Ecological engineering to mitigate eutrophication in the flooding zone of the River Nyong Cameroon

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Abstract

The focus of this study is to put in place a management strategy to resolve the pollution and siltation that caused the spread of macrophytes on the river bed leading to the reduction of phytoplankton nutritional sources for fishes.

The eutrophication that is defined here by the frequency of macrophytes that grow on the bed of the river under the effect of phosphorus and nitrogen enrichment, is one of the eminent problems for the local community of Mbalmayo, Cameroon because of permanent anthropogenic pollution by waste from households, plantations, the market and the slaughterhouse. A worsening of the problem is likely due to the population growth and natural degradation of the banks of the river. The population growth in the Nyong River basin leads to exacerbated deforestation, recurrent pollution and siltation of the riverbed, resulting in sedimentation. It follows that sedimentation accentuates the growth of floating macrophytes and in turn causes a gradual reduction in the flow of the river.

These complex interactions between uses and ecological functions are therefore at the heart of the issue of sustainable and balanced management of the Nyong River aquatic ecosystem, which is discussed in this article. In order to achieve this research work, an in situ investigations have been carried out using Tchouaffé theory of change (TToC), and the result is that techniques of renaturation and creation of buffer zones are the appropriate techniques to resolve the eutrophication of the Nyong River bed.

Key words: Degradation, deforestation, eutrophication, renaturation, ecological engineering, climate change, pollu-

Introduction

The starting point of this research is the observation that the Nyong River can no longer satisfy the many uses of yesteryear; for example, the permanent supply of drinking water, irrigation, fishing, aggregates extraction, the capacity to receive urban or industrial discharges, navigation, etc. As well as many recreational uses related to the landscape or ecological quality of this aquatic ecosystem. These uses are most often closely dependent on functions that the ecosystem provides in a virtually free way: self-purification of surface water, recharge of groundwater in good quality water, flow regulation (limitation of extreme values), maintenance of the sedimentary balance, the quality of substrates and habitats, sustainability of ecosystems and original landscapes, etc ... However, most of these uses listed above impact the ecosystem of the Nyong River more or less strongly and sustainably.

Growing of macrophytes on the Nyong River bed is therefore a major problem due to permanent anthropogenic

Introduction (cont....)

pollution from household waste, Japanese market, plantations and the slaughterhouse. A worsening of the problem is likely due to population growth and natural bank degradation. The population growth in the Nyong River basin leads to exacerbated deforestation, recurrent pollution and siltation of the riverbed, resulting in sedimentation. It follows that sedimentation accentuates the growth of floating macrophytes and in turn causes a gradual reduction in the flow of the river.

OJECTIVES

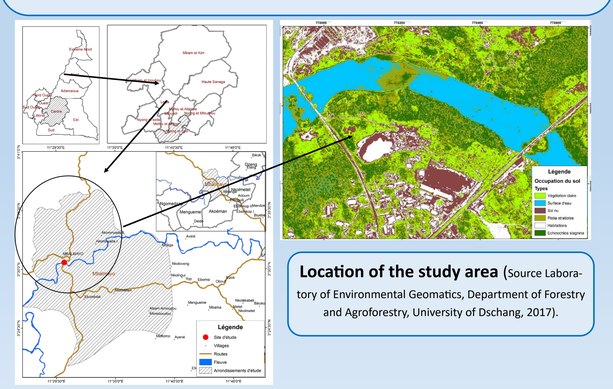
The main objective is to put in place a management strategy to mitigate eutrophication in the Nyong River flood zone.

To achieve this main objective, this research will consist of:

- Determining the current trophic status of the Nyong River in its stretch of Mbalmayo;
- Analyzing the typology of the actors and their roles;
- Presenting the utility of ecological engineering for controlling the eutrophication of the Nyong River;
- Applying ecological engineering to resolve the eutrophication

MATERIALS AND METHODS

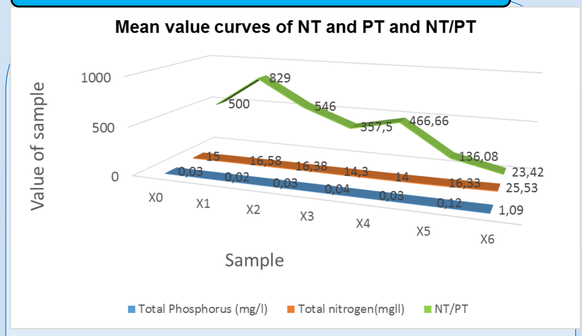
First, the activities carried out consisted of in-situ observations, physical -chemical analyzes of surface water and geo-referencing of impacted areas; and second, the activities ranged from semi-structured interviews, targeted focus groups (40 people),and applying TchouaffeTheory of change ('TToC) approach to select the potential actors.



Location of the study area (Source Laboratory of Environmental Geomatics, Department of Forestry and Agroforestry, University of Dschang, 2017).

RESULTS AND DISCUSSIONS

TROPHIC STATUS OF THE NYONG RIVER



According to Redfield (1958), in the pelagic ocean environment, the biological activity of phytoplankton had the effect of keeping this ratio approximately constant and close to his, 7.2 / 1 by mass (16/1 at atoms). This value is used as a benchmark by applying it to the total forms: NT / PT> 7.2 indicates a limitation by phosphorus, and NT / PT <7.2 a limitation by nitrogen.

It follows that all values of the NT / PT ratio are> 7.2 so the limiting factor of the Nyong River is phosphorus, factor to act upon in order to reduce the eutrophication of the Nyong River water body.

TYPOLOGY AND ROLES OF POTENTIAL ACTORS

Agent (Aa)/ Action (a)	Mayor 'M'	Farmers 'Agri '	Foresters 'F'	Fishers 'P'	Sand removers 'S'	Recherchers 'R'	NGO 'N'
Action of Mayor	management of agents						
Action of farmers	Codeci-sion	Farm organic management /Bio-organic					
Action of forester			Herbariu m planting				
Action of fishermen Pêcheur				Macrophytes harvasting			
Action of sand removers					Dredging of sediments		
Action of researchers						Buildi ng capacit y	
Action of NGOs							Sensitii sation
$F_{MAS=1}/n\sum$ Axa	Axa(M)	Axa (Agri)	Axa (F)	Axa(P)	Axa(S)	Axa (R)	Axa(N)
Performance of the	$F_{MAS}=\sum F_{Agents}+F_{Collectivs}$- $Sn^1/n_i=1/n(\sum Axa(i)+\dots+Axa(n))+1/n^1(\sum Axa(i)+\dots+Axa(n))$,using Tchouaffé theory of change : $P=[1/n^2\sum(A_{Agent})]x100$						

RISKS ORCHESTRATED BY THE POLLUTANTS OF NITROGEN AND

Too much nitrogen and phosphorus in the water causes macrophytes to grow faster than ecosystems can handle and they can severely reduce or eliminate oxygen in the water, leading to illnesses

ECOLOGICAL ENGINEERING TO REDUCE EUTROPHICATION

- Retention of nutrients:

It's difficult to transpose the experience acquired on extensive systems such as natural lagooning or filters planted with reeds to ZRVs(Buffer zones) because processing systems operate different from those of the ZRVs. A slight reduction in nitrogen fluxes from surface water can be expected if the passage times are not too short. In the case of permeable or highly permeable soils, large hydraulic transfers will lead to a deep leaching of the nitrates formed, the possible denitrification being considered negligible

- Pre-dam creation;

The primary objective of pre-dams is to prevent rapid siltation of the main reservoir by simply reducing the flow velocity and sedimentation of particles including those related to phosphorus. Intakes thus accumulate at the bottom of the basin and remain trapped there as long as the oxygen content is sufficient.

Treatment of tributary water or pipe: The physicochemical treatment of tributary waters upstream of the water can be done by setting up a dephosphatation station using Fe3 + or Al 3+ ferric ions as precipitating agent, followed by decantation.

Restoring the smooth functioning of the Nyong River

At the local level, the basic principle is to use buffer zones, whose main function is to filter the waters before their arrival in the aquatic environment. These buffer zones can be dry or wet (Grassed strips, vegetated ditches, Forest buffer zones (foresters), Artificial wet buffer zones (ZTHA) which is in an agricultural environment, a retention pond, an existing pond of variable depth and height of water, vegetated or not.

CONCLUSIONS AND RECOMMENDATIONS

Ultimately, this article puts within the scope of the Urban Community of Mbalmayo a tool for eutrophication management that requires the collective participation of potential agents such as fishermen, farmers, sand-removers, tradesmen, researchers and banks.The sand-removers who, by their activities, impact the water resources of the Nyong for the most part, will be able, in the framework of this study, to contribute to the protection of the banks, by planting the vetivers, the cleaning of the bed of the river by harvesting macrophytes that farmers can convert to bio-fertilizers. These macrophytes, once composted, can also be combined with sand to form bio-filters that will be essential for the treatment and purification of Nyong water.

It is recommended the renaturation or the creation of buffer zones. At the local level, municipal development plan and a full decentralization of river management from the periphery (Commune) at the national level.