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Preliminary phytochemical and antimicrobilal screening of ficus exasperata vahl (sandpaper).

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Abstract: The fresh leaves of *ficus exasperata vahl* were phytochemically screened and also investigated for the presence of certain biologically active compounds when both aqueous and petroleum ether extracts were tested on two respiratory infection isolates, streptococcus pneumoniae and streptococcus pyogenes.The phytochemical analysis results showed the presence of alkaloids, anthraquinones, flavonoids, glycosides, saponins, steriods, terpenoids, carbohydrates and tannins. The antimicrobial activities of the aqueous and petroleum ether extracts were determined by broth disc diffusion and agar diffusion methods. Only the petroleum ether extract showed significant activity in the inhibition of the growth of the test organisms.

Introduction

Sandpaper (*ficus exasperata vahl*) is a deciduous tree with an average height of 20m in forest, but only just about 2m in secondary forest regrowth where it occurs as a shrub.

The stem is round, soft, smooth and greyish, producing a creamy slash and a gummy exudate. The leaves are alternate, and their shape varies from ovate to obviate-elliptic or even lobed in young plants. Lamina is 3-17cm long and 7.5-11cm broad and borne on petioles of 1.5cm long (Adam, et al. 1964). Surface of lamina is very rough, with 3-4 pairs of prominent, up-curving veins. The fruits are glaborous or sub-glaborous fruits measuring 1.3cm in diameter and very rough like the leaves.

Locally, the sandpaper (*ficus exasperata vahl*) is known in different parts of Nigeria as Kausa or Baure (Hausa), Asesa (Igbo), Ipin or Erapin (Yoruba). It belongs to the Rosales order in the Moraceae family and is commonly pollinated by kadiba gestrai (Awake, 1998).

Across the African continent, *ficus exasperata vahl* is found widely distributed in forest and savanah regions. It is found in Mozambique, Zambia, and Northern Angola through to Senegal, and Ethiopia. It is also found in the Southern parts of the Arabian Peninsula and India. In Nigeria, the plant is widely distributed in all parts of the country (Sofowora, 1998, Bhavnani, et al. 2000, Nair and Charda, 2004).

Medicinal plants (herbal medicine) is still the mainstay of primary health care for most Nigerians, particularly the rural and semi rural dwellers. This is due to better cultural acceptability, comparative cheapness, carry over dependence, better compatibility with human physiology and fewer side effects. Also, the last few years have seen a major rise in their exploitation and use in the developed world (Iwu.1989, Iwu et al, 1999, Ibe and Nwufo, 2005,).

In traditional medicine, the leaves and bark of the sandpaper tree are prepared by decoction alone or in combination with other plants and have been used locally in the treatment of cough, diarrhoea, tuberculosis and abdominal pains (Bhavnani, et al. 2000, Nair and Charda, 2004).

The efficacy of *ficus exasperata vahl* for the treatment of respiratory infections necessitated this study to investigate the active ingredients present in the leaves only that could be used for the treatment of respiratory and probably, other infection.

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Material and Methods

Collection of plant materials

Fresh leaves of the plant were collected from some farmlands located in Bosso area of Niger State, Nigeria. They were washed with water, and transported to the chemistry laboratory, Federal University of Technology Minna, the leaves were air-dried under aseptic condition and pounded in mortar.

Preparation of the plant extract.

Two solvent were used, aqueous and petroleum ether using soxhlet extractor (Parekh et al. 2005).

Aqueous extraction.

40g of pounded *ficus exasperata vahl* leaves were weighed into 500ml distilled water, thoroughly stirred and allowed to stand for 24hrs. The mixture was then filtered and the filtrate was concentrated over water-bath (Harborne, 1984 (a)). This was then subjected to various analysis.

Petroleum Ether Extract:

10g of the pounded leaves were weighed into a soxhlet apparatus and extracted with petroleum ether (60-80oC) till the colour changed to colourless. The extract was then concentrated over water-bath after which it was kept for further analysis in covered and well-protected petri dishes.

Phytochemical Screening

Using standard analytical methods and reagents, the extracts were subjected to various tests for the presence of alkaloids, Anthraquinones, fluronoids, glycosides, saponins steroids and terpenoids, carbohydrates and tanins (Richard and Cannel, 1998, Harborne, 1964 (a), Baker et al, 1952, Base-Smith, 1962, Base-Smith, 1972, Harborne, 1964 (b), Harborne, 1984 (b)).

Chromatographic Analysis

Column and paper chromatographic analysis was carried out on the leaf extracts of the plant. A glass column was packed with silica gel in n-hexane. Solution of the extracts were then introduced and eluted with hexane-benzene-ethanol mixture (20:5:1) Each of the fractions collected was concentrated and phytochemically analysed.

Antimicrobial Susceptibility Test

Two respiratory infection isolates streptococcus pnuemoniae and streptococcus pyogenes obtained from the Microbiology Department of the Federal University of Technology, Minna, were used for the antimicrobial susceptibility. All cultures were checked for purity and maintained in nutrient broth slants (Parekh, et al, 2005).

Media Used and Preparation

Nutrient agar and nutrient broth were the media used for culturing the bacteria samples. 5g of nutrient agar was dissolved in 200cm3 of distilled water and sterilized. 6.5g of nutrient broth powder was dissolved in 500cm3 of water. The broth was pippeted into clean flavour bottles, properly covered, wrapped in aluminum foil and sterilized in an autoclave for 20 minutes.

Inhibiting Effects of THE LEAVES Extracts on Bacteria (Assay of Extracts).

Inhibiting activities of the leaves extracts were tested on respiratory infection organisms, streptococcus pnuemoniae and streptococcus pyogenes by inoculating the surface of already prepared nutrient agar with the isolates. Whatman's filter paper No 1 (6mm in diameter) was soaked in each of the extract and dried for 2 minutes and placed on the surface of the inoculated

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plates. This was then incubated at 37°C for 24 hours after which it was observed for any clear zone of inhibition.

Results and Discussion

Table 1 shows the result of the physical analysis of the extracts of the leaves of *ficus exasperata vahl*. The petroleum ether extract gave an oily deep blue-black colouration resin with a sharp odour. While the acqueous extract gave a dark-reddish-brown colouration with a pungent odour. This colouration in both extracts indicates the presence of Flavonoids (Harborne, 1964). The aqueous extract also showed a weak acidic properties with a pH range of 4.5 - 5.0.

Table 1: Physical appearance of leaves extracts of ficus exasperata vahl.

Extracts	Observation	Indication
Petroleum ether	Oily, deep blue-black gummy Resin with sharp odour.	Presence of Flavonoids in broth extracts.
Water	Dark reddish-brown with Pungent odour	

The phytochemical analysis of both the petroleum and aqueous extracts indicated the presence of saponins, alkaloids, flavonoids, carbohydrates, glycosides, steroids, terpenoids and tanins (Table 2). While the petroleum ether extract indicated high presence of terpenoids, moderate of saponins and tanins, the steroids and alkaloids were minimal. On the other hand, the aqueous extract indicated high presence of saponins, moderate of terpenoids, moderate of flavonoids and tanins. The glycosides and carbohydrates were also minimal. This tends to suggest that the type of natural products extracted is dependent on the type of extractant used.

Table 2: Phytochemical Analysis of the leaf extracts of ficus exasperata vahl.

Classes of natural products	Extracts	
	Petroleum ether	Aqueous
Alkaloids	+	-
Carbohydrates	-	+
Flavonoids	-	++
Cardiac glycosides	-	+
Saponins	++	+++
Steroids	+	-
Terpenoids	+++	-
Tanins	++	++

Key +++ = Highly present, ++ = Moderately present, + = Minimally present
- = Not present.

The results of the Phytochemical screening of the column extracts (Table 3), helps to reaffirm the presence of the natural products identified in table 2, with the n-hexane: ethane column extract given the highest number of natural products. When the petroleum ether extract was Chromatographed in butanol : acetaic acid

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water (20:10:1), three spots were obtained whose RF values were 0.92, 0.89 and 0.77 respectively. Which may be due to the cyanidin glycosides (Simonson, 1952).

Table 3: Phytochemical Analysis of Column Eluent.

Classes of natural products	Solvents		
	Hexane: n-butanol	Hexane: Acetic acid	Hexane: Ethanol
Alkaloids			+
Carbohydrates	+		+
Flavonoids	+		+
Saponins	+		+
Steroids		+	
Terpenoids		+	
Tanins		+	

The results of the antibacterial activity are shown in table 4. The petroleum ether extract showed antibacterial activity on both organisms, but the aqueous extract was only active against the growth of streptococcus pnuemoniae.

This phenomenon may have been due to the inability of the aqueous solvent to have extracted some of the active compounds in the leaves that could inhibit the growth of streptococcus pnuemoniae. This is also in line with the view that the successful prediction of the botanical active compounds will largely depends on the type of solvent, the extraction methods and the polarity of the compound being extracted by the solvent. (Harborne, 1984 (a)).

Table 4. Antimicrobial activity of extract of Ficus exasperata vahl on identified Microbes

Bacteria	Petroleum ether extract	Aqueous extract
Streptococcus pneumoniae	+	+
Streptococcus pyogenes	+	-

Key: + = Active - = Not Active

Generally, the activity of *ficus exasperata vahl* extract is attributable to the presence of saponins, tanins and terpenoids. Since saponins have been observed to be responsible for the toxic and stimulating activities of some medicinal plants (Paraya, et al. 1983).

Conclusion

The results from this work indicates that *ficus exasperata vahl* leaves have high content of natural products, whose extracts are active on streptococcus pnuemoniae and streptococcus pyogenes with the petroleum ether extract being more active than the aqueous extract. Therefore, leaves extracts of the plant are susceptible to have therapeutic effect against respiratory infections, especially those caused by streptococcus pnuemoniae and streptococcus pyogenes. Although the aim of the work was only to investigate the rationale behind the use the plant locally for the treatment of respiratory diseases caused by these

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microorganisms, it is suggested that further work be done to include more microorganisms responsible for other diseases. It is also suggested that LD_{50} levels of these extracts be investigated in order to establish the widely acclaimed toxic nature of *ficus exasperata vahl.*

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Reference

Adam, C.E., Bradford, K.M. and Early M.P. (1964) Principle of Horticulture, 2nd edition, Cambridge university press, London, UK.

Awake, May 1998; Can the Rainforest be sooed?; Journal of the Watchtower Bible tracts Society of New York, USA.

Baker, W., Harbrne J.B. and Ollis, V.D. (1952). Journal of Chemical Society. 3: 215.

Base-Smith, E.C. (1962). Lim Soc. Bot., 58, 39

Base-Smith, E.C. (1972). Phytochemistry, 12, 907.

Bhavnani, S.M. and Ballow, C.H., (2000). New Agents for Gram-positive Bacteria. Curr. Opin microbiol. 3: 496-501.

Harborne J.B. (Ed) (1964 (a)). Biochemistry of Phenolic Compounds, Academic press, London, UK.

Harborne J.B. (Ed) (1964 (b)). Comparative Biochemistry of the Flavonoids, Academic press, London, UK.

Harborne J.B. (1984 (a)). Phytochemical Methods, 2nd ed, Chapman & Hall, London, pp 60, 69, 87, 94.

Harborne J.B. (1984 (b)). Phytochemical Methods, 2nd ed, Chapman & Hall, London, pp 5.

Ibe, I. And Nwufo, C. (2005). Identification, Collection and Domestication of Medicinal Plants. African Fep publishers, Ibadan, Nigeria. pp 70-77.

Iwu, M. W. (1989). 'Food for Medicine' in M. Iwu (Ed), Dietary Plants and Masticatories as sources of Biologically Active substances; University of Ife press, pp. 303-310.

Iwu, M.W., Duncan, A.R. and Okonji, C.O. (1999). 'New Antimicrobials of Plants Origin' in Jarick, J. (Ed), Perspectives on New Crops and New uses, ASHS press, Alexandria VA. pp 457-462.

Nair, R. and Charda, S.V. (2004). Antibacterial Activity of some Medicinal Plants of the Saurashtra Region. Journal of Tissue Research. 4: 117-120.

Paraya, T., Yoshikawa, T., Orihora, Y. and Oda, H. (1983). Planta Medica, Journal of Medicinal Plants Research, Vol. 48 pp 83.

Parekh, J., Jadeja, D. and Chandu, S. (2005). Efficacy of Aqueous and Methanol extracts of some Medicinal Plants for potential Antimicrobial Activity, Turkish Journal of Biology. 29: 203-210.

Richard, J.P. & Cannel, E. D. (1998). Natural Products Isolation, Hamana press, New Jersey, USA. pp. 75-77.

Simonson, J.L. (1947-52). The Terpenes, Cambridge university press, Cambridge, UK.

Sofowora. A. (1982). Medicinal Plants and Traditional Medicine in Africa. Wiley Interscience, New York. Pp 142-145.

IMPACT OF HUMAN ACTIVITIES ON WATER QUALITIES AND SUSTAINABLE WATER DEVELOPMENTAL PROGRAMMES IN NIGERIA: A REVIEW

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Abstract

Water occupies the largest volume of space in the world, and serves as the most prominent sustainable factor for the existence of life. However, human activities have altered the qualities and quantities of most water bodies in Nigeria, in particular and the whole world in general. For instance, construction of dams has led to changes in the physical and chemical composition of the aquifer, which has consequently given rise to the growth of weeds that have rendered most water bodies unfit for navigation and agricultural activities. Industrial effluents, detergents, agricultural chemicals such as fertilizers and pesticides, as well as other surface run offs from industrial and farmland areas serve as ready reservoirs containing high concentrations of toxic elements and contaminants that could be harmful to life. This is a review of some of these activities of man that render such water bodies unfit for human use. This review has also shown that there is necessary need for government regulatory bodies and agencies on management of aquatic resources to make laws that will ensure safe water for consumption in Nigeria.

Key Words: Aquifer, effluents, navigation, aquatic.

INTRODUCTION

The most prized resource of any country in the world is water. This may not, however generally be realized until its uses are threatened by reduced availability or quality. Water occupies a prominent position among the people of the world (both rural and urban dwellers) and without it, life, in any form, is not possible (Lohani, et al., 1978). It may be said to have been the single most dominant factor in the settlements, civilizations and growths of ancient empires and kingdoms. For example, the Nile River provides the two basic necessities of human existence for Egypt and much of Sudan (Robert, 1988). Even in the modem ages, human settlements still tend to have been limited to those areas where water supply is relatively in abundance as it is not possible for man to survive where there is no water and to multiply without fertile lands that are adequately watered.

In most cases, the major quantities of water supply of these settlements come from the surface (oceans, rivers, prepared catchments, storage reservoirs and lakes) and underground (wells, natural springs, shallow wells, deep and artesian wells and horizontal galleries) sources (Kalmbach, 1982). The availabilities of water from these two sources vary with both season and the nature of the soil of a given region. Hence, depending upon the technological advancement of a given country, these two sources are heavily used for community water supply with the ground water lending itself more readily to smaller communities while the larger municipalities use surface water as their major source of water supply (Offodile, 2002).

The most important challenges of today's water resources management throughout the world are considered to be water scarcity, environmental degradation, economic development and ineffective administration. Sustainable development in general offers a scientific, economic and social alternative approach that ensures the healthy coexistence of mankind and the environment. The questions arising on the use of water these days concern the prospect of sustainable water management as well as the shifts that the whole process will require at the environmental, economic, social, administrative and political levels. It is therefore a great challenge to us that to have sustainable water resources management, recovering of costs, policy integration, and participatory planning, there is need for an envisioning programme that will ensure long-term water supply with the right balance between the expansions of water supply projects and water conservation (Yannis, 2003).

Importance of both Surface and Ground Waters

Both surface and subsurface waters are the direct sources of our developed water resources (Glenn *et al.*, 1981). Surface waters exist in natural basins and stream channels. In areas where flows in streams or rivers are large in relation to water demands of adjacent lands, towns and cities, development of surface water is accomplished by direct withdrawal from flow. Reservoirs are however, constructed to hold flow during seasons or years of high run off and later release for beneficial use. In most cases, these reservoirs do incorporate hydroelectric, flood control and recreational features in addition to their water supply function. They may include such functions as irrigation and fisheries. These reservoirs range in size from several million hectares for large multipurpose reservoirs to small ponds. Good examples of large multipurpose reservoirs are Grand Coulee and Hoover Dams in the United States of America, which are 168 and 221m high with storage capacities of 0.74 and 3.46 million hectares respectively (Glenn *et al.*, 1981).

Usually the subsurface water available for development

is referred to as ground water, which predominantly results from precipitation that has reached the zone of saturation in the earth through infiltration and percolation. While, groundwater is developed for use through well, springs and dugout ponds. However, in areas where groundwater is an important source of water supply it is being withdrawn much faster than being replenished from infiltration and percolation of precipitation which consequently results in ecological effect on the environment.

The Hydrology and Water Resources of Nigeria

Nigeria is a West African country covering an area of about 200,000 km^2 (Ademiluyi, 1988) with an estimated population of about 140 million people. It lies between longitudes 2° 49'E and 14° 37'E, and latitudes 4° 16'N and 13°52' N of the equator. The climate is tropical, characterized by high temperatures and humidity as well as marked wet and dry seasons. The durations of these seasons however, vary from the South to the North with decrease in the rainfall from the coast northwards. The South has an annual rainfall ranging from 1,500 to 4,000mm, while the extreme North has between 500 and 1000mm annual rainfall (Ita, 1993).

The country is endowed with both surface and underground water with the latter being about 30 times the former (Ademiluyi, 1988). These water resources form a vast expanse of inland freshwater and brackish ecosystem although their full extent cannot be accurately stated as they vary with season and from year to year depending upon rainfall. These water resources are however, spread all over the country from the coastal region to the arid zone of Lake Chad basin (Ita, 1993).

Two great river systems, namely, the Niger- dominate the hydrology of Nigeria and with the exception of a few rivers that empty directly into the Atlantic Ocean (Cross River, Ogun, Osun, Imo, Kwa-Ibo and a few others),all other flowing waters finally find their way into the Chad Basin or down the lower Niger to the sea. Figure 1 shows the hydrological map of Nigeria with the major inland waters.

Benue and the Chad

The Niger-Benue and Chad systems are separated by a primary watershed which extends from North-East and North-West from the Bauchi Plateau-the main source of their principal tributaries (Ita, 1993; Ita and Sado 1984; Ita, et al, 1985) and to the North-West of the Plateau lie the drift covered plains of central Hausa land, drained by many streams flowing outwards to form the major tributaries.

The rivers that flow into Lake Chad come from Central highland and the high plateau both of which converge to form the Komadugu-Yobe River just before flowing into Lake Chad (Offodile, 2002). Some of these rivers originate from the Cameroon Mountains. However, only a small part of Lake Chad lies within Nigeria which is not more than a mere vast swamp along the border. Most of the rivers flowing into this lake rise from the watershed areas of the Jos plateau and the Adamawa highlands and these include the Hadejia-Yobe, Alo and Yedseram from the southwest, and the Ba Mbassa, Chari, Illi and Lagone from the southeast. From the southeast to the northwest, the Rivers Yedseram-Ngadda together with all other minor tributaries and rivulets empty into the Lake Chad (Offodile, 2002). Within Nigeria, River Niger is fed by rivers flowing into it from all directions with head waters originating from the central plateau in the North, from the Yoruba highlands in the south, from Benin Republic to the west and from the eastern highlands. From outside Nigeria, we have a significant flow from the watersheds stretching westwards right up to the Fouta Djallon mountains of Guinea. The Benue River on the other hand, is fed by rivers emanating both from the high central plateau and also from the Cameroon mountains and Ogoja hills (Ita, 1993). Of the rivers flowing to the Atlantic Ocean, both the Ogun and Osun rivers are fed by rivers originating from the Yoruba highlands. They flow slowly from the north to south into the lagoons before discharging through creeks and swamps into the Atlantic Ocean. The Cross River on the other hand, is fed by many tributaries originating in the Cameroon Mountains. It flows east and then turns southwards and empties into the Atlantic Ocean with limited Delta formation. Those rivers flowing into the Atlantic Ocean in the south include; Imo, Kwa Iboe, Ase, Orashi, Benin and numerous creeks in the Delta and River states.

In general, the water bodies of Nigeria are divided into marine, brackish and fresh-waters (Ita, 1993) while the brackish waters with their saline wetland cover the surface area of 858,000 hectares, the freshwaters cover about 3,22,500 hectares. Other water bodies, including small reservoirs, fishponds and miscellaneous wetland suitable for rice cultivation cover about 4,108,000 hectares. The total surface area of the water bodies in Nigeria excluding marine and miscellaneous wetland suitable for rice cultivation is estimated to be about 14,991,900 hectares or 149,919 km^2 constituting about 15.9% of the total area of the country.

Human Activities that affect Hydrological Systems

Various human activities create many environmental problems rangingfrom global warming, biodiversity, ocean/water pollution, and ozone layer depletion to even total extinction of some species of plants and animals (Thomas, 2002). Among the activities that bring about

these deleterious effects are:

(i) **Construction of Dams for the generation of Electricity:** Water is a unique substance that forms a vital and integral part of man's life when put into many uses. These uses are however, affected by the presence of other substances (which could be from natural sources or as a result of human activities) in it. In different parts of the world, man made lakes and dams have been constructed for various purposes. For instance, the Volta Lake in Ghana, the Kainji and Jebba Dams in Nigeria constructed mainly for generation of electricity; the Nasser Dam constructed on the Nile for the regulation of water for the irrigation of Egypt. Others include the construction of seasonal reservoirs at Jabel Auliya (White Nile) and Sennar or Abbay (Blue Nile), Bakolori, Anka, Yomtera and Zobe all on the Sokoto System (Offodile, 2002 and Abdullahi, 2007) mainly for irrigation, while Lake Nwahdingusha and Koni on the River Lufira, and Nzilo on Lunlaba in Zaire are mainly for the supply of electricity (Beadle, 1981).

All these dams and Lakes have been constructed to improve the lots of humanity but they also have their own demerits especially in the tropics where they have adverse biological consequences (White, 1968), Principally, because construction of lakes and dams leads to the change of environment from riverine to lacustrine and consequent changes in the physical and chemical compositions of the former. Human activities in these environments have led to the growth of sudd forming weeds (e.g. *Vossia cuspidate, Pistia stratiotes*, and *Salvinia auriculata*). These usually render the waters unnavigable and inaccessible to other activities especially fishing. They also cause deoxygenation of these waters thereby making life unbearable to fish and other aquatic fauna. They also prevent the penetration of light energy into the waters making photosynthesis very difficult for the phytoplankton. These weeds, having formed mats, can also be blown towards the dam, which can eventually block the turbines. The decayed vegetation in these waters can also cause the accumulation of hydrogen sulphide (Ewer, 1966). The economic importance of the growth of water hyacinth (*Eichhornia crassipes*) on these water bodies cannot however, be over-emphasized. These weeds, having been established, are not easily eradicated and their eradication always involve huge economic losses. For instance, in Sudan it is stated that it costs the government up to 500,000 pounds each year to clear the waterways of label Auliya in as far back as the sixties (Hassan and Heinen, 1964).

The newly created environments also serve as conducive habitats for the aquatic vectors of certain important diseases plaguing man and domestic animals such as bilharzias and liver fluke (snails); malaria and filariasis (mosquitoes). Eventually, water pollution problems due to rural-urban migration are also observed in these areas. For instance, water pollution caused as a result of effluent discharge into these water bodies usually lead to the overloading of the marine environment as a result of certain chemicals and heat that have such deleterious effects act as harm to marine activities including fishing, impairment of quality for use and reduction of amenities (GESAMP, 1980; Deju, 1971; Richard, 1992).

Seasonal alternation between inundation and desiccation of considerable areas of land as a result of opening of the sluice gates in order to make room for the incoming floodwater in rainy season (annual draw down) also affects the ecology of these areas. In addition, a large number of people are displaced along the downstream of these dams like Kainji, Shiroro and Jebba Dam in which thousands of people are displaced every year. The socio-economic problems created by these displacements are enormous especially as some large agricultural lands are either washed away or drowned tectonic equilibrium is also offset by water bodies especially in regions of tectonic instability.

(ii) **Agriculture:** Agriculture is another human activity, which affects both surface and underground water quality. In agricultural practices, the use of chemical fertilizers, herbicides, pesticides and fungicides is employed to improve the output by farmers. The clearing of agricultural lands and eventual burning of the cleared vegetation, lead to the emission of high quantities of undesirable polyatomic gases like carbon dioxide, water vapour and oxides of nitrogen which reduces the earth's infra-red radiation with a consequent rise in the warming up of the earth's surface and the atmosphere. This ultimately leads to the destabilization of the earth's natural global climatic regime with a gradual but steady rise in the global temperature of between 1.5°C and 4.5°C and finally the rising trend in temperatures, evapotranspiration and the intermittent droughts as well as extension of the deserts most especially in the Sahel region (Offodile, 2002). Most of the herbicides and pesticides in common use in this country are harmful to the environment and some of them have been banned by some countries that are critical about their environmental degradation. For instance, fenthion, an insecticide, is effective also as an avicide and therefore widely used in many states in Northern Nigeria like Kano, Bauchi, Yobe and Borno which are prone to bird pests. DOT and gammalin, which have rodenticide properties although outlawed, are still being used illegally in some parts of the

country. These insecticides are classified as moderately to highly hazardous by World Health Organization and as harmful to extremely harmful to aquatic life (Ita, 1993).

(iii) Industrial: Paradoxically, while industrialization in most of our cities and towns have propelled the economic growths of these centers by creating wealth and employment opportunities for the youths, it has done a lot of damage to the environment. In these areas, fossil fuels are flared and toxic gases like sulphur dioxide and nitrogen dioxide are emitted to the environment and appreciable amounts of these substances (e.g. sulphur), build up in the soil and subsurface waters. Acidification of the soil and soil water also occurs (Michael and Frank, 1991).Unfortunately, despite the number of industries in this country that discharge these substances of varying environmental toxicity, less than 10% of them manage the waste in environmentally friendly manner (Louis, 2001). In most cases, these wastes are dumped in any available space on water or land. The lagoons, streams, and rivers which are the final recipients of these wastes and other surface runoffs are incidentally the sources of drinking water, fishing, livestock rearing, washing and recreation for a large proportion of the populace despite the fact that they serve as ready eutrophic reservoirs collecting high levels of toxic heavy metals like the case of the Jankara reservoir in Kano city (Butt, 1985; Adeniji and Mbagwu, 1990). When these lakes, rivers and aquifers become loaded with high concentrations of these chemicals and heat, they are no longer suitable for consumption nor can they support fish and wild life (Deju, 1971). Furthermore, the soils within the premises of these industries as well as the underground water are heavily contaminated with these hazardous wastes posing high risks to consumers of crops. Water from wells of such soils like the case of the Kurmin Gwari, a suburb of Kakuri, in Kaduna City has been rendered a danger zone for human habitation as well as agricultural activities (Thomas, 2002). The overloading of the Kaduna River with industrial wastes by the Kaduna textiles which have been reported to be discharging between 27 million and 35 million litres of untreated water daily and the large volume of waste discharged into the fragile coastal and marine environment from Rivers to Lagoons is estimated to be at about 313,000 tons per annum. These are other examples of the gruesome impacts of human activities on the fragile environment (Louis, 2001 ; Thomas, 2002).

(iv) Oil and Gas Explorations: The same sad tales are told in the oil and gas sector with oil spills and release of noxious gases into the atmosphere accompanying crude oil production. A large amount of gases is produced following the production of a single barrel of crude oil (about 1,000 standard cubic feet per barrel or about two billion standard cubic feet per day) but only less than 30% of this is being converted to useful fuel with the remaining being flared. In fact it has been estimated that Nigeria released 30 million tons of carbon dioxide into the environment in 1989, a value which rose to 35 million in 1994, thereby placing the country as contributing about 28% of the world's total gas flared and hence a significant contributor to the emission of greenhouse into the atmosphere and the acid rain phenomenon in the Niger Delta (Louis, 2001).

Deforestation: While many countries are in the bid of checking global warming which eventually affects the hydrology of the world by making efforts to conserve the forests, falling of trees is still unabated in this country due to the fact that many Nigerians are poorly served by electric energy with only about 34% of the country's households having access to this essential commodity. Nearly three-quarters of the country's households are still dependent on firewood for their energy.

On the domestic scene, whenever the raining season sets in Nigeria, residents of most of the major cities in the country, including our young and prestigious new Federal Capital-Abuja, are gripped by the reality of the annual charade of flood resulting mostly from lack of drainages or their blockage due to improper refuse disposal. As a result, surface runoffs and other sewage waters are directed into place of greater importance making the sites to stink, and a common example is the Abuja Monday Market (Maimuna, 2004). Our major roads can also be over flooded and submerged by this phenomenon as experienced in the case of Zone five, and some parts of Areas 2, 8 and 11 all in the Capital City of this great country (Yusuf, 2004). The use of automobiles which run on leaded gasoline resulting in increase of lead in both surface and ground waters of our big cities and towns due to vehicular emissions. The use of detergents in laundries can also lead to increase in the phosphate levels of our waters (Ita, 1993).

Mining: Mining activities also affect the potability of waters most especially the ground water by raising the dissolved organic matter, acidity and corrosive properties. A typical example of this is the pollution of Aboh and Onyeama coal field waters (in Enugu) where the samples have high temperatures of 30- 40°C and considerable quantities of hydrogen sulphide (Offodile 2002).

Suggestions: In the past, lack of care by man for his environment, though devastating in some areas, could apparently be solved by abandonment and immigration. Today, with rapid population growth and accumulated degradation, the easy option of just finding another source for our needs is no longer easy to come by (Ita and Michael, 1988). Consequently, solutions have to

sought since it is not morally sound for us to leave our problems for the coming generations to solve while we enjoy the benefits today (UNESCO, 1977; Zylicz, 2002). Furthermore, of all the natural resources that are in abundance, only water seems to be in the least abundance when potability is taken into consideration. Hence, despite the fact that water occupies the largest volume of space in the whole world only 0.62% of the total body is available for potability (Wilson, 1975).

In the industrially advanced countries, it is normal to provide at least some degree of treatment for water from any source and the public expect standard water supply services, efficient collection, treatment and disposal of waste-waters. This is because they have well-developed techniques and equipment needed to attain these goals. In rural schemes in developing countries, e.g. Nigeria treatment will not be feasible in many circumstances since in most cases, the facilities used to obtain potable water in these areas, if at all provided, are fashioned in accordance with the sophisticated developed-country style. These facilities can only be proficiently handled by the donor governments and agencies. Consequently, little values are derived from these facilities since no appropriate operation and maintenance back up are provided (Tebbut, 1983). In such areas, it is only necessary for us to consider water resources in relation to what is likely to be the most important parameter (bacteriological quality). This is because, local communities, especially those located down streams of urban sewers that do not have adequate provisions for their water treatment are highly prone to severe bacteriological water borne diseases like typhoid, cholera and dysentery (White, 1986;Terence, 1991).

Apart from adequate provisions by the Water Boards of every state of the federation for routine chemical, physiological and biological checks. Care should also be taken to ensure that the ecological upset caused by these pollutions is adequately measured to ascertain the severity of the pollutions. Also, since some sewage contain high organic manure useful for agricultural activities and for the enhancement of aquatic life which usually lure the rural and even some city dwellers into their direct use, despite the fact that they contain some toxic substances, which are detrimental to both aquatic and human lives. Hence, every effort should be made to dissuade these people from the use of such bodies for agricultural and other practices prior to proper treatment.

Traditionally, agricultural activities in river basins are known to have little effect on water quality and may even be regarded as a non-competing joint use of the resource. With the increasing human population and the need for more crop production, agricultural methods which are more advanced, requiring the retention of water in large dams for use in sophisticated irrigation systems have been adopted in various parts of these country. These have resulted in desiccation of downstream farmlands to the detriment of traditional agriculture and loss of fishery resources as a result of habitat loss (Welcomme, 1993). In addition, the use of inorganic fertilizers that accompany these aggressive agricultural methods, coupled with build up of salts in the soil, can lead to a sudden excessive growth of phytoplankton in stagnant ponds and pools when they are washed into other water bodies. Consequently, excessive bloom of these algae can lead to high biological oxygen demands resulting in aquatic pollution. In order to avoid these situations, it is suggested that water organizations of this country in conjunction with other non governmental organizations (NGOs) saddled with the responsibilities of providing wholesome water for communities be adequately funded to be able to fill all these ponds and also provide adequate sewage treatment plants for our big cities and towns. In rural areas where the achievement of the above goal may not be easy to come by, the use of hardy species of fish that can tolerate such polluted waters like Clarias and Tilapia could be of help to some extent (Ita, 1993). In order to prevent high health hazards, it is necessary to have and also enforce laws by state and Federal Ministries of Health prohibiting the catching and hence, consumption of fish from such polluted reservoirs and ponds.

We also, are aware of the fact that the intensive agricultural activities embarked upon in the Northern parts of the country not only require the application of inorganic fertilizers but also, the application of esticides for increased yield. These pesticides used in this country include certain chemicals that for environmental reasons have been partially or completely banned in developed countries (FEPA, 1991). These chemicals still continue to find their ways into Nigeria for pest control because the effective cheap substitutes have not yet been evolved and have been found to cause serious environmental problems, especially in the dry season when the dilution capacity of water systems is very low leading to an increase in the risk of high concentration of toxic chemicals with severe consequences (Ita, 1993). In light of these problems above, it is suggested that the government ban the use of these hazardous pesticides and herbicides and the more environmentally friendly substitutes provided for the farmers.

It is also suggested that in light of criticisms being leveled

against the nation's environmental laws including those of the water resources decree number 101 of 1993 (Offodile, 2002) which are still viewed as being ineffective in ensuring sustainable expectation and management of the nation's environmental codes to make the best practice standard in the world (Nnimmo, 2004), water and the Federal environmental agencies be given a kind of leadership that has seen the like of Prof. (Mrs.)Dorothy Akunyeli of NAFDAC to eliminate the ineptitude that bedevils the implementation of these codes (Louis, 2001).

Furthermore, although surface water tends to be the major source of water supply to towns and cities, the prevailing advance and unpredictable climatic conditions have made the need for a thorough study and development of underground water a necessity in Nigeria. This however has to be done with great care in order not to destroy some of the country's most important ground water resources (Offodile, 2002).

In general, the management of solid waste is so complex that this task should not be vested solely on the local government authorities but all the three arms of government should fully participate (Louis, 2001).

In order to cub the menace of greenhouse effect as a result of the release of large amount of noxious gases flared into the atmosphere by the oil sector, the Federal Government has set up the Nigerian Liquefied Natural Gas (LNG) in Bonny and also harness the vast potential to generate further foreign income for the economy. This plant was originally planned to be in full operation by the year 2004. However, we still experience the flaring of gases with hope that in the nearest future, this act will be banned.

Finally, it is important that the government curtails the spate of indiscriminate land use abuses particularly land reclamation in the urban areas. This is because; if this should continue unabated more wet lands will be filled for residential purposes which will force the water down streams into rivers, seas or oceans. This will eventually lead to increased water volume and consequent ocean surge and coastal flooding. As a result, the residential and commercial buildings within such areas will be at the danger of being washed away causing a great water pollution problem.

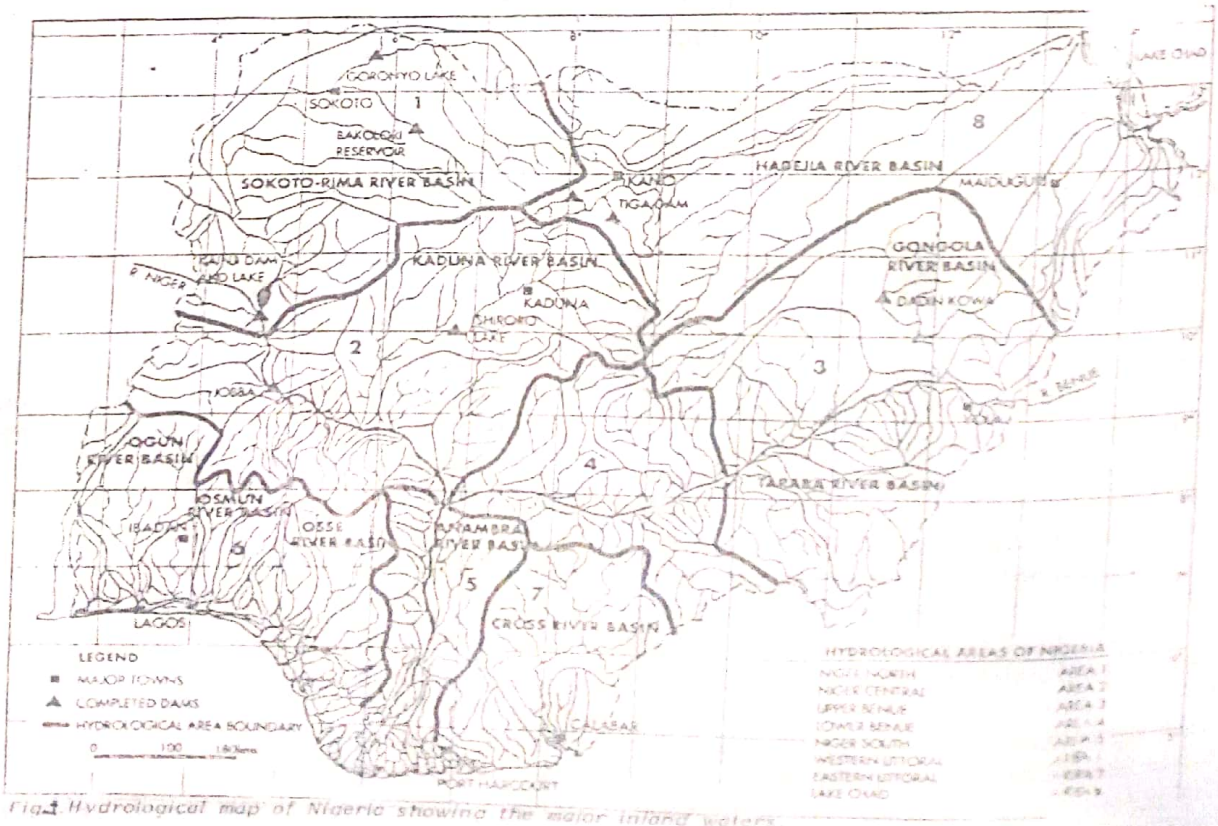

Fig.1 Hydrological map of Nigeria showing the major inland waters.

REFERENCES

Abdullahi , M. G. 2007. Ethopia: Echoes of the Queen of Sheba. Daily Trust, Friday May 16th, No. 49, pp 28 and 29.

Ademiluyi, J. O. 1988. Regional Profiles of Selected Groundwater Quality Measures in Nigeria. Water international, Official Journal of the International Water Resources Association, **13**: 130 - 135.

Adeniji,H.A.;Mbagwu,I.G.1990.Study of physico-chemical characteristics of some heavy metals in Jankara Reservoir, Kano State, Nigeria, NIFFR Annual Resort, pp 136 - 140.

Beadle, L.C. 1981. The Inland Waters of Tropical Africa (2nd Edn), Longman Inc., New York.

Butt, I.A.1985. Report on the industrial pollution of Jankara Dam Ministry of Health, Kano, Nigeria.

Deju, R. A. 1971. Regional Hydrology Fundamentals. Published by Gordon and Breach, Science Publishers, Inc. 440 Park Avenue South New York, N.Y. 10016.

Ewer, D.W. 1966. Biological Investigations on the Volta Lake, May 1964 to May 1965. In Man-made Lakes, Ed. R.M. Lowe McConnell, Academic Press, London.

FEPA,1991. Guide lines and standards for environmental pollution control in Nigeria. Federal Environmental Protection Agency (FEPA), Nigeria.

Gbenn, O. S.; Richard, K.F.; Takatt, W.E; Kenneth, K.B. 1981. Soil and Water Conservation Engineering, Third Edition.

GESAMP. 1980 Report of the eleventh Session. Reports and Studies No. 10. UNEP. [GESAMP IMO/FAO/UNESCO/IMO/WHO/IAEA/UNI UNEP. [Joint Group of Experts on the Scientific Aspects of Marine Pollution].

Hassan, A.; Heinen, E T.1964. Water hyacinth Control on the Nile River. Sudan Department of Agriculture, Khartoum.

Ita, E.O.1993. The Inland Fishery Resources of Nigeria. CIFA Occasional Paper No. 20.

Ita, E. O.; Sado, E K. 1984. Inventory survey of Nigerian inland waters and their fishery resources with special reference to ponds, lakes, reservoirs and major rivers: surface area survey and potential yield estimate. Kainji Lake Research Institute 1983 Annual Report.

Ita, E. O.; Sado, E.K.; Pandogari, A.; Balogun J. K.,; Ibitoye, B. 1985. Inventory Survey of Nigerian inland waters and their fishery resources 1. A preliminary checklist of inland water bodies in Nigeria with special reference to ponds, reservoirs, and major rivers. Kainji Lake Research Institute Technical Report Series.

Kalmbach, O. 1982. Encyclopedia Britannica (Macropaedia) Volume 19, (15th Edn). Hartmolls, Bodmin, Cornwall.

Lewis, I. 2001. Pollution, Waste Management, Desertification, Erosion Flood Control. The Nigeria Environmental Score Sheet. The PUNCH, Thursday, January 11, pp 29

Maimuna ,Y. 2004. Abuja Monday Market Traders decry stinking refuse. A DAILY TRUST article on Property and Environment. Wednesday, April 14, pp 26.

Offodile, M. E. 2002. Groundwater study and development in Nigeria. Published by Mecon Geology and Engineering Services. Jos, Nigeria.

Robert, O. C. 1988. The Jonglei Canal: Illusion or Reality? Water International. The Official Journal of the Int. Water Res. Ass. **13(3)**:144-153.

Tebbutt, T.H.Y. 1983. Principles of Water Quality Control.(3rd Edn). Pergamon Press

Terence, J.M. 1991. McGraw-Hili Series in Water Resources and Environmental Engineering (6th Edn). Published by McGraw-Hili Publishing Company.

Thomas, A. 2002 Industrial Pollution: Agonies of Kaduna South residents. New Nigerian Weekly, July 13, pp 4.

Welcomme, R.L. 1983 River basins F AO Fisheries Technical paper (202).

White, E 1968. The Place of Biological Research in the Development of the Reservoirs of Man-made Lakes, in Man-made Lakes, the Accra Symposium Ed L.E, Obeng, Ghana UP., Accra.

White, J.B. 1986. Waste Water Engineering, (International Student Edition) Printed and bound by Arnold Allion Printing Co. Ltd. Hong Kong.

Wilson, D.C. 1975 Encyclopedia Britannica.

Yannis, M. 2003. Urban Water Management in Greece, Present Conditions and Prospectives of Sustain ability, Water International.**28**: 43-51.

Yusuf, O. U. 2004. Environmental Rights Action (ERA) and friends of the Earth Nigeria (FOEN).A DAILY TRUST article on Property and Environment. Wednesday, April 14, pp 26.

Zyicz, T.J. 2002. The role of Science in sustainable development policy. Retrieved September 2003, from URL: ttp:www.sustainability.at/easy/easy. ecollpdr/zylicz paper.pdf