

# Water, Salt and Nutrients Budgets of Two Estuaries in the Coastal Zone of Cameroon

C. E. Gabche<sup>1</sup> and V. S. Smith<sup>2</sup>

<sup>1</sup>IRAD – Fisheries and Marine Sciences Research Station, Batoke, P.M.B. 77 Limbe, South West Province, Cameroon; <sup>2</sup>Department of Oceanography, University of Hawaii, U.S.A. (Corresponding author's Email: [cemenegab@yahoo.com](mailto:cemenegab@yahoo.com))

## Abstract

A biogeochemical model of water, salt and nutrients budgets for two estuarine systems within Cameroon's coastal zone (Latitudes 2°-13°N, Longitudes 2°-16°E) of sub-Saharan Africa is presented. Data requirements for the budgets include a detailed description of the estuarine systems (Cameroon estuary; Longitudes 9.25° – 10.00° E+, Latitudes 3.83° – 4.1° N+, considered as a pollution 'hot spot' and the Rio-del-Rey estuary (Longitude 8.3° E+, Latitude 4.8° N+), considered as a relatively similar but less polluted area). Others include the salinity of the systems and adjacent ocean, volume of fresh water input and output, concentration of nutrients for systems, adjacent ocean, fresh water and other sinks and sources. Hydrological data used include river discharge, rainfall and evaporation obtained from Cameroon's meteorological service, government sources and research. Modeling methodology was according to the Land Oceans Interaction in the Coastal Zone (LOICZ) biogeochemical budgeting guidelines and Computer Assisted Budget Analysis, Research, Education and Training (CABARET) note. For two seasons, one layered and one box models were developed for the estuarine systems considered to be completely mixed. Other budget estimates are given on the Dissolved Inorganic Phosphate (DIP) and Dissolved Inorganic Nitrogen (DIN), non-conservative materials and stoichiometric calculations of aspects of net metabolism. These results are compared to those of other estuarine systems of sub-Saharan Africa and similar regions of the world. The results gave indications of the level of eutrophication of coastal and ocean ecosystems and the degree of impacts on aquatic living resources (e.g. fish species and their food within the ecosystems). Mitigation strategies and measures are proposed for the future.

## Introduction

The state of biogeochemical (nutrient cycling between living and dead organisms, along ecological food webs and the earth's inorganic materials) processes of estuarine and associated ecosystems (coastal lagoons, mangroves and deltas) is based on land-based, offshore influences and physical processes. For regions bordering the Gulf of Guinea Large Marine Ecosystem, over 60% of industries are concentrated along coastal estuarine systems (UNDP, 1993). Of the approximately 14 estuarine and associated systems of the Gulf, six are highly polluted in parts, with eutrophication being a problem. These ecosystems lie

along an approximate 25,000 km along west and central African zone of sub-Saharan Africa (Shumway, 1999). They are constantly facing threats of degradation from multiple based human impacts such as over fishing; use of chemicals (e.g. gamma line) in fishing; sewage discharge; pollution from pesticides, fertilizers and industrial wastes; conversion of land for agriculture, fuel wood, oil and mineral extraction, land for reclamation, deforestation, dam construction and freshwater diversion. These threats are exacerbated by the rapid expansion of the coastal human population, growing at twice the mean annual rate of 2.9% in the region, with related increase in