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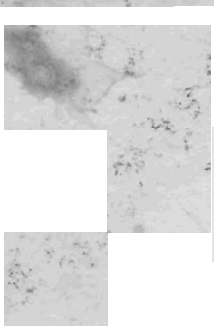

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NIGERIA'S WATER-SUPPLY NIGHTMARE

M. O. Ogedengbe
Professor of Civil Engineering

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by

M. O. Ogedengbe
Professor of Civil Engineering

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Nigeria's water-supply situation seems to have become a monstrosity, characteristic of a nightmare.

All over the country, virtually everywhere there is insufficient water to satisfy the basic human needs - drinking, cooking, washing and sanitation, let alone the commercial, industrial and agricultural needs. The quantity of water supplied in all the thirty six states of the federation is less than 25 litres per capita per day (lpcd) on the average. The comparable figure in the developed countries of Europe and America is about 400lpcd: The figure recommended by the World Health Organization (WHO) for countries in Nigeria's level of development is about 180lpcd.

Repercussions of non-availability of water in Nigeria's urban as well as rural areas have been enormous. Some examples:

- Waterborne diseases such as cholera, typhoid fever, infectious hepatitis, poliomyelitis, dysentery, diarrhoea, gastroenteritis, etc. have continued to afflict the populace (fatally in unbearably large numbers of cases) at a time when these diseases are virtually extinct in the developed world.
- In most of the largest urban centres: Lagos, Ibadan, Kano, Kaduna, Aba, Enugu, Benin, numerous residents, when they wash their clothes often have to carry the dirty wash-water back into the house to flush toilets in which human excrements have piled up for two to three days or more.
- Indeed much of Nigeria still takes care of its faecal wastes as if (even only partially) obeying Mosaic Law of over 2000 years ago. Moses is reported in the Bible (Deuteronomy 23 verses 12 & 13) to have told his people Israel:

> *'Thou shalt have a place without the camp wither thou shalt go forth abroad. And thou shalt have a paddle upon thy weapon and it shall be, when thou wilt ease thyself abroad thou shalt dig therewith and shall turn back and cover that which cometh from thee'.*

Yoruba version, in part:

> *'... yio si se, nigbati iwo ba gbonsè lehin ibudo ...'.*

One proof that even urban Nigeria is still essentially ancient and terribly undeveloped in waste disposal is in the fact that a new terminology has now crept into its vocabulary. The word is '*bushrine*' (as in latrine). To go to the bushrine is to go ease yourself in the bush nearby. The term could not have been invented by rural dwellers but by city dwellers, students of higher institutions in fact, who have WC's (water closets) but have no water to flush them and so resort to defecating in nearby bushes and other inappropriate places. The bushrine system constitutes a giant step backwards from the pail latrine era. In such situations, water supplies to conduct laboratory experiments or otherwise to carry out research should be grossly inadequate.

Whenever a fire erupts threatening to destroy lives and property the Nigerian fire trucks promptly start their alarm bells and sirens, and head out to pour one tankerful of water onto it and if that does not quench the fire - what sort of fire would one tankerful of water quench? - they go back and fetch another tankerful, and so on.

The normal thing of course, is for water for fighting fires to be available under pressure, to be tapped through a system of hydrants as part of the water distribution mains. In the past two decades or so, absence of such facilities have caused a number of fires to rage to destructive ends, e.g. Cocoa House fire in Ibadan, Nitel Building fire in Lagos, Calabar Market fire, and lately (May 6 1997 precisely), the Onitsha Main Market fire

ouple more examples should satisfy the needs of this part of the lecture. Hospital systems suffer immensely from water shortages. For example, on September 2, 1995 Newspapers widely reported that the University College Hospital (UCH) in Ibadan was turning back patients because of inadequate supply of water. About a week later Mr. Igenewari George, a Rangers International Football Club player, who received gun shot wounds after a match at Ibadan was rushed to the UCH, where reportedly lack of water made it impossible to save his life. He was transferred to a private hospital, where he later died! At least one Newspaper screamed on September 11, 1995:

'Water Shortage caused Ranger Footballer's Death'

> More directly on the sports scene, Nigerian Government officials expressed anger and disgust at not being approved by FIFA to host an international competition. As large quantities of water are needed for showering, flushing toilets and satisfying other sanitary needs practically all the water supplies of the cities (Ibadan, Enugu, Kaduna, Lagos, etc.) in which the competitions were to be held would have had to be diverted to the venues of the competitions for much of the duration of the games.

And yet, Nigeria has ample surface and underground water sources for its needs. The country is blessed with great river systems - Niger, Benue, Ogun, Osun, Imo, Cross, Sokoto, Kaduna; their numerous tributaries, and hundreds of others particularly in the South. Large quantities of groundwater are also available both within the basement complex and sedimentary areas. It was estimated (Ogedengbe, 1977) that not less than 300 billion cubic metres of water are being added to our surface and groundwater resources annually.

Rains that fall on our land area of about 900,000 km^2 produce runoffs which largely drain into the rivers and head for the Atlantic Ocean leaving only whatever our financial, managerial and technological abilities are capable of trapping, pumping, treating and distributing for our use.

Nigerian politicians, aspiring to be elected at Local Government, State or Federal Government level invariably promise provision of water to their electorates. Indeed during the recent Local Government electioneering campaigns, it was uncommon to see any campaign poster that did not prominently list supply of water in adequate quality and quantity among achievements intended. Such an intense emphasis on water, even at the Local Government level simply underscores certain facts namely: that Nigerians (urban and rural dwellers alike) value and appreciate potable water a great deal; that their current supplies are grossly inadequate and that they expect government to make water available free of charge or at affordable prices. This position is eminently reasonable. But supplies hardly ever improve. Naturally we were curious to learn what the true situation was with rural and urban water supplies, what stop-gap measures are needed, and so on.

Water Resources Research

At Obafemi Awolowo University, Civil Engineering, one of the newest programmes in the Faculty of Technology is twenty years old (1977 to 1997). Our activities here in approximately a quarter of a century started with an emphasis on meaningful research, strong teaching and strong service.

Our earliest effort in water resources and environmental engineering research was to visit neighbouring towns and villages to assess their water supply systems; and also to travel to as many Waterworks nearby as possible to assess production and supplies, their problems and prospects.

The assessment study of rural water supply systems had the following objectives:

(i) to select rural communities mostly around Ile-Ife, interview the inhabitants as to their sources of water, what diseases were prevalent in their communities;

(ii) to perform laboratory analyses on samples from selected sources so as to ascertain their physical, chemical and bacteriological conditions;

(iii) to develop simple water treatment measures that could be used by the villagers bearing in mind the financial and educational constraints of the people;

(iv) to visit hospitals serving the general area, obtain addresses of persons treated for waterborne diseases so as to establish direct or indirect relationships between incidence of waterborne diseases and the water sources.

The detailed study was preceded by a reconnaissance survey, by which a familiarization survey was made into several communities for an on-the-spot assessment of the water problem. On the first visit to each community a courtesy call was made on the community head who was told the purpose of the visit, i.e. to look at the water problems of the community, whereupon he designated one or two persons to lead the party to the water supply source of the community and to answer questions that the party might ask.

The coliform count - most probable number (MPN) index of the water supply sources studied - was exceedingly high (up to 11,000 coliforms per 100ml) in some cases (WHO recommended limit is in terms of 1 coliform per 100ml for potable water). Hospital records indicated that many

people from the area of study were treated at different times for waterborne diseases including cholera, typhoid fever, infectious hepatitis, guinea worm, etc., and that in a number of cases death from these diseases had occurred (Ogedengbe and Adeniji, 1978). The communities studied included Alagbede, Ajebandele, Alakowe, Aba Poju, Itamerin, Oke Opa, Obadimeji, Famia, Aba Titus, Iyanfoworogi and others over many years.

The numerous hand-dug wells found in urban, semi-urban and rural areas were also in subsequent studies found to be contaminated. The potential for soak-away pits and also pit latrines to contaminate water in hand-dug wells and the key factors involved were extensively studied in a cooperative effort with P. O. Aina who brought a strong background in soil physics to bear on the problem.

Water flows laden with germs of gastro-intestinal origin, organic matter, manifestations of common salt, etc. can and do reach hand-dug well waters from soak-away pits and from pit latrines, and significantly contaminate them. In the first study involving a soak-away system contamination reached up to 22 metres in a loamy soil.

Advice is given that persons who have to have soak-away pits or pit latrines coexist on the same building plot with hand-dug wells should recognize that contamination is a function of separation distance between the units, years of coexistence, type of soil, hydraulic gradient (i.e. slope), whether the well is lined (cemented from top to near bottom), whether the well cover is tight-fitting, and whether the buckets and ropes used are clean (Ogedengbe, 1981; Ogedengbe and Aina, 1980).

During visits to a number of nearby Waterworks, notably Eleyele Waterworks, Ibadan; Asejire Works; Iwo and Ede Works, some distressing inadequacies were observed, two of which were particularly relevant to our circumstance:

1. There were serious shortages of alum caused at that time by the fact that owing to Port Congestion the imported chemical was not coming in. As a result pumping of improperly treated water into the mains was the order of the day throughout the country.
2. Sand and gravel used in the filtration units of treatment plants were imported.

We decided to commence studies on these problems in addition to the ones already being pursued on rural water supplies.

On the problem of alum shortages, it was reasoned that a locally prepared polyelectrolyte could in the long run at least be a suitable

substitute for alum. It would have to be a cationic polymer of high molecular weight. The positive charge on such a product would carry out the function of neutralizing the negative charge on the colloidal particles in the water (the way alum is believed to work) and the long polymeric chain would 'bridge' (O'melia, 1969) the neutralized colloidal particles. The combined effect would be an effective sedimentation of the suspended solids. Cassava starch should be suitable as base material for the preparation of the polyelectrolyte.

With that hypothesis, preliminary experimentation began. Dilute solutions of cassava starch, cooked or uncooked, did not conduct electric current, let alone accept a positive charge. A suitable electrolyte was obviously needed to be added to it, or else a completely different approach was required.

Tony Ellis of the Department of Chemistry showed interest and agreed to put two undergraduate students to work on the chemistry aspect of the work as their final year projects.

The work up to that stage was quite interesting, the students were excited especially when, later, the preliminary results were published as Technical notes in a highly reputable, international journal (Ellis *et al.*, 1982) with their names included. But we were not pleased because of the processes involved: starch had to be dried, sieved and fractionated into amylose and amylopectin; each fraction as well as the unfractionated starch was oxidized with a hypochlorite in an acid medium; the product was filtered and washed with acetone. The process had continued with esterification, refluxing with monochloroacetic acid in toluene for several hours; followed by quarternization using tetraethyl ammonium bromide, ethanol, pyridrine, and so on.

The need to use large quantities of various chemicals, intricate equipment and procedures pointed up the apparent futility in attempting to obtain a commercially viable product along that line. Furthermore, the products obtained from the effort were not as effective as alum, except in low pH (pH 2 - 3) when both were used to coagulate water samples drawn from Opa dam.

We reminded ourselves that the purpose of the study was to produce a modified cassava starch that could (potentially) compete with alum in terms of both performance and economy. Back to the drawing board, so to say.

Finally, tedious months of work later in a new cooperative effort

with Eric Okoh of the Department of Chemistry a new product named 'IFECOAG' was made by dispersing 0.25g of cassava starch and 1.0g calcium hypochlorite in 100ml distilled water; making it up to a litre with boiling water and electrolysing by means of a battery charger at low current (0.1 amp) using aluminium rods as electrodes. IFECOAG was tested and found to be an effective water coagulant. It was found to be more effective than alum at water pH 7 causing better than 90% turbidity removal with dosages of about 30 to 60 parts per million. And unlike alum, IFECOAG did not depress the pH of the water with which it was treated (Ogedengbe and Okoh, 1982). Great. But much more work remained.

Numerous new questions arose: What is this product? Might it be able to act also as a disinfectant for water such that it might combine the actions of alum and chlorine? Is it safe to use it to treat water for human consumption? Would we need to feed it to animals including perhaps a pregnant gorilla? What role might there be for Histochemists in this work?

To date owing to shortages of equipment and funds, only a few of the questions have been settled. Eddie Ngaha of the Department of Biochemistry showed that *E. Coli* grew profusely in colonies on petridishes containing a mixture of lactose broth and IFECOAG. Therefore the product cannot serve as a disinfectant. Esther Balough of the Department of Food Science freeze-dried IFECOAG samples towards improving shelf-life. Here, clearly was a multi-disciplinary research project.

The other key issue was that of routine importation into the country of sand and gravel used in filtering water. The realization that imported filter sand is being used to filter water at waterworks all over the country and the general knowledge that silica sand is available in Nigeria in large quantities led us to start a campaign in local seminars, national workshops and international conferences. The clear message, sometimes controversial was that even if all research inputs were not yet completed, importation of sand into Nigeria must stop immediately.

At international meetings our presentations were decidedly couched carefully as all import-substitution drives were sensitive matters:

> 'Both the technologically advanced countries and the developing countries must justifiably feel embarrassed as long as sands for filters continue to be hauled across oceans and deserts from the former to the latter'.

Of course, feeling embarrassed is just a necessary first stage, doing something to find local substitutes is yet another.

Efforts needed to encourage use of locally available sands and gravels could be seen to consist of three phases as follows:

1. identification of local sources of sand and gravel and determination of yield in terms of usable proportions from each stock;
2. development of a simple system for washing and screening (grading) large quantities of these materials; and
3. study of overall filtration efficiency in relation to grade-composition, filter bed thickness, filtration rate and headloss development.

The subject matter of Stage 1 (i.e. identification of local sources) was taken up. Based on experience in the local construction industry (tipper-lorry-owners), sand-stocks were identified as to sources namely: river sand, beach sand, erosion sand, and bush sand (e.g. Majeroku sand). A tipper-lorry-load of each type of sand was procured. Representative samples were washed thoroughly and subjected to routine tests of specific gravity and solubility in 10% hydrochloric acid. A filter box was designed and constructed complete with underdrains, headloss manometers, etc. to carry out pilot filtration studies.

Each of the sources yielded more than 50% of silica sand stock in particle size range $0.4 \leq d \leq 1.18$mm. Turbidity removals and headloss development were satisfactory (Ogedengbe, 1982).

Stage 2 of the work was the most problematic however, namely, how to wash and grade large quantities of the stuff (toward commercial viability). This, really is the bottle-neck in the production of local filter sands. In an extensive cooperative effort with Toye Ige of the Department of Agricultural Engineering a machine for grading sand was designed, constructed and tested. The best performance of the machine, based on a factorial experiment and detailed tests, was found to be achieved at drive speeds in the range 180 - 220rpm; screen angle 20° 30° (to the horizontal) and sand moisture content not exceeding 2% (Ogedengbe *et al.*, 1983). Other efforts made by some of our undergraduates to grade sand includes the use of fluidisation technique.

The final stage, Stage 3, i.e. study of filtration efficiency using the processed sand and gravels always followed any efforts in Stages 1 and 2 to produce new filter sands. Numerous other filtration studies followed, including one in which palm kernel shells were prepared and used in place of sand (Ogedengbe and Olawale, 1983); and another in which dual-media comprising charred palm kernel shells (0.85 - 2.36mm particles) over fine

sand (0.425 - 0.850mm) were prepared, used, and performance-tested.

In the meantime, the issue of urban and rural water supplies at the macro level continued to be addressed. Over the years we carried out fairly detailed assessment of water supply systems, largely as closely supervised undergraduate students' projects. The states studied were Oyo (including Osun), Ondo (including Ekiti), Bendel (now Edo and Delta), Imo, Anambra, Akwa Ibom, Lagos, Kwara and Ogun.

We had found that many people who own hand-dug wells use the water to cook, wash and bathe but would not drink it. They say that the water has a 'funny' taste. Towards developing a solution to this and myriads of other related problems, a study to produce activated carbon was commenced. Palm kernel shells were procured in large quantities from the Okitipupa Oil Mills. Samples were carbonized (i.e. heated at high temperatures in the absence of oxygen), pulverized into powder or left as granules, and activated. The products were found, in varying degrees, to absorb colour, taste and odour from water. Other starting raw materials were subsequently tried, namely, cow bones, coconut shells, and saw dust.

Current efforts on this study are geared towards being able to prepare activated carbon to specification for domestic and industrial uses (much of the activated carbon used in industries is imported). The key parameters so far concentrated upon included the surface area (including interstitial area of the crevices created during carbonisation), phenol value, iodine activity, adsorption of Methylene Blue and of Chlorine, etc. The relevant isotherms are also being studied (Ogedengbe *et al.*, 1984 & 1985).

Our work is slowed down by lack of facilities and funds. We built a furnace with bellows (similar to what blacksmiths use) and developed a thermocouple to measure temperatures (thermometers that can read up to 1000°C are just not available). Means of standardizing the procedures are not available.

Nevertheless, a good measure of relative satisfaction has been recorded. Near the end of the 1995/96 session (i.e. in February 1997), the latest student to join in the study, Moji Lawal, completed the fabrication of a household filter earlier developed by Animasaun (1995), fitted it with a carefully packaged inexpensive activated carbon cartridge, and carried it to town to conduct an acceptability test. She reported (Lawal, 1997) that people who would not normally drink water from their own well declared that the water became drinkable after being passed through the filter. She reported at the orals where she formally defended her thesis, that someone

briefly discussed the possibility with her of commercial development of th system. The struggle continues.

By way of concluding this section of the lecture, permit me a bit of a digression to express a strong personal view on a couple of issues of interest to the academia.

1. Those who insist that, in joint-authorship, only persons whose professional inputs are clearly discernible in an article for publication should be included as authors, are reasonable. The practice of juggling names on a set of publications, each of which is of little or no complexity should continue to be discouraged. All colleagues earlier-named in this paper as having cooperated with us (the ones that resulted in publications) and other cooperating colleagues not mentioned in any of the above (e.g. Niyi Fapohunda, Francis Adeniji) made clearly discernible contributions.

2. In the seventies and through much of the eighties, departments bustled with activities in the evening and on weekends, as academic staff enthusiastically pursued their research. The pervasive anti-intellectual climate in the country is the root-cause of the near-disappearance of that culture. As knowledge knows no national boundaries, true academics in Nigerian Universities will have to find ways to return to the good old days of intense research activities.

Structural Causes of Water Supply Inadequacies

The problem is systemic. There is a lack of sustained development planning at the national level, and since the ruling class has in effect run the country as a unitary system at the expense of the Federal structure, the State and Local Governments have been rendered impotent. There is the resulting political instability, economic and financial mismanagement and corruption in high, medium and low places. With respect to public water supplies, the management failures can be seen to be reflected in numerous forms including the following:

1. Key national institutions in charge of water resources are run in such a way that they cannot perform in any way to do the nation any good, what with the merging and unmerging that go on. For

example the Federal Ministry of Water Resources and the Federal Ministry of Agriculture and Rural Development have been merged and unmerged at least four times in the past ten years, the latest unmerging being within the past two years. The River Basin Development Authorities have suffered the same fate. By Decree No. 25 of 1976 and No. 31 of 1977, 11 River Basin Development Authorities (RBDAs) were established covering the whole country; in 1984 the number was increased to 18 in a major structural rearrangement; but again in 1986, the former structure of 11 was reinstated. Government with much fanfare, established a Directorate of Food Roads and Rural Infrastructure (DFFRI) but within a few years, it abolished it. And so on.

2. Government does not seem to rate the success of its water supply programmes in terms of how much water is actually made available to the people in relation to per capita need or the health benefits that would accrue but rather in terms of how many boreholes are drilled or how many schemes are commissioned by officials who desperately need to have their names etched on some stone before they have to leave office. The highly-orchestrated commissioning of the Asejire Water Treatment Plant extension of about two years ago has turned out to be largely a farce, as were the '40 boreholes per state' of the Shagari era, to name just a couple of well-known instances.

3. Pumps and accessories constitute a major bottleneck in water supply schemes throughout the country. In 1992, Government set up the National Agency for Science and Engineering Infrastructure (NASENI) and charged it with the responsibility of establishing and operating a Science and Engineering Infrastructure Development Programme. Four different Institutes were subsequently created within NASENI and charged with specific responsibilities for R & D and commercialization of their results. The four Institutes are: 'Scientific Equipment Development Institute- SEDI' located at Minna; 'Centre for Adaptation and Technology- CAT' at Awka; 'Hydraulic Equipment Development Institute- HEDI' at Kano; and 'Engineering Materials Development Institute- EMDI' at Akure. Three of these, the ones in Akure, Awka and Kano, given the responsibilities charged to them could (potentially) move the nation forward in the shortest

possible time in: the development of engineering materials; the development of electronic components, circuits, devices, etc.; and the development of fluid-flow machinery and devices/ fittings, etc. Unfortunately they suffer from chronic underfunding and are bedevilled by politically-inspired inter-ethnic wrangling.

Funding issues are not seriously addressed at any level of Government. Both the Federal Government and the State Governments are running straight to the World Bank and the African Development Bank (ADB) for loans to prosecute water supply projects. With relatively easy accessibility to loans in hard currencies the pros and cons of other funding options such as revolving loans options; municipal and utilities bond options, matching grants options or combinations of these and/or other options, are treated as being largely academic. Even the enlightened citizenry seems to have gone numb believing, with or without concrete proof, that with the loans crooked government officials would always connive with crooked contractors and possibly also with crooked Bank officials to mulct the community of money by passing out the contract and/or the loan on kickback basis. Accountability is not the order of the day, regrettably.

5. Water resources continue to be polluted with industrial wastes, oil spills, domestic wastes, etc. Clearly, companies that are permitted (i.e. not forbidden) to neglect off-site costs generally would tend to devote an insufficient amount of resources to water quality management and to pollution abatement generally. It is an elementary aspect of public goods versus externalities, but it is a grave national problem.

6. There is an endemic level of unresponsiveness, one might even call it irresponsibility, on the part of all and sundry in the treatment of public utilities. For example, one government agency designs and constructs a road, and apparently promptly, another agency or person comes along and digs across it to connect water (as if it is not possible to plan and coordinate these activities *ab inito*). Also pipe bursts are left unreported and unattended to, resulting in prodigious losses of treated water.

Water Supply at Obafemi Awolowo University

The development of the Opa Waterworks for use of this University was a

continuation of the display of foresight demonstrated by the founding fathers of the University and succeeding flag bearers. At the beginning of the project in 1974/75, it was initially being called a Supplementary Water Supply for the University of Ife, which meant that the Water from Ede would continue to be counted upon. We argued and successfully got the word 'supplementary' removed because a wrong name was likely to adversely affect the size required. Discerning professionals could sense that the Ede supply would not be sufficient for the use of Ife township alone, let alone continuing keeping the University on it.

There are problems though arising from the increase in the population of the users, general age of the facilities and low operating funds. The key problems may be summarized as follows:

1. The water currently supplied to the University community is not adequate. High-demand areas, such as the student hostels; high-elevation areas such as much of roads 2, 17, 18, Old Bukateria, and the Vice Chancellor's Lodge; and faraway locations such as the University Teaching and Research Farm, are inadequately served.
2. An estimated 40% (at least) of water being currently produced is lost through leaks in the rising mains; at the one-million gallon underground storage on Road I; and through the back-wash water tank. We are aware that renewed efforts are being made to plug the leaks, but until this is actually done, the leaks remain a prodigious loss in money, distribution pressure and quantum of potable water.
3. Even if and when the leaks referred to in (2) above are plugged and required repairs on the low-lift and high-lift pumping systems are carried out, the time has come for the treatment plant to begin to be expanded to capacities projected up to the year 2020.

I should like, at this point, in my personal and professional capacities, to pay tribute to the management and staff of the University's Opa Waterworks. I believe that this community will agree with me that inspite of the societal odds against which we've all had to work the Division of Water Supply and Sewage Management has consistently scored a pass mark over the past twenty years or so.

Closing Remarks

It is difficult to imagine any clean and sanitary environment without an

adequate water supply. A plentiful supply of good water conveniently available makes both personal and environmental cleanliness possible and so plays an important part in the prevention of many communicable diseases. It is the overriding importance of water that differentiates it from other resources. Shortages of water stunt economic growth and keep the people destitute. I would say that judging by the pathetic state of its water supplies, Nigeria is truly underdeveloped. This is unfortunate for a country with such immense human and natural resources.

Water resources knowledge is multi-disciplinary requiring studied inputs of intellectuals in the fields of economics, law, political science, sociology, as well as chemistry, physics, ecology, geology, microbiology, agriculture and engineering.

Specifically, on the macro-scale, lawyers may wish to start making their inputs as to preferences on the allocation concepts of riparian right - right to the natural conditions of flow in a stream substantially undiminished in quantity and quality; the prior appropriation concept (first in time first in right); or centralized grants or permits. This seems a necessary preparation before serious conflicts begin to arise among states or individuals who need to abstract water for domestic, industrial and agricultural uses, including in particular, irrigation.

Economists and sociologists are needed to wade into the World Bank-triggered controversies such as: whether truly water can be said to have an economic value in all its competing uses and should be treated as an economic good (Serageldin, 1994); the role of differential pricing such that the rich subsidizes the poor, permitting public standpipes to be retained, and so on. Perhaps a whole new parameter that may be referred to as some sort of elasticity of opportunity cost needs to be looked into, if it could mean anything.

Mr. Vice Chancellor, this lecture is dedicated to my wife, ***Dr. (Mrs.) Rachael Olanike Ogedengbe***, of much cherished blessed memory.

I wish to thank my children: Olakunle, Temitope and Olufunke for their courage and steadfastness; our entire extended family; the Vice Chancellor, Principal Officers, staff and students of this great Institution; staff and students of the Department of Civil Engineering and of the Department of Sociology and Anthropology; the CMD and the entire medical personnel of the Obafemi Awolowo University Teaching Hospital Complex. The support that this entire community has so unstintingly given to us (intellectual, medical, materials, spiritual support) has made us feel

loved and is gratefully acknowledged.

It is pertinent also to acknowledge here with gratitude that Research funds were granted by the University, through the University Research Committee (URC), to carry out our work on polyelectrolyte coagulant and activated carbon.

On my part I pledge to continue efforts started over thirty years ago to assist Mother Nature in the restoration of disturbed harmonies, through research, teaching and service. So help me God. Thank you, good night, God bless.

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