LOCAL PERCEPTION OF CLIMATE CHANGE AND ADAPTATION IN MANGROVE AREAS OF THE CAMEROON ATLANTIC COAST

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ABSTRACT

Mangroves supply essential ecosystem services to tropical informal economies. In the Cameroon coastal region, the impacts of various projections on change in temperatures and precipitations sound low compared to the pressure of human activities. This survey evaluated the sensitivity of local population on the impact of climate change and the vulnerability of this coastal ecosystem. An investigation on 425 individuals was conducted on the following topics: the major income and development activities, the knowledge of the subject, the information sources, the origin of changes, perceptible effects, risks and consequences. More than 55% of interviewees have heard about climate change essentially from radio (20%). Industries (47.5%) are the main causes of temperatures (78%) and precipitations (67%) increased while inundation (39.1%) is constituted as the first risk. Compared with Cartesian predictions in the area, the results have shown the sensitivity of population to local variation of climate factors. No efficient endogenous measure of adaptation has been recorded. Forest and especially mangroves are the most affected ecosystems by local activities. Expected extension of the dry season could affect the natural regeneration and the structure of mangrove forests. Considering the importance of woody species in the local economies, the lack of appropriate actions and adaptation measures will lead to the total degradation of mangroves.

Keywords: Investigation, prediction, sensitivity, vulnerability, human activities.

1. Introduction

Several studies indicate that climate change is already taking place and the climate system is likely to experience some amount of change, regardless of whether emission reductions are successfully undertaken (Santer *et al*., 1996; Wigley *et al*., 1998). This means that each country must carefully assess how climate change may affect it, and how adaptations might be made. These national assessments are particularly important for countries that are vulnerable to current climate variability, environmental and growing socioeconomic pressures. As in some areas of Africa, Cameroon is characterized by a strong climatic variation since 1960. The rise of temperatures is sensitive on annual, seasonal and monthly scales. Significant studies on variability and the climatic fluctuations in relation to the development and the environment showed deficit in rainfall of about 20%; sometimes values higher than 25% on the Atlantic coast and in the forest areas which confirms that "wet" Tropical Africa is regularly under the effect of climatic variability (Otter *et al*., 2007).

Mangroves in Africa cover over 3.2 million ha, corresponding to about 20% of its global coastline coverage, with approximately 1.5 million ha located along the Atlantic coast (Massó i Alemán *et al*., 2010). As a consequence of the enormous anthropogenic pressures and multiple threats, a decline of more than 25% of the West African mangroves has been observed over the past 25 years (Giri *et al*., 2011). Rapid population growth has affected resources, including arable land, food supplies, water and energy, especially in developing countries where government policy-makers still pay little or no attention to protect these coastal ecosystems (Dahdouh-Guebas *et al*.,

2008; Walters *et al*., 2008). In spite of their biological, economical and ecological values, mangroves continue to be greatly degraded because of the sea level rise (Di Nitto *et al*., 2008; Gilman *et al*., 2008), herbivore pressure (Dahdouh-Guebas *et al*., 1997; Cannicci *et al*., 2008) and increasing anthropogenic disturbances (Valiela *et al*., 2001; Hauff *et al*., 2006; Duke *et al*., 2007; Din *et al*., 2008; Mohamed *et al*., 2009).

Cameroon harbours approximately 2 000 km^2 land-area of mangroves, distributed along the coast of the Guinean gulf (Din and Baltzer, 2008). Human activities appear to be the main factor influencing the structure and dynamic of mangroves. These disturbances in mangroves have been attributed to a combination of such factors due to the absence of adequate legislation regarding mangrove protection, and pollution in the peri-urban settings (Nfotabong-Atheull *et al*., 2013). The aim of this survey is to evaluate the sensitivity of local population on the impact of climate change and the vulnerability of this coastal ecosystem.

2. Material and methods

2.1. Study site

Cameroon has an extremely diversified landscape, including a variety of climatic and geomorphology zones. The study was carried out between Limbe and Kribi (Figure 1), dominated by two types of climate, influenced by the Harmattan and Atlantic monsoon winds. Heavy annual rainfalls are observed from Limbe (5 000 mm) to Kribi (3 000 mm). The tidal regime varies from 3 m (Douala) to 1.5 m (Kribi). The annual variation in salinity ranges between 0 and 20‰. The relative humidity is always closed to the saturation rate. The vegetation is consisted essentially of tree species, largely dominated by *Rhizophora racemosa* Meyer in all sites. The faunal components include vertebrates, (mammals, birds, reptiles and fish) and a wide range of invertebrates, mainly crabs and molluscs which constitute the bulk of benthic diversity in the region (Ngo-Massou *et al*., 2012).

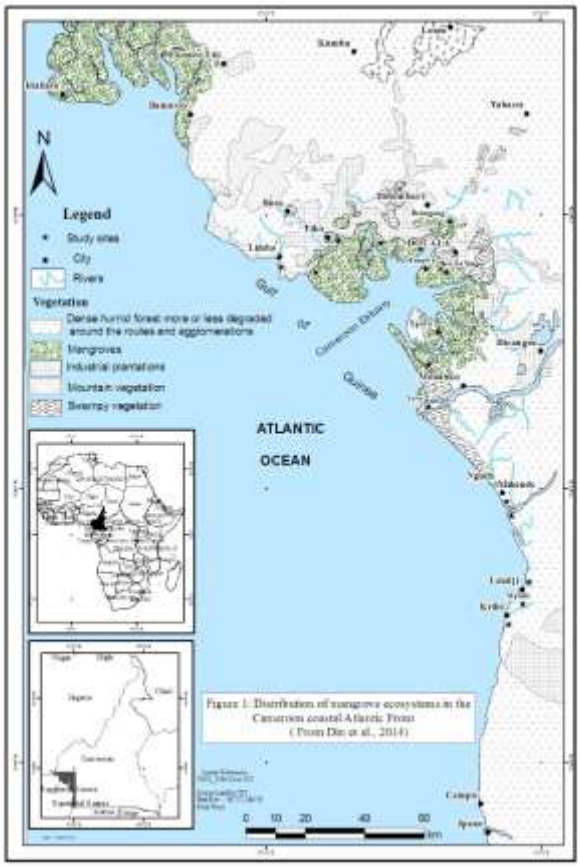

Figure 1: Distribution of mangrove ecosystems in the Cameroon Atlantic Front (From Din *et al*., 2014)

2.2. Data collection

Perception of climate change and adaptations were assessed using a participatory process associated with an analysis of climatic data. The questionnaire is a mixed type or semi-structured (Din *et al.,* 2008). Interviews were done in French, English and local languages with sometimes using the help of translators. A random sample of households was carried out. To avoid redundant information, only one person (>20 years) per house was questioned. The preference was given to elderly people who have been living in the area for more than a generation and therefore could relate changes that have occurred in adjacent mangroves to certain events or conditions. Interviewees were questioned on the following topics: the major income and development activities, the knowledge of the subject, the information sources, the origin of changes, perceptible effects, risks and consequences. Field data was analyzed simply with Excel 2010 software data base.

3. Results and discussions

3.1. Local perception of climate change

A total of 425 persons were questioned. The most practiced activities are trade in wood (24.5%), fishing (20.5%) and agriculture (19%). More than 55% of interviewees have heard about climate change essentially from radio (20%), followed by television (17.7%) and newspapers (15%). The effects of climate change felt are the rise in the temperatures (78%) and the rise of precipitations (67%). These effects have been felt for more than 10 years (72.7%). Contrary to scientific predictions, populations observed an increase of precipitations accompanied with the rise of floods frequency. Industries (47.5%) through gases emissions, followed by transport (29.3%) and deforestation (16.5%) are responsible for the changes according to the interviewees. The production of charcoal and firewood constitutes the most significant form of woody species exploitation. The coastal zone of Cameroon represents the major economic pole of the country and the increased of development activities is accompanied with the production of GHG which deteriorate the atmosphere layers and modify the climate characteristics.

The major risks from climate change according to the interviewees are inundation (39.1%), soil erosion (21.8%) and salt water intrusion (14.2%). Violent winds have also been sporadically mentioned. Inundation and erosion involved land lost as a result of sea level rise. Increased erosion could result in the removal of mangrove soils that lie above mean sea level, with subsequent deposition offshore (Ellison, 1992). Erosion along the seaward margin of the mangrove would also expose less productive anaerobic soils, leading to a better-oxidized and more productive soil system. As a consequence of deforestation, rapid erosion would occur, resulting in the formation of small cliffs in the seaward front. The salinity of mangrove creeks varies with time and location. The phenomenon of salt water intrusion occurs in all the rivers of the Cameroon Estuary and the predictions of changes will worsen the potable water supply in the dry season, especially in the Douala city which is the biggest town of the country.

3.2. Perception by gender

Only 17.8% of women noted that the climate of their area has changed against 82.2% of men. The most widespread channel of information is radio (women, 35.6% and men, 41.6%). This change has been felt since 5 years for 69.3% of women, and since 10 years for 52.3% of men. The ages of the individuals were gathered into three classes of amplitude 20 with a base of 20 years. The first class was the most represented (55.8%) while the class of 60 - 79 years was the least (17.9%). Nearly 62% of individuals in the first class, 27.5% of the second and 10.5% of the third were informed of the climate changes. The channel of information more used is television (46.3%) for the first class, the press (43.2%) for the second and the radio (54.2%) for the last class. Changes would have occurred since nearly 5 years (64.8%) for the 20 - 39, 10 years (47.2%) for people between 40 and 59 years and more than 15 years (59.5%) for people over 59 years.

3.3. Local endogenous measures

Facing climatic risks usually observed in the locality, people adopted various kinds of behavior to be considered as potential options of adaptation (Table 1).

Table 1: Local endogenous measures of adaptation

Major risks	Consequences	Endogenous adaptation measures
Inundation	Loss of land	Building of pile dwelling
	Disturbance of fishing and agricultural activities	Construction of small dams
		Trees planting
	Infrastructure damages	Dig out of gutters for the streaming water
		Change of activities
		Migration of the population
Soil erosion	Stranding of surface water	Building of pile dwelling
	Loss of soil fertility	Dig out of gutters for the streaming water
	Loss of the biodiversity	Trees planting
	Various conflicts with the access, stock management	
Salt water intrusion	Scarcity of potable water	Collect water only at low tide
	Sanitary disasters	Avoid children carrying water
	Diminution of agricultural products	Use of selected seeds
Violent winds	Perturbation of fishing activities	Select periods of fishing
	Damage of agricultural products	Building of hedges
	Infrastructures damages	Poles to support crops

It is recognized that efficient measures of adaptation led to reduction in the vulnerability. Few studies have been interested to the capacity of population reactions to the environmental constraints and the extreme climatic events. The options of adaptation could produce optimal results when they have been integrated into large scale policies, like the fight against natural disasters or regional planning of coastal development. On the field, in order to mitigate the effects of the floods, population selected pile dwellings or dams. In the plantations, the farmers protected their crops by building hedges to adapt to the winds which generally preceded heavy rainfalls. In all cases, local populations are always attentive to measures supported by Government or local council. Due to the low capacity of local population adaptation and the high exposure of coastal areas to climatic risks, this zone has been considered vulnerable.

4. Conclusion

Mangroves of Cameroon are only found in the Atlantic front. Predictions on climate change and sea level rise are already felt by local populations except the difference of appreciation on rainfall. Perception of climate change varied significantly by age and sex. The increase in frequency of floods and their impacts must be the relevant indicator for populations to refuse predicted rainfall deficits in the area. Expected extension of the dry season could affect the natural regeneration and the structure of mangrove forests. No efficient endogenous measure of adaptation has been recorded. Considering the importance of woody species in the local economies, the lack of appropriate actions and adaptation measures will lead to the total degradation of mangroves.

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