANNING TECHNIQUES
  Planned Retreat
  Transferable Development Rights
  Temporary Occupation

INTERIM MANAGEMENT MEASURES
  (Structural Options)
  DO NOTHING

Climate Adaptation Futures, Gold Coast (Australia), 29 June-1 July 2010
The costs of adaptation

- The assessed options are limited ↔ limited expertise
- The costs are important but less than the economic value at risk
- Efforts are still needed regarding protection options
- Which pertinence to invest in protection works?

<table>
<thead>
<tr>
<th></th>
<th>Ben</th>
<th>Cam</th>
<th>Com</th>
<th>Maur</th>
<th>Sén</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eco V. Million$</td>
<td>251.6</td>
<td>1,909</td>
<td>400</td>
<td>6,330</td>
<td>603</td>
</tr>
<tr>
<td>Protect Costs</td>
<td>215.3</td>
<td>44</td>
<td>82*</td>
<td>1,824</td>
<td>845</td>
</tr>
<tr>
<td>Actual GDP</td>
<td>2,650</td>
<td>10,181</td>
<td>218</td>
<td>1,064</td>
<td>4,971</td>
</tr>
</tbody>
</table>
Protection options

The concrete wall of Diokoul

Structure Design

10 years after!

Climate Adaptation Futures, Gold Coast (Australia), 29 June-1 July 2010
Failure of the concrete wall of Rufisque in August 2004
Climate Adaptation Futures, Gold Coast (Australia), 29 June-1 July 2010
Legal and institutional aspects

- **National laws**
  - Code du domaine de l’État (loi n°76-66 du 2 juillet 1976) : definition of the national maritime domain « the sea zones covered and discovered during the highest tides, together with a 100 m zone from the limit reached by the highest tides »
  - Mining Code which defines the conditions for sand extraction
  - Environment Code which defines the protected zones and environmental impact studies
Responsibilities
- Ministry encharged of environment
- Other Ministries (fishery, urbanism; equipment, mines, energy; tourism)
- The problem of competence transfer to decentralized structures
- Other authorities

Other concerned structures
- Commission on sustainable development
- Civil society and NGOs
- Associations and communities representants
- Private sector
Raising awareness

- Too weak sensitization
  - Sand beach mining
  - Buildings on the beaches
- The role of medias
Ces vagues qui font le bonheur des petits baigneurs causent périodiquement des ravages sur les maisons rufisqueaises du front de mer.

LA MER FAIT DES VAGUES
CINQ QUARTIERS RAVAGÉS A RUFISQUE

Cinq quartiers de Rufisque viennent d’être envahis par les eaux à cause de la mer en furie.
Les Rufisquois en ont perdu le sommeil. Cependant, une digue de protection est en construction pour contrer définitivement l’avancée de la mer. Le maire de Rufisque, Mbaye Jacques Diop a rendu visite hier aux victimes. M. Diop a promis à l’occasion, non seulement une aide matérielle, mais que tout sera fait pour trouver une solution durable à ce drame.

(LIRE PAGE 13)
Photo Hellio Van Ingen/FIBA

Climate Adaptation Futures, Gold Coast (Australia), 29 June-1 July 2010
The ACCC Program

Adaptation to Climate and Coastal Change in West Africa

UNDP/GEF-UNDP-UNESCO/IOC
Problem Analysis

Identified problem

Coastal erosion

Impacts on ecosystems, populations and economies

Responses of systems

Other factors

Climate Change

Sea level rise

ACCC Project

Increase response capacities

AMA, Ostende, 12-14 octobre 2009
Sites prioritaires : projet ACCC

Ile de San Antao
Vile de Porto Novo
Vile das Bombas

Ile de Maio
Ribeira da Lagoa

Presqu'île du Cap-Vert

Nouakchott

Niayes
Mboro
Kayar
Lac Ourossaye

Delta du Saloum
Differe à Palmarin
Ernela, Niodor, Palmarin
Sokone

Tanbi Wetland Complex

Bald Cape à Cape Point
Allahein Delta à Bald Cape
Mauritania

At site level: dune stabilization to fill the breaches
Sensitization
At national level: introduction of CC issues into the littoral law and the director schemes for the towns and national parks
At site level

- Mangrove restoration and dune afforestation

- inclusion of CC into local land use plans

At national level

- the littoral law
At site level:
- building of an ecotourism camp
- Extension of the Sandwatch programme
Cape Verde

At site level: remove invasive trees
Sensitization (5th of June)
Campaign for turtle protection

Integration of CC into local development plan
Guinea Bissau

Sensitization
Beach cleaning
Mangrove restoration and dune afforestation
Integration of CC into tourism strategy
Regional level

Capacity building
Communication: www.acce-africa.org
Regional cooperation
Transboundary activities (Sandwatch)

Creation of a network of parliamentarians and local decision makers for coastal states (APPEL)

Training workshop on dune afforestation techniques

Training on Sandwatch (www.sandwatch.org)
Recommendations

- Strenthening or creation of observation networks
- Favour planning options (director schemes, ICZM)
- Where it is necessary do a good choice of protection options
- Develop policies for integrated coastal zone management
- Better integration of local decision makers and populations
- Sensitization, information, education