Environmental / climatic changes
&
the people ...

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SHOULD I STAY OR SHOULD I GO ?
Case study # [1]

The poor population trapped in the coastal area of Cotonou affected by a rapid erosion

Introduction

Sea level rise is assumed to be the most direct mechanism of climate change, mainly by thermal expansion of ocean.

Sea level rise is said to cause most migration in the future. Without adaptation, 0.2–4.6% of global population is expected to be flooded annually in 2100 under 25–123 cm of global mean sea-level rise (Myers, 1993; Hinkel et al., 2014).

In some regions, it may be simply short translatory movements of populations along the coast.

The littoral of Cotonou (Benin) records a significant coastal erosion, mainly due to unsuitable port infrastructures and human activities, but that will be accelerated in the future by climate change (Ozer et al. 2013).

Objectives

Understand the dynamic of population in the coastal area of Cotonou exposed to a rapid erosion and put it in the context of the climate change:

- Assess the extent of the processes (coastal erosion and habitat’s destruction)
- Determine the vulnerable populations
- Identify the adaptation strategies by populations
- Know the responses to this process by authorities
- Underline the needs in the context of climate change
Data and method

Literature (scientific articles, reports, regional studies, press...)

Recent very high resolution satellite images from GoogleEarth

Field missions in 2012, 2013 and 2014
→ Pictures
→ Discussions with institutional actors, local authorities and researchers
→ Interviews of resident populations (20 individuals)

Study area

Main causes of the coastal erosion in Cotonou

The obstruction of the littoral transit by the harbor structures (built in 1962) and recently extended by Bolloré S.A. without any environmental impact assessment

The decrease in sedimentary inputs from the West due to dams on rivers and diverse coastal protection constructions

The sand quarries carried out on the beach
Significant change in the coast line

According to Codjia (1997), between 1963 and 1997, the shoreline retreated by 400 meters in the area east of the harbour of Cotonou, with a maximum speed of 36 meters per year, that is to say a loss of around 112 hectares of land.

Between 2002 and 2011, we have calculated a retreat of the shoreline by 100 meters in the same zone. Coastal erosion is observed until Nigeria, which is 27 km East of Cotonou, with an erosion of 30 meters in 10 years recorded at the border. This is a novelty because beyond the 6th km east of the groyne of Safiato, the coast was recording sand accretion between 1963 and 2000 (Kaki et al. 2011).

Two types of settlement and two types of population

Well-off population

Standing house

Precarious population

Making shift houses

Two processes of habitats’ loss

Houses destroyed by the encroachment of the sea

Houses destroyed by the authorities
Progressive destruction of standing houses

The well-off people generally leave the coastal area and go to live inland.

Fast destruction of makeshift houses

Makeshift houses destroyed by the sea in 24h (30-31 May 2014)

Dynamic of settlements

Progressive replacement of standing houses by makeshift houses near the coastline.
Who are the people trapped in the risk zone?

Fishermen

Precarious population

Characteristics and dynamics of the trapped populations

In July 2014, the most of the respondents were living for less than 5 years in their current habitat, nobody has a property title.

Fishermen
- Native of the region of Grand-Popo (on the coast 90 km West) or born in the area from parents native of the region of Grand-Popo
- Coming in this coastal zone in the 70's in order to have better live conditions
- Successive displacements in the zone because of the encroachment of the sea
- Currently settlement in makeshift house
- Not satisfied by the new infrastructures to protect the coast
- BUT want to remain close to the sea for their activities

In July 2014, the most of the respondents were living for less than 5 years in their current habitat, nobody has a property title.

Precarious population
- Coming in the zone because no money to go elsewhere
- Money for settlement but not rent
- Successive displacements in the zone if not recently arrived
- Life in very precarious makeshift house
- Want to leave the area but no financial means and no relatives to help/welcome them

In July 2014, nobody knew where they would go.

‘Measures’ taken by the population

Protection by ruins of standing house
- Very short displacements

Protection by bricks of destroyed house

All these ‘measures’ are temporary and allow at the best to gain a few months
Measures taken by the authorities

Local authorities

• According to district chiefs, the Government does nothing
• The wish of the town council of Cotonou is to solve the erosion problem
• Awareness campaign of fishermen. In some cases, local authorities try to persuade fishermen to go away from the sea

National authority

• In March 2009, under the pressure of NGOs, all marine sand quarries are closed (Decree No. 2008-615 of 22 October 2008)
• Since May 2014, 7 groynes are built at the East in the most exposed zone (45.4 milliards FCFA, financed by la Banque islamique de développement (Bid), la Banque Arabe pour le développement économique en Afrique (Badea), le fonds de l'Opep pour le développement international (Ofid), le fonds Saoudien de développement (Fsd), le Fonds Koweitien pour le développement économique arabe (FKDEA) and l'Etat béninois).

Protection by groynes

At the scale of a groyne, positive effect to the West but negative effect to the East

A the scale of the protected zone, the problem is transferred at the East of the zone with 7 groynes

What are the real issues in this risk zone?

• The coast of Cotonou is under the sea level
• A rise in sea level of 0.81 m is expected in 100 years
• There is a disproportionate population growth in the city of Cotonou (rural exodus) as in other coastal zones of West Africa
• Authorities have few means to prohibit new habitats near the sea seen that the land belongs to individuals
• There is no legal recognition of people displaced by natural phenomena
Conclusions

- Multi-temporal analyses of recent very high resolution satellite images from GoogleEarth show that there is a rapid process of settlement / destruction of makeshift houses by coastal erosion.

- Most poor respondents made several successive perpendicular or parallel displacements (sometimes more than 10) always in the coastal area and fear the future.

- Fishermen do not want to leave the coastal area to remain close to their activities and precarious population would leave but have no alternative.

- Need to find alternatives of the rehouse of poor population threatened by the erosion but difficulties because the city of Cotonou suffering of a disproportionate population growth and a lack of resources.

- Need to prohibit new installation/construction in the zone at the East of the 7 groynes but difficulties there is no repressive legislation.

- Need to integrate people displaced by natural phenomena in the legislation (Kampala convention).

B. Coastal areas: a global threat

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Estimations of sea level rise by 2100

- IPCC AR5
- Rahmstorf, 2007
- Horton et al., 2008
- Gehrels et al., 2007
- Vermeer and Rahmstorf, 2009
- Jevens et al., 2009

Potential impact of sea level rise: Nile Delta

Population: 3,800,000
Cropland (Km²): 1,800

0.5 m

Population: 6,100,000
Cropland (Km²): 4,500

1.0 m
De puissants hommes d'affaires américains appellent à lutter contre le réchauffement

Accord décisif sur le climat entre la Chine et les États-Unis

L'Europe se fixe un cap ambitieux sur le climat
Les trois engagements du G20 : croissance, transparence fiscale et climat

Au G20, difficile lutte pour un paragraphe sur le climat

Climat : l'Europe en avance sur ses objectifs de réduction de gaz à effet de serre
New record of CO2 emissions in 2013

In 2013, natural disasters have moved three times more people than conflicts.
In the atmosphere...

... more and more population...

X 2 between 1960 and 2000

World population (1961-2013) and forecast (2014-2050)
… more and more energy needs …

X 3 between 1960 and 2000
... exponential growth ...

... for growth, fossil energy is great ...

... But not eternal ...
L'effet de serre, c'est bon pour la vie.
Global carbon dioxide budget (1990s vs 2000s)

1990s: 39%

2000s: 47%

Global carbon dioxide budget (2010)

9.1±0.5 PgC y\(^{-1}\)

5.0±0.2 PgC y\(^{-1}\) [50%]

2.6±1.0 PgC y\(^{-1}\) [26%]

2.4±0.5 PgC y\(^{-1}\) [24%]

Calculated as the residual of all other flux components

5.0±0.2 PgC y\(^{-1}\) [50%]

Average of 5 models

Global Land & Ocean Temperature Anomalies (1880-2014), Jan-Oct
Warmest years:
- 2014
- 2010
- 1998

Global air temperature per decade from 1850 to 2010

Decadal average

Changes in Temperature, Sea Level, and Northern Hemisphere Snow Cover
Origine anthropique

• Always increasing trend of CO₂ concentration in the atmosphere.
• Same trends for methane et le nitrous oxide

D’après Petit (2003)
Heat wave
Europe, summer 2003:

79 000 deaths
(overmortality)
Rainfall changes in 2090-2099 Vs 1980-1999
Summer in the Northern hemisphere Nord (JJA).

Crop yields in a warming world
Many consequences

VIRTUALLY CERTAIN (> 99%)
VERY LIKELY (90% to 99%)
LIKELY (66% to 90%)
VIRTUALLY CERTAIN (> 99%)
Are we ready to change?

YES, WE CAN

Global fossil fuel CO\textsubscript{2} emissions

Fossil fuel CO\textsubscript{2} emissions vs IPCC scenarios

Emissions are heading to a 3.2-5.4°C "likely" increase in temperature
Global Carbon Project, 2013

Fossil fuel CO2 emissions (territorial)

CO₂ emissions (GtC/yr)

6 5 4 3 2 1 0
62% Annex B
Developed Nations

34% Developing Nations
Non-Annex B

4% International Bunkers


8.8 tons CO₂

2012

8.8 tons CO₂

7.1 tons CO₂

2012
Emissions fluxes in trade (Mt C y⁻¹)

China’s CO₂ % of global emissions
2012

8.8 tons CO₂

- 11.3 tons CO₂

7.1 tons CO₂

5.9 tons CO₂

± 11.3 tons CO₂

- 1.2 ton CO₂

BELGIUM


-4.8%
Emissions de CO₂ dues à la combustion des énergies fossiles intégrant les flux

- Territorial: full lines
- Consumption: light lines

Global Carbon Project 2013
Fossil fuel CO2 emissions per type

- Coal: 43%
- Oil: 29%
- Gas: 18%
- Other: 5%

Who is using coal?

China: 250 Tg C/y
India: 150 Tg C/y
Dev. world: -50 Tg C/y
World: 200 Tg C/y

Keep Calm. Everything is under control.
Are we ready to change?

YES, WE CAN

Bon appétit, les ouistitis!

Variations autour de **NOUS** et notre assiette
Entrée
16 000 km, 
Pour le transport aérien…
100 g par personne, 
Soit 10,2 kg de CO₂ pour 8 personnes
TOTAL: 30 000 km,
Soit 12 kg de CO$_2$ pour 8 personnes

Land use in 1973
11/02/2015

1 300 km, pour le transport aérien...
200 g par personne,
Soit 14,5 kg de CO₂ pour 8 personnes

3 200 km, pour le transport aérien...
100 g par personne,
Soit 2,1 kg de CO₂ pour 8 personnes
1 500 km, Pour le transport terrestre…
100 g par personne,
Soit 0,2 kg de CO₂ pour 8 personnes

PLAT PRINCIPAL :
16 000 km cumulés: 16,9 kg de CO₂

Dessert
Salade de fruits
SALADE DE FRUITS
DISTANCE TOTALE CUMULÉE ENTRE PRODUCTION ET ASSIETTE :
117000 km = 3 x le tour du monde

SALADE DE FRUITS
CHAQUE FRUIT = 100 g, soit une salade de fruits de 1200 g :
9.3 kg de CO2
Entrée - plat - dessert:
5,4 kg de nourriture
ou
163 000 km
ou
38,2 kg de CO₂

Soit les émissions de CO₂
d’une voiture sur 210 km,
soit 13 litres d’essence
Are we ready to change?

YES, WE CAN
Are we ready to change?

YES, WE CAN

La semaine du 11 au 15 octobre [2010], un maximum de 6078 km d'embouteillages pendant l'heure de pointe…

Cliquez ici pour lire plus d'informations sur les embouteillages.
L'affiche est toujours là... 7j/7, 24h/24... partout, souvent, puissamment.

5.000.000 de véhicules particuliers fin août 2007. Toujours plus de voitures sur nos routes, c'est toujours plus de files laissant plus de temps aux conducteurs de lire les messages publicitaires.
Febiac
Voitures et environnement (2008)

Are we ready to change?
YES, WE CAN
La semaine du 11 au 15 octobre [2010], un maximum de 6078 km d'embouteillages pendant l'heure de pointe…

4,1 tonnes de CO₂
3,2 tonnes de CO₂
1,3 tonne de CO₂
Are we ready to change?

YES, WE CAN

“Today, the situation is under control. Go back to your cabins.”

- Officer aboard the ill-fated Costa Concordia

Today...
Case study # [2]

KINSHASA (DRC)
Case study # [3]  

DJIBOUTI
Case study # [4]

NOUAKCHOTT
(Mauritania)
References


