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PERNICIOUS DEGRADATION OF COASTAL ENVIRONMENT OF GABON: EXAMPLE OF THE NORTH COAST OF LIBREVILLE

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Abstract

Gabon has, between Cocobeach and Mayumba, the longest coastline (more than 800 km) of Atlantic equatorial Africa (Cameroon, Equatorial Guinea, Gabon and Congo). The socioeconomic development of Libreville, the capital city, has been reflected in the construction of a number of infrastructures (roads, administration, housing buildings) and the setup of numerous economic activities (sand extraction from the dunes, hotels, harbour and airport structures), mainly along the coast. At first sight, the coastal natural areas to the north of Libreville seem healthy, to the extent that the beaches of this sector are often stormed by visitors during the weekend. Nevertheless, some indications (stemming from basic chemical analysis of marine waters but also from the existence of numerous solid wastes) seem to indicate that this coast is affected by pernicious pollutions which cause, among others aspects, the degradation of coastal environment. Also, the country has been trying to set up, since 2009, an economic policy which includes the development of industrial activities, some of which will be settled along the coast. There are, in particular, projects of construction of the new port in deep water of Mayumba, on one hand and the setting up of a special economic zone at Port-Gentil, on the other hand. If these projects were to succeed, they would contribute to widen the area disturbed by human activities along the coast of Gabon. Given the above evidence, this work thus aims at drawing the attention of the highest authorities of the country for the setting up of a policy devoted to protect the coastal fringe which is, at global scale, an environment whose importance and fragility were highlighted in several studies.

Keywords: Atlantic equatorial Africa, Gabon, Libreville, coast, degradation, environment.

1 INTRODUCTION

The coast is a band within which the land-sea contact shifts. The physical features of this geographical area change under the combined influence of marine waters (sea level, waves, tides and currents), global climate, natural evolutions (geologic structure) and anthropogenic factors. Libreville is the capital city of Gabon which is located on the western coast of Africa. The main city of Gabon which is home to over half the population is established on part of the northern coast of Gabon. The increase of anthropological constraints during the last decades led to a massive occupation of the north coast of Libreville, from where three major hydrographic collectors pour on the shores solid and liquid waste stemming from the districts they cross. Several studies have been done on the coast of Gabon in particular for understanding new aspects of the coastal and submarine Quaternary in Gabon and neighbouring countries (Giresse, 1975). Other studies were interested in mangrove soils (Marius, 1971) and in the study of mangrove swamps themselves (Lebigre and Marius, 1981). The problem of sanitation in Libreville was treated, among others, in terms of solid waste (Edou, 2005). Even if we recall in the discussion the pernicious effects of the coastal erosion in Libreville, this work aims above all at drawing attention to the existence of a latent phenomenon which degrades profoundly the quality of littoral environment. The approach which consists in solving environmental problems by isolated recommendations is doomed to failure because of the scale of the problems and the fact that they are likely to worsen in a context of global climate change (Magnan, 2009). From this observation, it seems sensible to propose the implementation of a research program on coastal environments, the outcome of which could serve as decision-making tools during the elaboration of public policies.

The problem of sanitation and waste management concerns, in fact, all the countries of the sub-region. In Brazzaville the management of solid waste by municipalities is handled with great difficulty. Thus the wastewater produced by the main hotels and hospitals is rejected without processing into the natural environment (Moundza et al., 2008). While the problems related to the pollution of the most densely populated coastal stretches have not been solved, Gabon seeks to implement, since 2009, an economic policy which requires an expansion of industrial activities, some of which will be settled along the coast. Projects include the construction of a new deepwater port in Mayumba, on one hand, and the implementation of a special economic zone in Port-Gentil, on the other hand. If these projects were to succeed, they would contribute to extend the area disturbed by human activities along the coast of Gabon.

2 COASTS OF GABON AND LIBREVILLE IN PARTICULAR

Gabon has, between Cocobeach and Mayumba, the longest coastline (more than 800 km) of Atlantic equatorial Africa (Cameroon, Equatorial Guinea, Gabon and Congo). The morphology of the coastal region, located between 1°09' N and 3°55' S, comprises, from north to south, three main parts: (i) a *rias* domain with the estuaries of Muni, Mondah and Komo ; (ii) a central part marked by the Mandji island and the maritime and inland delta of the Ogooué river, and (iii) the southern coast, with coastal sand barriers that enclose numerous lagoons, and confer a rectilinear aspect to the coastline. The city of Libreville, which belongs to the northern segment of the coast of Gabon, spreads out on more than 40 km in length between Owendo and Cap-Estérias. The space between Port Mole and the “cite des Ailes” (about 10 km) provides the framework for a study on the different modes of pollution that affect the coast north of Libreville.

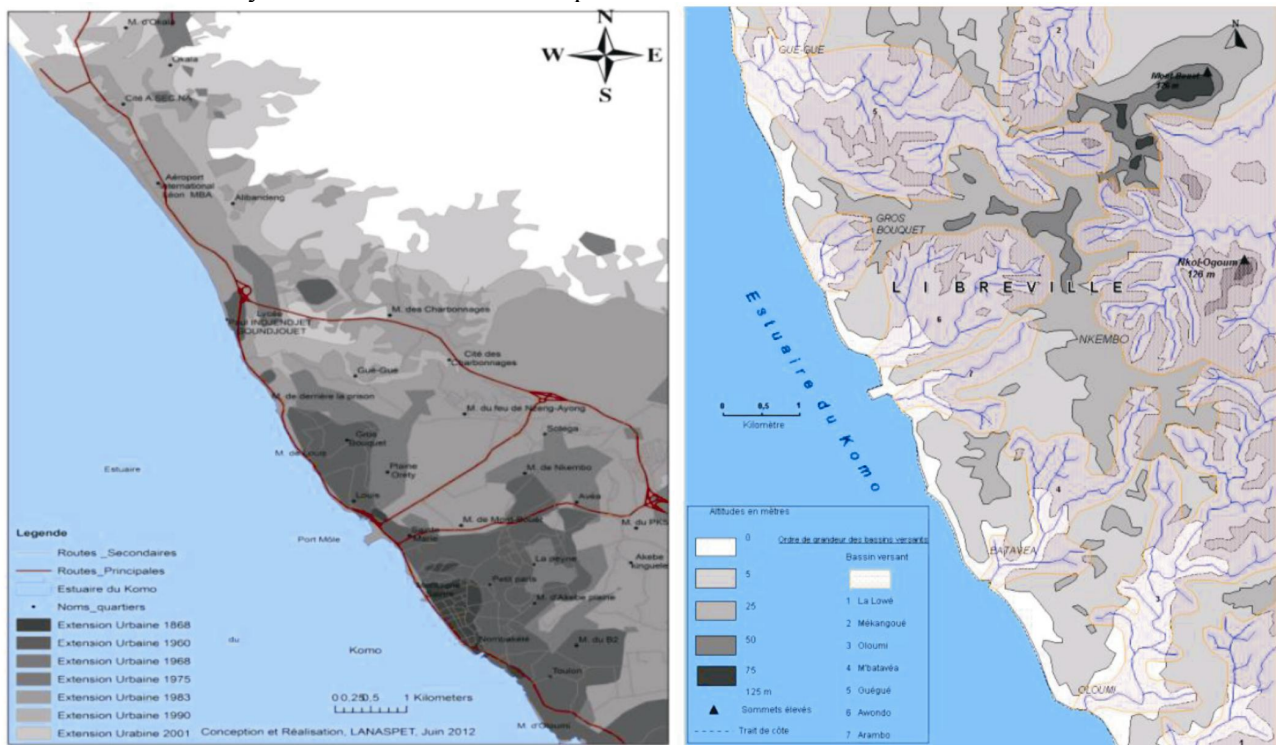


Figure 1. Study area of the north coast (a) and main river systems (b) of Libreville

The study area presents a coastline with a sandy beach where the limit of high seas is, in places, determined by numerous human settlements. Indeed, the seaside and its immediate neighbourhood (less than a kilometre on the mainland) have been the subject of a number of socioeconomic realizations. These include harbour infrastructures (Port Mole), airport (Léon Mba international Airport), road (the seaside boulevard) but also social structures such as schools (the Estuaire public High school) and hospitals (Jeanne Ebori). The neighbourhood of this coastline also includes some very rich districts (Louis, Batterie IV), private residences, hotel facilities (Tropicana, Maïsha) and some big restaurants of the capital (Dolce Vita, the Lighthouse of the wide) which have a sea view. Even if coastal human occupation was firstly made on the coast between 1888 and 1960, the north coast of Libreville and its neighbourhood were the subject of much more settlements during the 1980s (figure 1 a) and it is this movement which led to the creation of new districts in the North of Libreville (Sabliere, Angondjé). But the human settlements and the numerous socioeconomic activities set up along the coast influenced negatively the coastal environment.

3 TELLURIC POLLUTIONS ALONG THE NORTH COAST OF LIBREVILLE

The virtual absence of data as essential as those concerning the chemistry of waters is understandable by the lack of interest aroused by the mid-marginal Gabonese coast. Yet this part of the coastline still has the major interest of being little affected by man, while being partially threatened by its location near the major towns of the country, Libreville and Port-Gentil (Lebrigre, 1983).

3.1 The role of the rainwater and main hydrographic collectors in the degradation of the environment

Libreville is located in the wettest regions of Gabon; it almost rains all year long: the wet period lasts 9 months, with mean monthly rainfall totals over 50 mm (118 mm in September against 394 and 482 mm in October and November respectively). But high rainfall amounts are also recorded in December (304 mm), in January (258 mm), in February (251 mm), in March (355 mm), in April (337 mm), and in May (267 mm). The June-August period is the driest. This heavy rainfall feeds a dendritic river system (figure 1 b) of 108 kilometers long divided into 21 watersheds among which those of the Gue-Gue, the Awando and the Arambo which concern our zone and reach the coastline between the Egen fuel station in Sainte-Marie valley and the interchange of the airport.

These powerful collectors, in the zones of confluence with sea waters or the Komo estuary, deposit any sorts of solid waste and the urban effluents which are afterward spread along the coast by sea currents and waves. Figure 2 gives an idea of the solid waste deposited on the coast between the Gue-Gue bridge and “Cité des Ailes” (Okala). These uncontrolled dump sites, at the origin of an aesthetic pollution along the north coast, are mainly constituted of packagings (bottles), of foodstuffs such as drinks and oil which are contained in plastic materials.

Libreville being the shop window of Gabon, the presence of solid waste on beaches tarnishes the image of a country which says it wants to promote coastal tourism.

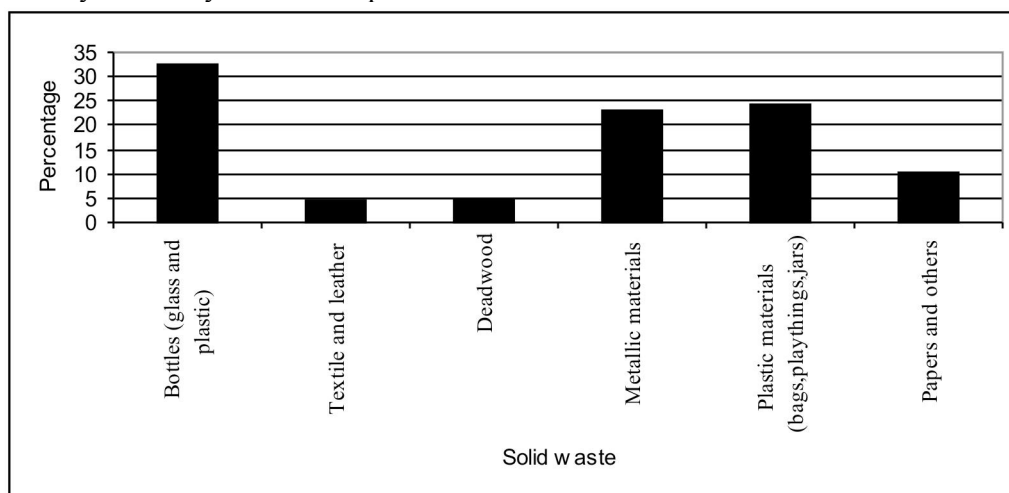


Figure 2. Proportions of various types of solid waste scattered along the north coast of Libreville

3.2 Deterioration of the water quality

To determine the drinkability of water three indicator microorganisms of pollutions are looked for. They are, in particular, total Coliforms, faecal Coliforms and Streptococci. Coliform bacteria exist in feces but can also occur in certain natural environments (waste water, soil, vegetation). Coliforms being bacteria living in the intestines of animals or humans, their presence in water indicates a faecal pollution. The main coliforme bacterium specifically of faecal origin is Escherichia Coli (E. Coli). Samples of water were taken from two streams (Awando, Sabliere) and the outflow from the army mess upstream to their confluences with sea. The results of the microbiological analyses of the various samples show some consistency. These analyses reveal the presence of faecal Coliformes (Escherichia Coli). Also, waters of Awondo and of the stream of Sabliere also present a contamination to total Coliformes and faecal Streptococci (Awando, only) which can provoke medical affections. Table 1 presents the results of microbiological investigations of the outflow from the army mess.

This microbial pollution results not only from waste water dumped on the coast by the big collectors of the study area (Arambo, Awando and Gue-Gue) but also by the drainage channels of the economic operators (restaurants, hotels) whose activities are adjacent to the coast. The same applies to the numerous private residences by the sea.

The absence of the water purification systems leads to blameworthy behavior from local residents who opted for the “whole in the sea”. That is why between the bridge of Gue-Gue and “Cité des Ailes” on

about 5 km, there are about thirty rivulets, originating from private residences and economic structures, which pour waste water into the sea.

The degradation of water quality also results from the pouring, even on a small scale, of residual water or industrial liquid effluents. Indeed, a drainage system evacuates waters used for car washing in fuel stations towards the sea. Actually, the analysis of waters collected in streams close to fuel stations along the coast (Engen and Total) indicates the presence of hydrocarbons. While the normal threshold is 0,1 mg / l, waters of the rivulet coming from the army mess (Plate 1) may contain 10 mg / l, that is to say 100 times over the standard. The link between the activities of the Total fuel station (near the Léon Mba international airport) and high rates of hydrocarbons found in waters which reach the sea in front of this station seems obvious. Besides, some beaches of the north coast have the peculiarity to have a greenish colouring which seems to indicate the presence of seaweeds favoured by the eutrophication of the environment. Only measurements at regular intervals, can detect a deterioration of environmental parameters in time and space.

Table 1. Results of microbiological investigations of the outflow of the army mess

Microbiological parameters	Raw water	Raw water quality thresholds
<i>Coliformes</i> /100 ml	62 000	50 000
<i>Escherichia Coli</i> /100 ml	34 659	20 000
<i>Entérocoques</i> /100 ml	5 712	10 000

4. DISCUSSION AND RECOMMENDATIONS

4.1 Elements of discussion

This work does not pretend to make a complete inventory of the various modes of pollutions of the north coast of Libreville because such a research requires resources which we do not have. The objective is to draw the attention of authorities on a problem which although sneaky is no less serious for the coastal environment of Gabon. In addition, the coastal areas undergo demographic, economic, and ecological pressure and coastal erosion of coast may constitute a risk to people and properties. These are particularly acute issues in in Gabon where almost three quarter of the population live between Libreville and Port-Gentil, both towns being located on the coastline. In fact, the problem of insalubrity in Libreville exceeds the limits of the coastal domain to the point that the Gabonese government had registered to the Council of Ministers of May 6th, 2010 the question relative to insalubrity in the municipalities of Libreville and Owendo [south of Libreville].

The elaboration of a Plan of Cleanliness for these municipalities was to completed by proposals relating to public awareness, together with sanctions to punish the uncivil acts of some city-dwellers. This plan was never born. Nevertheless, the degradation of marine waters by the liquid effluents can have a sanitary incidence on the numerous Gabonese people who take advantage of sea resources. Faecal Coliformes and faecal Streptococci (*Entérocoques*) found in waters which reach the coast result from an animal or human faecal pollution and demonstrate the potential presence of pathogens able to cause enteric diseases.

4.2 Recommendations

If there is one aspect of the knowledge of the coast which has been extensively studied in Gabon, it is that of coastal erosion (Mombe Nguema, 2000; Rabenkogo, 2007), which results in the retreat of the coastline (limit of most high tides) and the shift and modification of the landscapes. The dynamics of the coastline still deserves to be further studied for a better understanding of the evolution of the coastal system balance (Abdellaoui and Ozer, 2007). However, issue related to pollution, in connection with, among others aspects, sanitation, are less well documented.

The search for solutions to the problem of the pernicious degradation of the coast of Libreville should thus be done as part of an integrated management of the coasts of Gabon, which underlies a responsible and sustainable approach. The global consideration of human, economic, urbanistic and environmental parameters is a pre-requisite to guarantee the success of this new policy in favour of the preservation of the coastal environment.



Plate 1. Example of a polluting economic activity (Total fuel station of hotel Okoumé Palace) which pours small doses of hydrocarbons on the beaches of Libreville. Plate b illustrates the presence of an oil slick from the water outflow originating from the army mess.

Isolated solutions recommended by decision-makers for the management of coastal pollution are ineffective. It is desirable that the government implements a research program on environment around the main coastal cities (Cocobeach, Libreville, Port- Gentile, Gamba and Mayumba, to which could be added the city of Lambaréné located in the delta of Ogooué which is the main supplier of inland water – either safe or polluted - to the Atlantic Ocean in Gabon) (figure 3).

In a country where the “whole to the sea” made the ocean water a garbage dump, this program of research should, eventually, not only set up a network of observations of environmental parameters near the coastal cities quoted above, but also provide elements of decision for a policy addressing both the issues of the protection of urban or industrial areas as those of high environmental value such as the breeding grounds of tortoises lute on the beaches of Libreville and Mayumba.



Figure 3. Main coastal cities which may be involved in the research program on the coastal environments of Gabon

5. CONCLUSION

In the end, even if we stigmatized the degradation of coastal environments through unchecked deposits made of solid waste, this study first aimed at emphasizing the pernicious degradation of the coastline and its neighbourhood by wastewater discharged by natural water streams and the water outflow resulting from economic activities settled along the coast. Bacteriological analysis revealed the presence of a microbial pollution due to Coliformes and Streptococci which result from residual waters or from sewage. Also, waste water from garages and especially fuel stations contains hydrocarbons, in quantities reaching between 10 and 100 times above the normal threshold. The process of eutrophication of waters also favours the proliferation of green seaweeds. The pollution of the coastal environment in Gabon may not be so important than expected but only an absence of forward-looking vision may lead the country to wait until the last moment to fight against them. Only the implementation of a research program between Cocobeach and Mayumba can allow to issue policy decision elements for an integrated management of Gabon coast.

REFERENCES

- Abdellaoui (El) J. E., et Ozer A., 2007 : Etude diachronique et historique de l'évolution du trait de côte de la baie de Tanger (Maroc). *Revue Télédétection*, vol.7, n°1-2-3-4, 157-171.
- Edou M., 2005 : Gouvernance et gestion des déchets à Libreville, Le Gabon malgré-lui, *Rupture-solidarité*, n°6, Ed. Karthala, Paris, 141-158.
- Giresse P., 1975 : Nouveaux aspects concernant le Quaternaire littoral et sous-marin du secteur Gabon-Congo-Cabinda-Zaïre et accessoirement de l'Angola, *ASEQUA, Bull.*, 46, 45-52.
- Lebigre J.-M., 1983 : Les mangroves des rias du littoral gabonais, essai de cartographie typologique. *Revue Bois et Forêts des Tropiques*, n°199, 3-28.
- Lebigre J. -M. et Marius C., 1981 : Etude d'une séquence mangrove-tanne en milieu équatorial, baie de la Mondah (Gabon), *Symp. Internat. Lagunes côtières*, Talence, 10 p.
- Magnan A., 2009 : La vulnérabilité des territoires littoraux au changement climatique : Mise au point conceptuelle et facteurs d'influence, hypothèses de recherche. *Institut du développement durable et des relations internationales (Iddri)*, n°01, 30 p.
- Marius C., 1971 : Notes sur les sols de mangroves de l'estuaire du Gabon, Libreville, ORSTOM, 23 p.
- Mombe Nguema J., 2000 : Le traitement de l'érosion marine sur la côte septentrionale du Gabon : de l'embouchure de l'Ogooué à l'estuaire du Mouni. Université de Nantes, Thèse de Doctorat, 640 p.
- Moundza P., Samba G., Bal-kiabiya K., Dailly S., 2008: Brazzaville, croissance urbaine et problèmes environnementaux. *Revue Gabonaise de Géographie*, 3, 42-57.
- Rabenkogo N., 2007 : Le littoral du Nkomi : contribution géographique à la conservation des milieux naturels. Université Montpellier III- Paul Valéry, Thèse de géographie et aménagement de l'espace, 306 p.