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Environmental impact of water hyacinth prolifiration and control along the river Niger

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INTRODUCTION

The river Niger, with a catchment area of about 1,471,000 sq. km., is situated between latitudes 4° and 17° North, longitude 12° West and 15° East, from the Fouta Djallon Mountains, at approximately 800 m altitude, in the Republic of Guinea, where it takes its source, to Nigeria where it empties into the Atlantic Ocean (see Figure 1). It is the longest river in West Africa, about 4,200 km long, which is the third longest in Africa and the ninth in the world (NBA Documentary Report 1)

The river catchment area covers 9 West Africa and part of Central African Countries, namely: Benin, Burkina Faso, Cameroun, Chad, Cote D'ivoire, Mali, Niger and Nigeria. This countries constituted the Niger Basin Authority member countries.

The Niger Basin Authority (NBA)

The Niger Basin Authority (NBA), was formed as the custodian of the river Niger by its 9 member countries with the following main objectives:

> Maintaining co-operation, harmonisation and co-ordination of national policies for the development of the resources within the river Niger Basin.
>
> Planning and development of the Basin by preparing and executing an integrated development.
>
> Designing, realising, exploiting and maintaining common works and projects.

The Population

The population of the Niger Basin was estimated at more than 84 Million inhabitants as at 1980, distributed as follows : Bénin (1,950,000), Burkina Faso (2,400,000), Cameroon (2,100,000), Côte d'Ivoire (800,000), Guinea (2,500,000), Mali (4,000,000), Niger (2,700,000), Nigeria (67,500,000), and Chad (80,000), at an average annual growth rate of 3% (NBA Documentary Report 2).

The Climate

The Niger basin has three climatic zones viz the Guinea, the Sudanese and the Sahel, as well as two seasons, the rainy and the dry. The highest annual rainfall is found in Guinea

Climatic zone, ranging from 1,200 to 3,000 mm while the lowest of between 100 to 500mm, is found in the Sahel Climatic zone. Over 60% of the river drainage area falls within the Sahehian West Africa, see fig. 1. The Temperature could be as low as 6°C during the cool weather and as high as 46°C during the hottest weather.

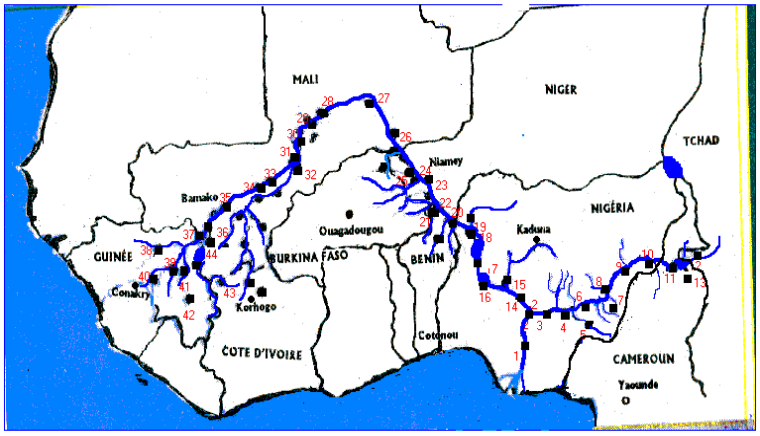

Figure 1. Hydroniger Data Collection Platforms Along the River Niger and its Major Tributaries.

River Niger Drainage Distribution

With an active drainage area of about 1,500,000 sq km, the river Niger drainage area cuts across the nine countries in West Africa and part of Central Africa, in the following proportion: Republic of Benin (2.5%), Burkina Faso (3.9%), Cameroon (4.4%), Côte d'Ivoire (1.2%), Guinea (4.6%), Mali (30.3%), Niger (23.8%), Nigeria (28.3%), and Chad (1.0%). It also cuts across part of Algeria. The river Benue is longest tributary of the River Niger, with a drainage area of about 450,000 sq km covering Chad, Cameroon and Nigeria

Table 1. River Niger Basin distribution in the 9 countries.

Country	Surface Area In Km²	Portion Of The Basin In The Country (%)	Portion Of The Country In The Basin (%)
Guinea	130 000	6	53
Mali	490 000	25	46
Côte d'Ivoire	20 000	1	6
Niger	430 000	21	34
Burkina Faso	75 000	4	28
Benin	45 000	2	41
Nigeria	650 000	32	66
Cameroon	90 000	4	18
Chad	10 000	1	1
Algeria	60 000	3	3

Source : Yaya Idrissa, Colloquium on the Safeguard of the River Niger, 1995

About 510,000 sq km of the basin is located in desert zone, with about 220,000 sq km in Mali and 230,000 sq. km in Niger. As a result of uneven water distribution, the Niger Basin is often sub-divided into 4 zones, namely: the Upper (covering part of Guinea and Mali); the Inland Delta (covering major part of Mali); the Middle (major part of Niger); and the Lower Niger (covering major part of Nigeria). Generally, the river is the most important source of water for irrigation, domestic water supply and hydro-electric power generation for the NBA member countries. Fig 2 shows the hydrograph of the river Niger at Niamey.

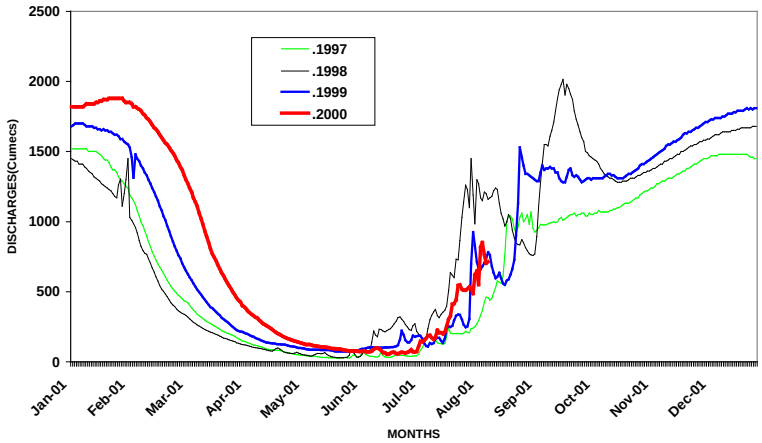

Figure 2. Comparative hydrographs of river Niger in Nimey, Niger.

Environmental Problems on River Niger

Most of the Upper, Inner Delta and the Middle Basins of the river Niger, that fall within the sub-Sahara region are highly susceptible to the harsh sahelian climate and desertification. Since most of areas are sedimentary, during the wet season, the rainfall which is usually very intensive with short duration, causes flash floods that often destroy houses, properties and farmland. Persistent flood occurrence is always noted at the downstream of the Niger basin, towards the Niger Delta in Nigeria, during wet seasons. Pollution of the river is from waste disposal, dumping of refuse, human and animal waste, fertilisers and pesticides used in agriculture particularly through rainfall runoffs. River Pollution through Oil Spillage is also very common in the Niger Delta part of Nigeria. Sedimentation has also continued to raise the river bed, exposing adjacent areas to inundation. Another serious problem facing the river Niger is the proliferation of water-weeds particularly water Hyacinth.

WATER HYACINTH PROLIFIRATION ALONG RIVER NIGER

The River Niger has been consistently infected by floating plants, the most widespread now a days, is the water hyacinth. The infestation starts from the upstream of the river within the Kabala pond at Sebenikoro in Guinea and move downstream through out the river course, up to the Niger Delta area in Nigeria. The rapid growth of this plant is as a

result of the increasing concentrations of dissolved organic materials, inorganic phosphorus and nitrogen as well as other suspended solids, deposited into the river mostly through rainfall runoffs.

Factor enhancing the Spread of Water Hyacinth

The high concentration of nitrogen and phosphorus levels in the river through pollution coupled with the huge sediment load, has been one of the major factors that enhanced the rapid growth and the wide spread of water hyacinth in the river Niger. The nutrients (nitrogen and phosphorous) increase the local food chain, providing a nutrient rich environment in which water hyacinth thrives.

Impact of Water Hyacinth on Environment

The plants clog and are also bind together by suspended sediments, to cover an expansive water surface layer thereby blocking incoming sunlight and sometimes paving way to eutrophication with its attendant negative consequences on fauna, flora, the environment and the ecosystem.

Absorption of dissolve oxygen : The growth of Water Hyacinth in a polluted environment causes high biomass production, which in turn consumes the majority of the dissolved oxygen (DO) in water, leaving the already stressed aquatic life consequently gasping for air.

Absorption of dissolved nutrient: The dissolved nutrient such as Nitrogen and phosphorous into the river are absorbed by the plant as a source of nutrient. The high density of the plant is always found in an environment where these nutrients are highly concentrated, consequently purifying the water body by removal of the dissolved Nitrogen and phosphorous water.

Heavy pollution due to Eutrophication development : In area along the bank of the river most where flow is almost static, eutrophication is often found to develop. This is almost similar to cases of eutrophication occurrence in lakes where dissolved nutrient are highly concentrated. The environmental becomes polluted with the foul smell of methane gas.

Blockage of Sunlight : As a result of covering a wide range of surface area of water body, the water hyacinth prevents the penetration of sunrays. The clogging of the plant with other suspended sediment, block incoming sunlight thereby reducing the penetration of dissolve oxygen (DO) in water, required for the survival of aquatic life.

Migration of Fish and Other Aquatic life : As a result of inadequate dissolved oxygen (DO) and nutrient in a water hyacinth water body, aquatic life such as fish migration to other areas for survival.

Problem on Navigation : The large expanse of water hyacinth over a wide surface area of water, prevents easy movement of boats. Navigation in such areas can be very difficult.

Endangering Hydro-Power Turbine : When water hyacinth enters into Hydro-power plant, it could clog the Turbine which could consequently get choked, and becomes reduced in performance and efficiency as well as the turbine life span.

Irrigation water quality : As a result of nutrient deficiency in water hyacinth infested river, the water quality for irrigation when using such water is usually reduced, and thereby reducing crop yield.

Mosquitoes and diseases : Water hyacinth infested areas are natural breading grounds for mosquitoes. Such area could be proned to diseases, most especially when water is not thoroughly purified before drinking. High rate of diseases is also known to have contributed to the high mortality rate and slow development and the resettlement in such areas.

Effect on the Economy : As a result of lack of adequate fish in river, fishermen and fish traders are usual out of job. Unemployment could become the order of the day.

WATER HYACINTH CONTROL STRATEGIES

Existing Methods

The existing methods of water hyacinth eradication are by physical, mechanical, chemical and biological methods.

Physical method : The most common control method of water hyacinth along the river Niger is by physical removal of the weed, using local the people and the fishermen. Hundreds of people are usually involved using tools such as racks, cutlasses to manually remove the weed and deposit them to the riverbank directly or using boats. The use of this method is very low that is extremely laborious and slow.

The Mechanical Method : One of the most common mechanical used for waterweed removal is by the used of the weed-mower. This is a boat equipped with racking and collection system that uproots the weed using through its racking system. It is one of the most efficient methods of waterweed removal. The machine is not yet common in the Niger Basin.

Chemical method : Chemical are some used to kill weeds and was sometimes said to be effective but also found to be dangerous because of its toxicity of such chemicals.

Biological Control : Biological method of waterweed control is often carried out using weevils such as neochetina bruchi and neochetina eichhoriniae (ABN-INFO). This method is not very common in the basin.

The NBA Approach

In trying to find an efficient and a more sustainable approach to the solution of water hyacinth proliferation in the river Niger system, the NBA looked into the possible ways the weed could be positively used to serve the communities particularly, in the rural ar-

eas. This therefore informed the NBA experimentation for the use of the plant for the production of biomas gas. Generally, from studies and researches carried out on the aquatic weeds, showed that water hyacinth has high energy storage through the its capacity to absorb heat energy and potential in producing methane gas which is highly combustible, in an environment of biodegradation.

NBA experiment was therefore in the areas of biogas production as a source of domestic fuel. The idea is to provide an alternative source of fuel to replace firewood at the local level.

The experiment carried out by the NBA focused on biogas production using the water hyacinth as the major raw material. which it could eventually become commercially viable and marketable. It could also become imported commodity to areas where they are scarce or even planted these areas. This way the plant will be totally eradicated.

The Water Hyacinth Biogas Production : The Material requirement is Water Hyacinth and Animal Waste in an anaerobic condition. There should be in enclosed decomposition chambers connected to a gas collection chamber. The decomposition chamber contained the sealed. This gas collection chamber can be fitted with tap and compressor for filling up gas cylinders for home use. Under normal condition, two 8 cubic meter anaerobic decomposition chambers can produce about 1500 cubic meter of gas daily.

The Water Hyacinth Biogas Characteristics : The gas production is under anaerobic decomposition of water hyacinth

The produced gas contains principally methane (CH4) and little amount of Carbon dioxide (CO2) and Water Vapour H2O.

The CH4 gas is highly combustible and if the CO2 and H2O are totally removed the gas would be more inflammable.

The gas production can continue as long as 40 days under normal anaerobic conditions before replacement of the raw material.

Advantage Biomas Gas Project :
Sources of Fuel for Domestic Use: The Biomas gas is a cheaper source of fuel for domestic use. Its introduction could drastically reduce the present over dependency of firewood for domestic use.

The Organic Fertiliser: The anaerobic decomposed residue is very rich in nitrogenous material and an excellent organic fertiliser.

Raw Material for Fire Extinguisher: The separated CO2 and H2O are good raw materials for the production of fire extinguisher.

The Poultry Feed: The anaerobic decomposed residue is a favourable breading ground for earthworms. The worms are important ingredient for poultry feed.

Electricity Production : A highly purified Biomas gas could be used for electricity generation.

Source of Fuel for Automobile: A highly purified Biomas gas could also be used for gas engines and vehicles.

Promotion of Afforestation: When the water hyacinth biomas gas is widely used, it would enhance the promotion of afforestion by its being an alternative to fire wood. In the sahelian areas, the few trees would be preserved while the desertification encroachment mitigated.

Disadvantages of Biogas

Difficulty in bottling the gas
Contains little CO2 and H2O
Methane gas are not produced immediately until after about 3 days of anaerobic decomposition.
Gas production decreases after about 45 days
The organic fertiliser from the bye product takes longer reaction time than chemical fertiliser

GOVERNMENTS AND INTERNATIONAL SUPPORT

Support from Governments

The Governments of the NBA member Countries have been striving hard to find solutions to various problems facing the river Niger. For instance, in 1985, the 4th Summit of the Heads of State and Government of the NBA member Countries that was held in Nigeria, discussed with great concern the particular alarming hydraulic situation of the river Niger and its catchment area, following the impact of the pollution, flood, draught, desertification and water hyacinth encroachment, with its attendant environmental degradation.

The consequently mandated the NBA to provide potable water to the rural communities, under the village water program. Hydroniger National and Inter-state forecasting centres were also established to effectively monitor the river Niger and provide real time data necessary for the water resources development of various countries. The recent NBA member Country Council of Ministers meeting held in Garoua, Cameroun also implore the organisation to look into the various ways of combating the rapid infestation of water hyacinth along the river Niger system.

Support from International Communities

As a result of the possitive result obtained from the biogas experiment, a joint working collaboration between the NBA and the UNICEF is underway, for the construction of water hyacinth biogas system at Yantala hospital and the Orphanage Centre, in Niamey. This is an assistance to provide hospital and the orphanage with a source of cooking fuel.

A workshops and training are also to be planned for not only for the rural dwellers but the urban as well in order to bring this initiative to their doorstep. All these can not be effectively carried out without adequate support from donor organisations.

CONCLUSION

The present environmental degradation as a result of the continuous proliferation of water hyacinth within the river Niger system, had been a matter of serious concern and worry to Governments, International Organisation, Donor Agencies and even Scientists. The negative impacts of these problems are not only on fauna, flora, environment and but the ecosystem as well.

Although the NBA biogas project is still at its infancy, the joint working coorperation between it and the UNICEF to eradicate the weed and serve the people is highly laudable. The NBA needed support from other Donor Organisations to achieve its set objective such as the village to village program on Biomas gas training. This could not only serve to provide alternative to firewood, but also has potential of providing employment opportunities particularly, in the rural areas and above all, total eradication of water hyacinth.

With an improvement on the present method of biogas production, biogas electricity and fuel for gas engine are feasible in the very near future.

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