

**ENVIRONMENT,
MAN AND
SCIENCE**

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VALEDICTORY LECTURE

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When I was delivering my inaugural lecture on June 4, 1981, I drew attention to the fact that I was the first Professor to give an inaugural lecture from the Department of Botany since the Department was established in 1948. Coincidentally, I wish to say here again today, by the Grace of God Almighty, that in the history of the Department I am the first Professor to give a valedictory lecture.

The topic of my lecture is one that should interest anybody who is desirous of living long and in good health on earth and it is one that has engaged my attention for the past two decades. I thought I should share with you my observations, views and findings on this topical issue in this farewell speech marking my departure from a community that has been my place of abode for almost thirty-eight years.

The present state of the environment world-wide should be of great concern to everybody. Increasing daily is the rate of industrial pollution, sewage pollution, solid waste generation, oil pollution, deforestation, desertification, ozone layer depletion, global warming and so on. All these, which are as a result of man's activities, are gradually taking their tolls on the planet earth and on mankind.

In the beginning God created the earth and equipped it fully for the sustenance of man's life and comfort. He created plants and animals and related them to each other in a beautiful ecosystem and gave man dominion over them (Genesis 1:1-31). Thus God gave mankind a clean environment and left them to make the best of it for their continued existence on earth.

Gradually, however, the earth started to change as a result of man's activities in pursuit of better conditions of living. Through his quest for food, shelter and wealth, he has continued to deface the earth's surface, generate unwanted plant and animal wastes, leaving the air impure and the waters less and less clean, all these to his own detriment. Man seems to have forgotten that he is holding the earth in trust for God and for himself and generations yet unborn. The Psalmist says: *"The earth is the Lord's and the fullness thereof; the world, and they that dwell therein"* (Psalm 24:1). We are God's tenants on earth and to show that we deserve to continue to stay, we have to take good care of this abode.

All our three environments, air, soil and water, are polluted through our activities.

AIR POLLUTION

Fossil fuels and fuel wood (firewood) are the major sources of air pollution when these are burned to produce energy. Fossil fuels include natural gas, coal, crude oil and its refined products, which include petrol (gasoline), diesel, kerosene, fuel oil and naphtha. On combustion the fossil fuels (coal, crude oil and its derivatives) produce carbon dioxide, carbon monoxide, nitric oxide, nitrogen dioxide, sulphur dioxide, sulphur trioxide, hydrogen sulphide, volatile organic compounds (VOC), mercaptans (methyl, ethyl, dimethyl sulphides) and particulates, such as fly ash, unburnt carbon and heavy metals all of which are emitted as smoke into the atmosphere causing serious pollution. The volatile organic compounds are hydrocarbon vapours, paracyclic aromatic hydrocarbons (PAH) and BTEX (benzene, toluene, ethyl benzene, xylene). The heavy metals in the ash are chromium, nickel and vanadium.

Fuelwood, on burning produces carbon dioxide, carbon monoxide and ammonia. The combustion products of natural gas include carbon dioxide, carbon monoxide and oxides of nitrogen.

Air pollution also occurs through release of gases and vapours into the atmosphere from various factories such as in the production of chemical fertilizer, pesticides, sulphuric acid, cement, paper and pulp, paints, iron and steel, etc. Air pollutants from these factories include, among others, carbon dioxide, carbon monoxide, sulphur dioxide, hydrogen sulphide, methane and mercaptans. Other gaseous emissions are odours containing hydrogen sulphide, ammonia, phenols, trimethylamine and mercaptans. Burning of refuse gives rise to considerable amount of smoke and objectionable odours. Automobile engines produce fumes and smokes containing carbon monoxide, carbon dioxide, sulphur dioxide, oxides of nitrogen, hydrocarbons and particulates containing lead and carbon. The release of these gases to the atmosphere seriously impairs man's health and causes considerable damage to the environment.

In some cities, fog combines with the fumes to form smog,

which causes lung problems.

Some of these gases cause global warming, ozone layer depletion, acid rain and even mutation of genetic material. Nitrogen oxides and hydrocarbons react in the presence of sunlight to produce ozone (O_3) and peroxyacetyl nitrate (PAN). Breathing ozone affects respiratory and nervous systems resulting in respiratory distress, headache and exhaustion. Ozone is not damaging to animals alone, but also to plants, resulting in leaf mottling and reduced growth. High levels of carbon monoxide increase ozone formation. Carbon monoxide impairs respiration by combining preferentially with haemoglobin and preventing the haemoglobin from carrying oxygen. The result is suffocation. Carbon monoxide is a major component of the automobile exhaust and the smoke from generators, which have caused the deaths of many people, particularly when such generators are operated inside living houses without adequate ventilation.

OZONE FORMATION AND DEPLETION

The ozone shield is a layer of ozone (O_3) in the stratosphere, some 50 km above the earth's surface, which absorbs much of the ultraviolet (UV) radiation of the sun, preventing it from reaching the earth's surface. In the history of life, ozone shield permitted life on land to exist, while aquatic organisms are shielded by water. In the stratosphere, UV accelerates ozone formation by breaking down oxygen molecules into oxygen atoms. An oxygen atom recombines with an oxygen molecule to form an ozone molecule. This is ozone formation. Ozone depletion is caused by the release of chlorine atoms in the atmosphere by UV breaking down several cm^3 of CFC's into chlorine and carbon atoms. In the troposphere, chlorine breaks down oxygen into atoms, and the oxygen atoms finds an ozone molecule to form 2 molecules of oxygen. Chlorine atoms (Cl) combine with ozone and strip off its oxygen atoms one by one thereby destroying it. Chlorine atoms come from breakdown of CFC (chloro-fluoro - carbon) used in refrigerators and air conditioners as well as in cleaning agents, production of plastics and as spray can propellants. High level of CFC is known to accelerate ozone breakdown into oxygen molecules in the troposphere, and this is referred to as ozone thinning.

Adverse effects of UV radiation include increased mutation rate, which can lead to skin cancer and cataracts, depression of immune system predisposing the human body to attacks by diseases, impaired plant growth and death of planktons. It was observed in the 1980s that some depletion of worldwide ozone had occurred and by the 1990s an annual loss of 40 - 50% of ozone above Antarctica was reported. United Nations Environment Program (UNEP) predicts a 26 percent rise in cases of cataracts and non-melanoma skin cancers for every 10 percent drop in ozone. This transfers to 1.75 million cases of cataracts and 300,000 more cases of skin cancer every year. This calls for great concern.

ACID RAIN

Both sulphur dioxide and nitrogen oxides released into the atmosphere from the various sources mentioned above, including power stations and generators are converted to acids when they combine with water vapour in the air. This results in acid rain. Rain normally has a pH of 5.6, but near urban areas, rainfall pH is nearer 4.0, while some fog clouds drop to as low as 1.7 (very acidic). Living vegetation and building limestone rapidly deteriorate under such acid rains. Other adverse effects of acid rain include killing small invertebrates and decomposers and threatening the ecosystem, reducing agricultural yields, killing lakes and forests, causing extensive structural damage by corroding marble, metal and stonework and degrading water supplies by leaching heavy metals from the soil into drinking water supplies. It has also been implicated in increasing cases of lung cancer and colon cancer (1).

GREENHOUSE EFFECT

This is the warming of the earth surface caused by accumulation of greenhouse gases, which include carbon dioxide, nitrogen dioxide from the above mentioned sources, among others, and methane released from sewage, oil and gas wells, cows etc. These gases allow solar radiation to pass through it to the earth's surface without hinderance. The earth absorbs solar radiation at daytime and at night it becomes a hot body and gives off heat, which would have escaped to the outer space, but, instead, trapped by these accumulated gases within the lower atmosphere thereby causing a rise in the atmospheric temperature, i.e. global warning.

Among others, global warming causes melting of the glacia in the poles and a rise in the sea level resulting in flooding with the associated damages. Sea level rise also causes flooding from rainstorms resulting from the "backwater" effect by which higher sea level slows the speed at which low areas drain into the sea (2,3). Global warming also causes loss of boreal forests, which are sensitive to warmer temperature and water resources fluctuations. The predicted global warming will accelerate sea level rise by 30 – 50cm by the year 2050. This would make some island countries uninhabitable. The salinity of estuaries would increase, thereby decreasing arable land areas, thus threatening food production and impairing water quality.

It is disheartening to note that America, the biggest air polluter and highest contributor to the greenhouse effect and global warming has refused to ratify the 1997 Kyoto Agreement reached by Environmental Ministers around the world to cut down on greenhouse gases emission because they say it would affect their economy. One wonders which should take priority, human life or the economy.

SOIL AND WATER POLLUTION

Most of the water pollutants originate from land in the form of solid and liquid wastes. The solid wastes, such as market wastes, kitchen and household wastes, crop residue, industrial waste, human faeces, etc. carelessly dropped or dumped on the ground, get carried into the canals, streams and rivers by run-off rainwater. Some of these wastes are dumped directly in dams, canals, streams and rivers. Others include chemical fertilizer, which is leached into surface and ground water; pesticides and herbicides used for spraying fields, which are also washed off by rain into nearby streams and rivers where they cause pollution. These lead to poisoning and death of animals and plants and some of the microorganisms important for nutrient recycling.

The liquid wastes include sewage and industrial effluents, domestic wastewater, used motor oils, washings from abattoirs etc.

FERTILIZERS

Chemical fertilizer was invented in 1876 by the German Chemist, Justus Von Leibig. However, plants had always depended on the nutrients naturally present in the soil for their growth and development. But as these soils are over exploited through agriculture and grazing, among others, without adequate return of organic matter to the soil, the soils become gradually impoverished, resulting in decline in crop yield.

To improve the yielding capacity of the soil therefore, farmers had to resort to the use of chemical fertilizer. However, chemical fertilizer, which is a mixture of Nitrogen, Phosphorus and Potassium (NPK), has some adverse effects on the environment. Excess application of chemical fertilizer to the soil has been shown to increase the rate of nitrogen fixation, while the presence of fixed nitrogen greater than natural levels has been shown to considerably reduce plant diversity in some ecosystems. The nitrogen accelerated the growth of plants that were best able to take it up at the expense of plants that were less well adapted. Chemical fertilizer is also leached in large quantities into streams, rivers and lakes where it causes eutrophication and promotes over growth of algae (algal bloom) at the expense of other species. The algae use up so much oxygen that there is none left for the plants and animals. The growth also blocks out sunlight, resulting in death of underwater life. The algae eventually die, leaving a stinking decaying mass.

In soils dependent on chemical fertilizer, there is considerable decline in quality of organic matter with plant diseases becoming more prevalent.

Observations have shown that crops grown on excess chemical fertilizer do not keep in storage; they decay readily. Yam tubers obtained using chemical fertilizer have been observed in some cases to change colour (turn purple) after boiling and produce purple-pounded yam. We can now see why greater premium is placed on organically grown crops.

Persistent use of chemical fertilizer may lead to soil erosion because, unlike organic fertilizer, the chemical fertilizer does not hold the soil together. Hence, the action of the rain and wind washes or blows the valuable topsoil away, an action, which greatly disposes the land to desertification (4).

BIODIVERSITY DESTRUCTION

Apart from environmental pollution, man's destruction of the ecosystem, particularly the rain forest, continues at an alarming rate with grave consequences on our continued existence. We should bear in mind that plants and animals in their natural environment make up the ecosystem. Within an ecosystem there are three actors - the producers, the consumers and the decomposers. The producers, which are the green plants, take carbon dioxide from the air, water and nutrients such as nitrogen, potassium, phosphorus and the micronutrients from the soil and with energy from the sun, through the process of photosynthesis, produce high-energy foods. The consumers, which are the animals, by ingesting the food utilize some of the sun's energy stored in it for their daily activities. The decomposers, microorganisms, use the energy in animal wastes and dead plants and animals and by that convert the organic molecules to stable inorganic compounds, which become available to the green plant to start the process all over again. Each animal has its preference for food. If the plant serving as its source of food is destroyed, as occurs through man's activity, it may lead to its extinction. Other animals depending on that animal for food in the food web will also suffer.

No doubt God has created the planet earth with its plants, animals, waters and oceans and the mineral resources buried inside the soil for mans existence and survival. However, man should realize that for his continued existence, he should embark on prudent management of these natural gifts. We should realize that we are just one of the many players in the web of life, all interdependent on one another and we should stop eroding the very foundation of our own existence with mass species (plants and animals) extinction as a result of deforestation and bush burning, and soil, water and air pollution. This 6th great mass extinction period on earth that we are now causing by the annihilation of the web of life, will very soon result in our own extinction.

In 1992, some 1,700 of the world's leading scientists, including majority of the most intellectually elite people on earth, the Nobel Laueates in the sciences, signed the document "World Scientists Warning to Humanity." It states, "Human beings and

the natural world are on a collision course. Human activities inflict harsh and often irreversible damage on the environment and on critical resources and may so alter the living world that it will be unable to sustain life in the manner that we know." The over 6 billion people now living on earth are already far beyond its carrying capacity. Our reckless expansion into the forest areas is causing countless atrocities to all life sustaining ecosystems. The virgin rainforests are home to 61.8% of all the biological diversity on earth. In this, the richest environment for life, we are destroying a land area of about 240 square miles every day. This destruction of virgin rainforests land area causes between 93 and 1,609 rainforest species extinctions per day.

The Omega point is the point in time when all of the devastation we have inflicted over the years to our life-support ecosystems finally becomes too much and they irreversibly fail, no longer able to sustain the human race. In short, we are gradually burning ourselves out. However, if we are going to survive, we must change our ways completely and immediately. As Albert Einstein said, "We shall require a substantially new manner of thinking if mankind is to survive." Mark Elsis of LOVEARTH states that "At our current rate of mass species extinctions due to rainforests destruction Omega point for Homo Sapiens will occur between 2012 and 2016" (5).

THE NIGERIAN SITUATION

The state of the environment in Nigeria today, occasioned by human activities, leaves nothing to write home about. It is simply sickening. Our forests are being depleted rapidly and air, land and the waters are heavily polluted.

As a result of fast population growth and industrialization, our towns and cities have continued to expand at an alarming rate. This, no doubt, is taking its toll on our forests and the bio-diversity. The forests, which are the reservoir of bio-diversity, particularly the plants, on which our continued existence depends, are rapidly being destroyed.

Our activities have continued to contribute to biodiversity destruction in a number of ways including, forest clearance for farming, housing and establishment of industries, indiscriminate

logging, felling of trees for firewood, grazing, bush burning and oil pollution. Federal Environmental Protection Agency (FEPA) in 1992 reported that between 1950 and 1992 in Nigeria two species of animals and 20 species of plants have become extinct, 48 species of animals and 143 species of plants were endangered, 16 species of animals and 45 species of plants were categorized rare, 30 species of animals and 20 species of plants were vulnerable, while 422 species of animals and 305 species of plants were endemic. More than 70% of the variously threatened plant species occurred in various parts of southwestern geographical areas covering various unique habits. All these species face greater danger of systematic extinction with each passing day unless we take urgent steps to stem this dangerous trend.

Most Nigerians are environmental polluters. Carelessly, we litter every available space with pieces of paper, cans, fruits peels, empty yoghurt and milk cartons, leaves and the sachets of the so called "pure" water, the production of which is now a booming business in the country. Unknown to consumers, most of these waters are impure. Put an unopened sachet of water in the sun for a few days the water turns green due to algal growth; or plate out the water on agar in the laboratory, you observe colonies of bacterial growth. The major component of urban refuse here is the pure water sachet, which constitutes the greatest problem in solid waste management for the very important reason that it is not biodegradable. When carelessly dumped into drains and canals or are carried there by run-off rain water, the pure water sachets obstruct free flow of water and cause flooding. They also get carried into rivers, the lagoon and the sea where they foul outboard engines of boats. Everywhere is a toilet. People (men and women) urinate anywhere they are pressed, behind buildings, by the roadside and even in open places not minding the moral aspect of it. People defecate in bushes, on refuse dumps or in leaves and throw them into gutters, canals or streams. The market women defecate in chamber pots inside their shops and empty these in the drain or canal next to them from where it is carried into the nearby stream.

The motor mechanic pollutes the soil around his workshop with spent engine oil, spent carbide and scrap metals. Casual roadside sellers of petroleum products are not left out. All these get washed into the stream by run-off rainwater.

Sewage sludge sucked by vehicles from septic tanks is emptied into canals, streams, rivers or the lagoon.

In the riverine areas, people defecate directly into the river adjacent to them and swim and bathe in the same river and also use the water from the river for domestic purposes. It is common practice to see women bathing their babies in moving boats by dipping them in the river.

Solid waste generated on land is one of the major sources of our water pollution. This waste, with its faecal contamination, contains various types of pathogens particularly those responsible for water borne diseases such as cholera, dysentery, diarrhoea, typhoid and hepatitis. No fewer than 12 million people worldwide die every year from water-borne diseases and estimated 4 billion cases of diarrhoeal disease occur every year, causing about 4 million deaths, mostly among children.

Cholera outbreak is a very common occurrence in Nigeria particularly in the rural areas due to the filthy way of life of the inhabitants, carelessness and neglect by government. Between December 25, 2005 and January 4, 2006 there were two cases of cholera outbreak. On 2nd January, 2006 the Vanguard Newspaper reported on its page 7 under the heading, "Cholera claims five in Bayelsa" that, quote, "It was a black Christmas for residents of the riverine town of Isoni in Sagbama Local Government Area of Bayelsa State as five lives were reportedly lost in an outbreak of cholera." Apart from the five, several others were said to have been hospitalized in the epidemic, which broke out in the town between December 25 and 28, 2005 and most affected were children. A native was reported by the paper as lamenting that in spite of the several millions of naira that accrue to the council area on monthly basis, most of the communities in the hinterland of the state do not have potable drinking water thereby forcing the people to rely on the same streams and rivers in which they defecate as their source of drinking water with the result that they are exposed to water borne diseases.

This is a great indictment on our governments, particularly as this type of attitude of the local government is not limited to Bayelsa State alone.

On January 4, 2006 the Guardian reported on its front page that a cholera outbreak in Ilase Agbara, a border town between Lagos and Ogun States, has killed 23 persons and sent 40 others to the hospital. The same news, together with a pictorial view of the affected area, was carried by the Nigerian Television Authority (NTA) in its Network news at 9.00 p.m. on 13th January, 2006. The picture of the area as shown on the television revealed a very filthy environment with refuse strewn all over the place and dirty water covered with refuse and human wastes.

These are the reported most recent examples of outbreak of epidemics as a result of pollution.

Sewage and industrial effluents are also major sources of water pollution in Nigeria.

Sewage, which is the wastewater of domestic origin arising from toilets, bathrooms, kitchens and laundry sources, is a dark or yellowish brown liquid rich in odour and pathogenic organisms. Sewage is highly implicated in cases of acute morbidity and mortality among children in Nigeria. Sewage is a carrier of organisms responsible for water borne diseases and discharge of improperly treated sewage into streams and rivers leads to contamination of such water bodies.

Water is an essential medium used in the various processes in industries. Much of this water is discharged as wastewater or effluent, polluted by by-products of the manufacturing process and other waste materials. Factory effluents contain a variety of pollutants including food processing wastes, acids, alkalis, chlorides, oil, nutrients, anions, refined petroleum products, toxic wastes pathogens, objectionable odours etc., depending on the type of raw material used and items manufactured by the factory.

The air is constantly being polluted by smokes from factories, generators, motor vehicles, burning of refuse, bush burning and gas flaring. Added to this is the open air burning of confiscated expired and fake drugs and contaminated food items by NAFDAC as well as the open air burning of seized hard drugs by NDLEA.

OIL POLLUTION

Oil pollution in Nigeria is due to a number of causes among which are spillages, which frequently occur during the development, production, transportation and storage of crude oil and its refined products. Others occur as a result of illegal bunkering, vandalism and accidental blow-out (rupture of pipelines). Since 1976 there have been over 550 reported cases of crude oil spillages in the Niger Delta alone in which over 2.8 million barrels of crude oil were released. Crude oil with the associated natural gas and brine water from drilling oil wells are conveyed under high pressure to flow stations where they undergo separation. The gas is passed to a flare pit on land flow stations or to burners off-shore and flared. This gives rise to the combustion gases, carbon dioxide, carbon monoxide and the nitrogen oxides, which are environmental pollutants. The terrible heat produced has adverse effects on the people living around the area as well as the vegetation and biodiversity. Over N1 billion worth of gas is flared annually in Nigeria; what a great economic loss. Crude oil spillage in the oil industry can never be completely prevented no matter how careful the operators may be. However, what is important is how the spillages are handled by the oil companies involved. Data have shown that there were 2,252 incidents of oil spillage from the Eastern Operations of the oil companies alone between January 1989 and February 2000. During this period a total of 536,858.84 barrels of crude oil were spilled, out of which only 23,003.86 barrels were recovered, with 513,845.98 barrels (96 percent) lost to the environment as pollutant (DPR; NNPC Port-Harcourt). There is no month spillages don't occur.

Oil pollution in Nigeria also occurs as a result of bunkering and sabotage by inhabitants of the oil producing areas who embark on such actions as a way of venting their anger against the oil companies for polluting their land and waters thereby depriving them of their means of livelihood. On several occasions this has led to fire outbreaks causing vegetation destruction, loss of human lives and death of animals.

Oil pollution destroys the vegetation and this may take years to recover or may never recover. It alters the species diversity. It destroys recreational grounds. It causes economic damage by

destroying farmlands and fishing grounds. It is injurious to aquatic life; some of which are heavily contaminated or die. Consumption of the oil contaminated aquatic animals (fish, crabs etc) and drinking oil contaminated water leads to gastrointestinal disorders in man.

Studies carried out in the United States of America have confirmed that epidemics of gastroenteritis have been attributed to the seas foods taken from oil polluted coastal water of Louisiana, New Jersey and Naples (6). It has also been confirmed that exposure to petroleum or its products either in the refinery or through community water supply is one of the confounding variables for gastrointestinal cancer (6). In Nigeria, the valuation report of the Texaco Oil Blow-out at Apoi 20 (otherwise known as Funiwa 5), off Sangana, Rivers State (now Bayelsa State) of 17th January, 1980, which is considered to be one of Nigeria's worst oil disasters, confirms the above health hazards. The report noted that in March, 1980, 180 people died out of 3,819 people seen by the doctors in connection with the incident. The greater percentage of these deaths was found to be caused by gastroenteritis and whooping cough through drinking of the oil polluted water (7).

SOLID WASTES

Improper municipal waste management is a major environmental problem in Nigeria. Heaps of garbage adorn the streets in our towns and cities. This has continued to constitute great headache to our governments.

Sources of solid wastes include individuals, households, animals, automobiles, factories, commercial enterprises, laboratories, hospitals and clinics and market places. The composition of solid waste includes, among others, compostable organic matter particularly from kitchen and market wastes, faecal matter, paper, plastic, textile, rubber, leather, pure water sachets, bone, scrap metal, tins, bottles, oil and grease, ash etc. Solid waste can also contain pathogenic microorganisms and parasites as well as toxic chemicals such as pesticides, heavy metals, volatile organics and solvents.

Heaps of refuse on our streets constitute a public nuisance; they are offensive to sight. In most cases refuse is dumped indiscriminately in open drains and canals where they prevent free flow of water resulting in flooding during heavy rains. Heaps of garbage on our streets also encroach on roads and diminish landscape aesthetics. Decomposing piles of refuse give off offensive odours and attract flies which play a prominent role in the spread of diseases. Leachates from such piles contaminate both surface and ground waters. Two general methods of refuse disposal practice in Nigeria are dumping and burning.

The refuse deposited on the streets are collected by vehicles owned by governments or their agents and dumped at designated central dumping sites where they are left to decay. However, collection by the vehicles has never been regular due mainly to lack of adequate funding, hence the persistent huge refuse deposits on our streets. They usually resort to burning of the refuse with the smoke generated polluting the air and contributing to the greenhouse effect.

BUSH BURNING

Bush burning is another serious cause of environmental degradation. Bush burning is a common occurrence in Nigeria, particularly during the dry season. It is either accidental or deliberate. The accidental cases occur through fuel tanker accidents, during illegal bunkering or through careless disposal of unquenched cigarette butts or by not properly putting out cooking fires especially by the roadsides. However, bush burning in Nigeria is mostly deliberate. It is either carried out by individuals or groups of individuals hunting for rats or other bush animals for food or farmers preparing the land for cropping or by the cattle rearers to prepare the land for fresh grass growth for their cattle during the rainy season that follows. As a result of these activities vast areas of forest are destroyed with the resultant alteration in bio-diversity. The natural habitats of the animals are destroyed. While some of the animals are killed, others are forced to migrate to other areas. Some rare species and endangered species are thus hunted to extinction. Many plants of economic and medicinal importance are destroyed. Many rare plants that hold the key to the cure of some

chronic diseases are burnt to extinction; these include those already known and those that are yet to be exploited. Many food crops are also destroyed. Some of the microorganisms responsible for soil fertility through nutrient re-cycling are killed. During the re-growth of the vegetation in the rainy season there is usually a change in the species diversity.

Bush burning also deprives the bush animals of their sources of healing the herbs. Like human beings these animals in the wild do fall sick and when this happens they, by instinct, know which herbs to eat to be cured. When they are in labour they know which herbs to chew for easy delivery. In fact some of our forefathers who were farmers and hunters learnt the art of herbal medicine through their observations of these animals in the forest, sensing that any herb that could cure an animal must be able to cure a human being. This practice is still on today.

Bush burning in Nigeria is gradually altering our ecological zones, turning our forests into savanna and the savanna into desert. Desert encroachment in the northern part of the country is a great problem facing the country today. Bush burning contributes to the greenhouse effect in two ways; by increasing the amount of carbon dioxide in the atmosphere and at the same time depleting the number of the available green plants, which act as sink for carbon dioxide.

MY CONTRIBUTIONS

Realising that, to save our environment, scientists have got a major role to play, I decided to focus my attention over the years on finding solutions to some of our pressing environmental problems.

As soon as NTA Channel 10 carried the news of the invasion of the Lagos Lagoon by a "strange" weed on its 9.00p.m. Network news broadcast on 9 January, 1985, I was the first scientist in the country to identify the weed as water hyacinth (*Eichhornia crassipes*) and to alert the nation on the terrible nature of the weed and the adverse effects it would have on our people and the national economy should it be allowed to spread unchecked on our waters. I immediately wrote a report on the weed and sent a copy to the Federal Ministry of Science and Technology and another to NTA.

Thereafter NTA sent some of its staff to Sudan and Egypt, where the weed had been prevalent for years, to verify my claims about the weeds both in my television interview and my report. The team returned a few days later and confirmed all I had said about the weed and, in another television interview, sought my advice on how this problematic weed should be tackled.

It was also on the basis of the report I submitted to the Federal Ministry of Science and Technology that an Interministerial Committee was set up in the Ministry in March 1985 to handle the control of the weed. I was a pioneering member of this Interministerial Committee and I was later appointed the National Research Coordinator of the Water Hyacinth Project. I have since continued to play a leading role in finding lasting solution to the weed problem and evolving viable economic uses for it from which the nation could benefit.

The spread of water hyacinth *Eichhornia crassipes* in the tropical and sub-tropical freshwaters around the world is a good example of the economical damage man has brought on himself as a result of undue disruption of natural ecological balance.

Water hyacinth is one of the world's eight worst weeds and certainly the worst floating aquatic weed known. It is a perennial freshwater plant which is tropical and sub-tropical in habitat with its origin in the Amazon Basin, South America. It is a free-floating monocot belonging to the order liliales and family pontederiaceae. Water hyacinth grows and multiplies vegetatively at an alarming rate and covers water surfaces fast. The weed grows in rivers, lakes, ponds, canals, drains, dams, ditches and reservoirs. It propagates vegetatively through stolons giving rise to off-shoots that are interconnected. Under favourable conditions ten plants can multiply to 600,000 and cover an acre of water in only eight-months.

Water hyacinth is one of the world's most economically damaging weeds. It makes navigation difficult or impossible, makes fishing impossible, blocks canals and pumps in irrigation projects and disrupts power generation in hydroelectric projects. As the weed cover becomes more dense, it destroys fishing grounds by shading and cutting off oxygen supply to the fishes. Fishing activities are also paralysed.

Through evapotranspiration, water hyacinth can increase the rate of water loss two to eight times of water loss from a free water surface. Hence it accelerates the drying-up of rivers, lakes, reservoirs, canals, river basins and dams.

In its natural habitat in the Amazon Basin, the water hyacinth is not a problem because, naturally originating on the weed are certain weevils, *Neochetina eichhorniae* and *Neochetina bruchi*, which feed on the weed and keep its population low. These weevils are host-specific to the water hyacinth and there is an ecological balance between the weed and the insects. The water hyacinth became a nuisance the moment it was taken out of its natural habitat without the weevils, thereby disrupting the natural balance and setting the weed free.

The spread of water hyacinth through human activity started in 1884 when it was first introduced into the United States of America at a Cotton Exposition in New Orleans, Louisiana by Japanese exhibitors who had gathered the plant from its native habitat in Venezuela and offered it as souvenirs to visitors to their stands because of its lovely green colour and beautiful lavender flowers. Unfortunately, however, this nice gesture had a sad ending because many of the plants were later carelessly thrown away in drainages, canals, swamps and streams from where they multiplied vegetatively at a fast rate and colonized other rivers. This was the beginning of America's water hyacinth problems. Today water hyacinth is a great nuisance in over 50 countries around the world with millions of dollars being spent every year to clear the weed from waterways. The water hyacinth entered the Nigerian waters from Benin Republic via Badagry around September 1984 and got to the bar beach in January 1985. It has now spread to over 14 states of the federation. The weed thrives best in polluted waters.

My efforts in the area of economic utilization of the weed have paid off. Through intensive research over a number of years I have been able to develop a special microbial formula for fighting environmental pollution and promoting clean environment, land and water. This material, which consists of a powdery substance specially obtained from water hyacinth and heavily impregnated with a special combination of microorganisms capable of breaking

down organic matter rapidly, I have patented in Nigeria as OBD-plus (Oso-Biodegrader-Plus). OBD-plus does the following, among others:

- (a) It breaks down refuse into nutrient-rich organic fertilizer within four weeks;
- (b) Purifies fresh sewage into clean water:
 - (i) OBD-plus is currently being used in combination with water hyacinth, specially trained to withstand toxicity, to purify the sewage of the entire University of Ibadan community into clean water. This system has been in use since 1992 and apart from saving the University the headache of sewage disposal, it has continued to save the institution a lot of money annually.
 - (ii) At the instance of the then Federal Ministry of Works and Housing, the system was installed at the Federal Housing Estate, Surulere, Lagos in 1999.
 - (iii) The system was installed at the Covenant University, Ota in 2003 for the treatment of the sewage of the entire University community.
- (c) OBD-plus purifies industrial effluents into clean water:
 - (i) The OBD-plus technology in combination with trained water hyacinth was installed at the Nigerian Brewery Plc, Ibadan in 1997 for the treatment of the brewery effluent into clean, odour-free water. This had contributed to the winning of two FEPA Awards by the Brewery at the World Environment Day Celebration at Abuja on June 5, 1997.
 - (ii) OBD-plus is the bio-treatment agent currently being used, in place of the imported material previously being used, by De-United Foods Industries, Producers of Indomie Noodles, at Ota, Ogun State.
 - (iii) Besides, OBD-plus has been tried on a number of other industrial effluents with success. These include factory effluents from Associated Match Industries (Nig.) Limited, EFCO Foods Limited and Sweetco Foods Limited, all at Ibadan, WEMABOARD Central Industrial effluent treatment plant at Ikeja receiving effluents from over 60 industries and Agbara central industrial treatment plant (Tables 1 - 6).

TABLE 1
LABORATORY ANALYSIS OF UNTREATED AND OBD-PLUS TREATED
FACTORY EFFLUENT FROM DE-UNITED FOOD INDUSTRIES,
PRODUCERS OF INDOMIE NOODLES, OTA, OGUN STATE

Parameter	A		B	
	Untreated Effluent	OBD-Plus Treated Effluent	Untreated Effluent	OBD-Plus Treated Effluent
Appearance	Cloudy-white	Clear Transparent	Cloudy-white	Clear Transparent
Odour	Unpleasant	Odourless	Unpleasant	Odourless
pH	6.74	7.10	6.79	7.12
TDS (mg/l)	372.3	194.6	374.5	194.9
TSS (mg/l)	334.6	84.7	336.8	85.2
COD (mg/l)	513.8	112.6	518.3	116.2
BOD (mg/l)	246.8	8.8	252.7	8.4
DO (mg/l)	2.4	11.9	2.7	11.5
TPH (mg/l)	17.8	0.12	18.2	0.14
NH ₃ - N (mg/l)	19.8	5.2	19.5	5.6
Phosphate (mg/ml)	9.6	3.3	9.4	3.7

TABLE 2
LABORATORY ANALYSIS OF UNTREATED AND OBD-PLUS TREATED
FACTORY EFFLUENT FROM ASSOCIATED MATCH INDUSTRIES
PRODUCTION PLANT AT IBADAN

Parameters	A		B	
	Untreated Effluent	OBD-Plus Treated Effluent	Untreated Effluent	OBD-Plus Treated Effluent
Appearance (Colour)	Brown, Turbid	Clear, Tinted Yellow	Brown, Turbid	Clear, tinted Yellow
Odour	Unpleasant	Odourless	Unpleasant	Odourless
pH	8.20	7.30	8.30	7.30
TDS (mg/l)	584.2	179.6	584.5	179.4
TSS (mg/l)	438.6	62.8	438.4	63.2
COD (mg/l)	614.8	103.2	615.3	102.9
BOD (mg/l)	384.6	9.5	384.8	9.3
DO (mg/l)	2.9	12.6	3.1	12.3
TPH (mg/l)	19.2	0.10	19.5	0.08
NH ₃ - N(mg/l)	23.2	2.1	23.6	2.3
Phosphate (mg/l)	13.7	4.2	13.5	3.9

TABLE 3

LABORATORY ANALYSIS OF UNTREATED AND OBD-PLUS TREATED MIXED FACTORY EFFLUENTS FROM EFCO FOODS LIMITED, IBADAN

Parameters	A		B	
	Untreated Effluent	OBD-Plus Treated Effluent	Untreated Effluent	OBD-Plus Treated Effluent
Appearance	Black	Clear Transparent	Black	Clear Transparent
Odour	Unpleasant	Odourless	Unpleasant	Odourless
pH	6.40	7.10	6.30	7.13
TDS (mg/l)	363.54	217.06	365.46	215.82
TSS (mg/l)	343.11	86.34	346.83	86.30
COD (mg/l)	479.4	103.5	480.4	103.3
BOD (mg/l)	234.8	12.6	232.6	12.4
DO (mg/l)	2.5	13.2	2.3	12.9
TPH (mg/l)	18.9	0.17	19.2	0.18
NH ₃ - N (mg/l)	23.6	4.3	24.2	4.7
NO ₃ ⁻² (mg/l)	0.55	0.21	0.53	0.19
Phosphate (mg/l)	13.3	4.3	12.6	3.9
Ca (mg/l)	72.8	35.7	73.1	36.2
Pb (mg/l)	0.16	0.03	0.18	0.02

TABLE 4

**LABORATORY ANALYSIS OF UNTREATED AND OBD-PLUS TREATED MIXED
FACTORY EFFLUENTS FROM SWEETCO FOODS LIMITED, IBADAN**

Parameters	A		B	
	Untreated Effluent	OBD-Plus Treated Effluent	Untreated Effluent	OBD-Plus Treated Effluent
Appearance	Blackish	Clear Transparent	Blackish	Clear Transparent
Odour	Unpleasant	Odourless	Unpleasant	Odourless
pH	6.60	6.98	6.61	6.97
TDS (mg/l)	347.84	212.8	348.62	210.6
TSS (mg/l)	329.37	82.78	331.44	82.92
COD (mg/l)	464.3	97.2	464.5	96.8
BOD (mg/l)	213.2	11.6	212.4	11.8
DO (mg/l)	3.1	13.7	2.8	13.1
TPH (mg/l)	16.6	0.13	17.1	0.12
NH ₃ - N (mg/l)	14.6	3.8	15.2	4.1
NO ₃ ²⁻ (mg/l)	0.32	0.14	0.33	0.16
Phosphate (mg/l)	11.2	4.1	11.4	3.8
Ca (mg/l)	53.4	31.6	53.7	32.3
Pb (mg/l)	0.16	0.03	0.18	0.02

TABLE 5
LABORATORY ANALYSIS OF UNTREATED AND OBD-PLUS-TREATED WEBA
BOARD CENTRAL INDUSTRIAL EFFLUENT TREATMENT PLANT, IKEJA,
LAGOS

Parameters	A		B	
	Untreated Effluent	OBD-Plus Treated Effluent	Untreated Effluent	OBD-Plus Treated Effluent
Appearance	Blackish	Clear	Blackish	Clear
Odour	Unpleasant	Odourless	Unpleasant	Odourless
pH	8.16	7.42	8.10	7.40
TDS (mg/l)	352.14	204.21	352.19	206.30
TSS (mg/l)	318.2	96.2	320.6	97.3
COD (mg/l)	482.6	104.2	483.8	106.4
BOD (mg/l)	209.8	11.2	210.3	10.8
DO (mg/l)	3.4	12.3	3.1	12.7
TPH (mg/l)	15.63	0.16	16.21	0.18

TABLE 6
LABORATORY ANALYSIS OF UNTREATED AND OBD-PLUS TREATED
EFFLUENTS FROM AGBARA CENTRAL INDUSTRIAL EFFLUENT TREATMENT
PLANT

Parameters	A Untreated Effluent	OBD-Plus Treated Effluent	B Untreated Effluent	OBD-Plus Treated Effluent
Appearance	Cloudy Dark	Clear Transparent	Cloudy Dark	Clear Transparent
Odour	Unpleasant	Odourless	Unpleasant	Odourless
pH	7.90	7.10	7.89	7.08
TDS (mg/l)	363.4	188.6	357.8	187.9
TSS (mg/l)	321.7	86.3	318.2	89.1
COD (mg/l)	537.4	108.7	543.8	105.4
BOD (mg/l)	253.7	9.7	257.2	9.4
DO (mg/l)	2.8	11.4	3.2	11.3
TPH (mg/l)	19.4	0.15	18.8	0.17
NH ₃ - H (mg/l)	21.6	6.3	22.1	6.7
Phosphate (mg/l)	11.2	4.1	11.6	4.5

- (a) OBD-plus biodegrades crude oil and its refined products at a fast rate, hence, it is a useful agent in the bio-remediation of oil polluted environment (land and water). As a result of its remarkable ability to agglomerate oil into a lump both on land and on water it is a good agent for deployment in Immediate Response Action (IRA) for the arrest of spread of oil when there is a spill and as a clean-up agent of oil polluted land and water.
- (b) OBD-plus biodegrades and detoxifies drilling mud used in the oil industry and makes it safe for discharge into the environment.

Drilling Mud

During crude oil drilling operations fluid drilling mud is pumped and recirculated through the borehole to serve as a lubricant to the drilling bit and to counteract water, oil and gas pressure by virtue of the hydrostatic pressure of the column of the drilling fluid. The fluid drilling mud generally consists of a colloidal suspension of clays (usually bentonite) in water with various chemical compounds added for specific purposes at a given site. Many of these additives are organic and include, among others, lignosulfonates and chrome lignite. Lignosulfonate is a by-product of the sulphite pulping process. Both lignosulfonates and lignites serve as thinners or dispersants in the mud. Lignosulfonates, however, pose environmental pollution risks mainly because of their high water solubility and resistance to microbial degradation although many of them can serve as carbon source for some microorganisms.

Safe disposal of undesirable drilling mud not re-used is presently a big problem worldwide. The current practice in on-shore operations is to dump it in temporary or permanent pits, which of course, overflow into the surrounding land as a pollutant. In off-shore drilling, however, this is deposited into the surrounding waters where it also causes pollution.

Results of my work have shown that drilling mud is phytotoxic to maize. It causes abnormal growth and death of the seedlings. However, I have been able to demonstrate that treating it with OBD-plus biodegrades it and renders it non-toxic and safe for discharge into the environment (Table 7). The OBD-plus treated drilling mud supports good growth of crops as shown by a trial on maize.

TABLE 7
LABORATORY ANALYSIS OF UNTREATED AND OBD-PLUS TREATED
DRILLING MUD

Parameters	Untreated Drilling Mud	A			Untreated Drilling Mud	B		
		OBD-Plus-Treated Drilling Mud				OBD-Plus-Treated Drilling Mud		
		After 7 Days	After 14 Days	After 21 Days		After 7 Days	After 14 Days	After 21 Days
PH	9.10	7.55	7.40	7.10	8.90	7.50	7.30	7.00
PO ₄ (mg/kg)	32.36	11.62	9.14	4.76	32.43	11.57	9.12	5.12
NO ₃ (mg/kg)	8.23	2.16	1.94	0.96	8.23	2.24	1.88	0.98
NH ₃ (mg/kg)	23.62	9.46	5.16	2.14	23.53	9.54	5.12	2.17
Org. Carbon (%)	49.76	29.64	26.22	18.26	51.25	30.28	25.94	18.33
Org. Matter (%)	85.79	51.10	45.20	31.48	88.36	52.20	44.72	31.60
Moisture (%)	41.83	19.62	13.76	13.06	41.79	19.58	13.79	12.96
Cd (mg/kg)	1.37	0.86	0.54	0.24	1.37	0.92	0.48	0.26
Zn (mg/kg)	78.22	66.46	54.52	41.32	79.14	66.53	54.48	39.96
Pb (mg/kg)	3.24	1.42	1.02	0.86	3.27	1.37	1.04	0.88
Mn (mg/kg)	196.5	124.6	117.2	102.5	196.7	124.6	117.4	102.7
Cu (mg/kg)	6.8	4.5	2.8	1.2	7.2	4.7	3.2	1.4
Total Phosphorus (%)	0.76	0.48	0.31	0.13	0.84	0.54	0.27	0.15
K (%)	0.83	0.56	0.43	0.24	0.86	0.61	0.39	0.22
Na (%)	0.47	0.26	0.19	0.11	0.45	0.24	0.23	0.09
Fe (mg/kg)	16.62	11.74	8.26	5.26	16.65	11.66	7.94	5.22
Oil (%)	51.76	8.42	0.52	0.12	51.82	8.36	0.48	0.09

SUGGESTED SOLUTIONS

The following are being proffered as solutions to some of our environmental degradation problems.

Solid Waste Disposal

For proper handling of solid waste in this country, an integrated solid waste management approach is here being recommended. This is turning the waste to wealth through recycling. Since the waste is made up of compostable and non-compostable components, these can be sorted out and the compostable part can be processed into organic fertilizer, while recyclable components of the non-compostable part will be sent to the relevant factories as raw materials for recycling. The non-compostable and non-recyclable components can then go into landfill.

The facilities for the integrated management should be located adjacent to each other and these should consist of a composting plant, material recovery facility for easy separation of the refuse into compostable and non-compostable parts, and a landfill for the non-recyclable and toxic components. The hazardous wastes can be "imprisoned" by mixing with cement into a concrete.

In the meantime there are some human scavengers whose source of livelihood is the refuse dumps. For instance in Lagos, as far back as 1998 about 10,000 of its inhabitants earned their living from the dumps (the Punch, March 5, 1998, p.12). According to the paper, Ladi Akerele, 18, a school drop-out said, "I pray daily so that solutions may not be found to the problems of waste management in Lagos because that may deprive me my source of revenue." The scavengers search through the refuse dumps for plastics, metals and other objects, which they sell to middle men, who in turn sell them to recycling industries. Like any other trade, the scavengers even compete keenly for these objects. The paper also quotes one Taiwo Obiyan, a father of three and a scavenger as saying: "I often wake up as early as 5a.m. in order to arrive at waste dumps before my other colleagues and before those whose discharge the waste." Obiyan had by then been out of job for seven years, having been retrenched from his job as a messenger in a private company. However, according to him, he does not regret

his present job. The paper quotes him as saying, I quote: "while I was employed, my salary was N2,500 a month, but today I make as much as N7,000 monthly as a scavenger." Obiyan maintained that he manages to feed his family and pay the school fees of his children from the proceeds of his job. This scavenging is not limited to Lagos, it is the practice all over the country. The scavengers even recover a lot of useful items, which they sell for good money.

In the integrated solid waste management programme being proposed, however, some of these scavengers can be organized into groups and employed on regular salaries for the sorting of the refuse as a way of providing them jobs.

Garbage collection and disposal should be well organized and adequately funded. Ideally, like in the developed countries, separation of garbage into compostable and non-compostable components should be at the household level with the garbage bins placed in front of each house from where garbage collection vehicles regularly evacuate them. In Nigeria, however, due to lack of proper planning of some of our towns and cities or parts thereof, most houses are inaccessible to vehicles and this will make the above arrangement difficult to implement in these areas. It is pleasing to note however, that in few of our cities like Lagos and Ibadan, private refuse collectors are now actively involved in refuse collection at household level, but they only operate in areas accessible to vehicles.

Aforestation and Anti-desertification: the Place of Organic Fertilizer

Organic fertilizer is the answer to some of the environmental problems facing Nigeria today, viz; desertification, soil erosion, water pollution by chemical fertilizers, herbicides and pesticides and safe food production.

The northern part of the country, which produces the bulk of the cattle and vegetables consumed in the country is over-grazed and over-cropped. It is also in the north that felling of trees for firewood is most intensive. These have led to a great reduction in the vegetation cover and the resultant depletion in the organic matter and nutrients in the soil. To sustain good crop yield every year the farmers have had to result to the use of considerable

amounts of chemical fertilizer. In fact, that is where the bulk of the chemical fertilizers produced locally in the country as well as those imported are being used. Deny a northern farmer the supply of chemical fertilizer, then you are looking for trouble. However, as the chemical fertilizer cannot hold the soil particles together, the land becomes prone to both water and wind erosions, which further impoverish the soil and aid desertification. Parts of the chemical fertilizers get washed into nearby streams and rivers by run-off water during rainstorms thereby polluting the water bodies. Over application of chemical fertilizers also results in food contamination.

Any afforestation/anti-desertification programme embarked upon in this country that does not give priority to the use of organic fertilizer is a joke. This is because, unlike chemical fertilizer, the organic fertilizer binds the soil particles together thereby preventing the soil from water and wind erosion. It also retains moisture and restores the fertility of the soil by supplying the needed balanced nutrients for plant growth. It minimizes/eliminates the use of herbicides and pesticides, which are environmental pollutants, as it suppresses weed growth and attack of crops by pathogens. It will reduce dependence on chemical fertilizers, which are also pollutants. Besides, conversion of urban solid wastes to organic fertilizer is a profitable way of ridding our streets of sickening garbage heaps.

Government should intensify its afforestation/anti-desertification programme by financing large scale production of organic fertilizer for its successful implementation. OBD-Plus, which converts refuse into nutrient rich organic within four weeks, will be a candidate of choice here.

Air Pollution

To reduce the current rate of air pollution in the country the following steps are being suggested:

- Burning of refuse should be minimized; disposal should be by recycling.
- Gas flaring should stop.
- Deliberate bush burning should be out-lawed.
- NAFDAC and NDLEA should forthwith desist from the dangerous practice of open air burning of confiscated drugs;

- furnaces should be built for such purposes.
- Government should intensify efforts at raising the level of power generation in the country to reduce dependence on the use of private generators.
 - Greater attention should be paid to exploitation of other source of energy such as: solar energy, which does not generate additional heat or smoke to the atmosphere; falling water for the production of electricity in hydroelectric dams and wind power in windmills for pumping water or generating electricity. Unlike fossil fuels, which are non-renewable, these alternative sources are renewable.
 - Effective solution should be found to the menace of smoking vehicles on our roads.
 - Deforestation should be discouraged, while tree planting by individuals, private concerns, governments and government agencies should be encouraged to provide adequate sinks for carbon dioxide, the major greenhouse gas.

Water Pollution

To minimize water pollution from industries, our environmental law enforcement agencies should ensure that all industries in the country put in place effective industrial effluent treatment facilities in their factories. The arms of the law should descend heavily on defaulters and the law enforcement officers should not compromise their positions no matter the temptation, monetary or material.

At the moment the central sewage treatment system being employed in Nigeria is the activated sludge plant. This is an imported technology, which is very expensive to install and operate. The plant breaks down easily and it is expensive to repair; all the spare parts are imported. As a result, many of them have been abandoned in the country. It is here being recommended that indigenous central sewage treatment system should be put in place to replace the existing non-functioning ones as has been done in the University of Ibadan. Such indigenous system should also be installed in deserving places

in the country, like the police and army barracks, housing estates, secondary schools and tertiary institutions. Such central sewage treatment system should also be installed in strategic places in our cities for the deposition and treatment of the sewage sludge evacuated from household septic tanks instead of dumping in canals, streams or in the lagoon.

Oil Pollution

In the activities of the NNPC and the oil companies, oil spillages cannot totally be avoided. However, what is important is how such spillages are handled. To this end, NNPC and the oil companies must put in place effective facilities for Immediate Response Action with adequate equipment and procurement of agents that can arrest the spread of oil both on land and on water. To bring succor to the riverine communities whose lands have been devastated through oil exploration activities and to restore lasting peace to the Niger Delta region, NNPC and the oil companies should, as a matter of urgency, embark on massive clean-up and bio-remediation operations of the affected lands and waters by employing effective, fast acting and environmentally safe biological agents to restore the environment to positions suitable for the use of the people in fishing and other economic and recreational activities. The Niger Delta Development Commission (NDDC) should play a prominent role here as well.

In view of the high level of its toxicity, drilling muds should be well treated to de-toxify it before discharge into the environment. Effluents from flow stations should be treated free of oil before discharge into the receiving waters.

Our findings have shown that OBD-Plus is a good biological agent for all the above. In addition to this, however, our scientists should research further into technologies that can complement the use of OBD-Plus in fighting this and other environmental pollutions.

SUSTAINABILITY

To promote clean, healthy and sustainable environment, governments at all levels should:

- (i) Embark on public enlightenment to create the awareness among the people on the dangers inherent in environmental

pollution and degradation. They should run jingles on radio and television to this effect. States that may have been doing this already should intensify their efforts and make it all embracing.

- (ii) Environmental management should be taught in primary and secondary schools so as to create the awareness among the children at an early age of the essence and importance of keeping the environment clean.
- (iii) Government should construct toilets in public places and, to maintain hygienic use of such toilets, they should be manned by government employees whose duty would be to keep the toilets clean and ensure their proper use.
- (iv) Similarly, government should provide well secured refuse bins along the streets for passers-by to drop wastes.
- (v) The monthly environmental sanitation exercise carried out in some states should be embraced by all states of the federation. Apart from this, every household should be encouraged to devote some time every weekend to the general cleaning of their compound with the refuse so collected properly disposed of in authorized places.
- (vi) Federal and state governments should enact laws against environmental pollution, particularly indiscriminate dumping of refuse especially in drains, canals, roadsides and other unauthorized places. In this connection, it is pleasing to note that Bauchi State Government, in its determination to ensure a hygienic and environmentally clean society, recently concluded plans to enact a legislation aimed at prosecuting violators of environmental laws in the state.
Similarly, Lagos State Government has declared year 2006 as the year of total clean-up for Lagos and has therefore urged residents and Lagosians to imbibe culture of cleanliness at all times and in all places. The environmental laws of the state are also said to be currently being reviewed.
- (vii) To solve the problem of refuse collection from the houses inaccessible to vehicles, each household should be provided with refuse bins in front of their houses and government should employ people to go round the houses regularly and

empty the bins into bags and take them to designated collection points where they should be promptly picked up by vehicles for proper disposal. Such collection of refuse from doorsteps will minimize dumping of refuse in drains and canals by individuals

- (viii) Each household should be made to pay refuse collection levies monthly to assist government in providing these services.
- (ix) Government should pay attention to the provision of good drainage systems in our towns and cities. It has been observed that lack of proper planning of parts of our towns and cities and poor drainage cause flooding whenever it rains with the run-off water washing garbage and improperly disposed human wastes into houses. This often results in epidemics.
- (x) As Nigerians are always waiting to be forced to do what they know should be done, I would advocate the re-introduction of Sanitary Inspectors.
- (xi) Our governments at all levels should let the welfare of the people be paramount in their minds and hence provide them with all necessary amenities as provided for in their annual budgetary allocations for raising the people's standards of living and not to convert the funds meant for such purposes to their personal use as currently being witnessed in some parts of the country.

CHALLENGE TO SCIENTISTS

The salvation of the planet earth rests with scientists. They are the ones to find lasting solutions to the problem of environmental pollution in all its ramifications. They should provide, among others:

- Technologies for effective recycling of pure water sachets and nylon bags as well as the development of bio-degradable polyethylene bags.
- Affordable and effective technologies for sewage and industrial effluent treatment.
- New strains of microorganisms through biotechnology for fast bioremediation of oil polluted environments and fast nutrient recycling in solid waste management.

- Biological herbicides to replace the environmentally unsafe chemical herbicides.
- Alternative sources of energy to cut down on the use of fossil fuels and firewood to save our forests and reduce air pollution and the greenhouse effect.
- Alternative energy source for car engines to reduce air pollution.

Scientists in Nigerian universities have continued to embark on researches over the years to produce publications aimed mainly at obtaining promotion – the publish or perish syndrome. Most of these end up on the shelves. It is high time we changed the trend and undertake researches aimed at solving national and international problems and also evolving new innovations. To this end, it is pleasing to note that the University of Ibadan has taken the lead through the establishment of the University Mission Research (UMR) programme, which is innovation development oriented, initiated by the Professor Falase Administration. The UMR under the able chairmanship of Professor S. S. Ajayi of the Department of Wildlife and Fisheries Management at the moment has as its focus the Processing and Management of Wastes for Sustainable Agricultural and Industrial Development – Waste to Wealth. Under this theme, fourteen projects are currently being undertaken, each by a group of scientists on the campus. I was appointed chairman of the Monitoring Team whose duty it was to ensure that the researches were thoroughly and promptly carried out and the funds judiciously spent. I make bold to say that tremendous achievements have been made in the various projects with innovative findings, some of which have now been patented. This type of research, aimed at solving specific national problems, should continue to be funded by the University as this will also boost the image of the institution.

Many people expressed surprise when they learnt that at the 2005 rating of Universities worldwide no Nigerian or even African University was listed among the best 200 in the world. The reason for this is not far fetched. There is a high level of infrastructural decay in our universities. The laboratories are ill-equipped and there are no chemicals to run adequate practical

classes for the students not to talk of doing meaningful research. Many students have to resort to doing their research in laboratories outside the university. We should be reminded that universities are recognized not only by the number of students being turned out every year, but more by innovative research findings providing solutions to national and international problems. At this juncture I wish to appeal to our governments to make adequate funding of research in our universities a priority. It is gratifying to observe that the Federal Government has recently embarked on the refurbishing of a number of Teaching Hospitals in the country. I commend the government for taking this bold step to revamp our health sector. I would like to seize this opportunity to appeal to the Federal Government to extend this kind gesture to a number of the Federal Universities to upgrade them to world standard. I call on the Vice-Chancellor, the Management and Council of this University to make a strong representation to this effect to the Presidency through the appropriate channels without further delay.

Poverty and Environmental Pollution/Degradation

Environmental pollution in Nigeria is mostly poverty and policy driven. It is poverty that makes people not to be able to afford good toilets for proper sewage disposal; it is poverty that militates against proper refuse disposal; It is poverty that gives rise to high rate of proliferation of pure water business in the country; it is poverty that makes people live in slums under unhygienic conditions with the attendant spread of diseases and epidemics; it is poverty that makes people put fire to bushes to hunt for bush animals even as small as rats and rabbits for food; it is poverty that makes people resort to cooking with firewood; it is poverty that made some people accept toxic waste to be dumped in Koko near Sapele in 1988, an action that gave birth to the Federal Environmental Protection Agency (FEPA) the same year and have since continued to create awareness on the state of our environment and it is poverty that forces people to make a living on dumped refuse, exposing themselves to various health hazards. Urban planning fail to integrate efficient sewage treatment systems.

I hereby call on our governments at all levels to upgrade the conditions of living of the people and provide them with

necessary facilities for healthy living.

Be an Environmental Watch-Dog

In conclusion, I wish to remind you once more that the planet earth belongs to all of us and it is the binding duty of all and sundry to ensure that the environment is kept clean. I call on everyone to be an environmental watch-dog. Therefore be patriotic and ensure that:

- your vehicles don't smoke by taking prompt care of the engine.
- You should not litter.
- If you see anybody dropping litter on the ground anywhere, don't hesitate to ask him to pick it up.
- If you see anybody urinating or defecating where he should not, be bold enough to challenge him.
- If you know of any industry discharging untreated effluents into the environment, alert the appropriate authorities.
- If you see anybody putting fire to bushes, inform the appropriate authorities.
- In short, if you see anybody, group of persons, business concerns or industries committing atrocities against the mother earth don't hesitate to alert the appropriate authorities. We should remember that it is how we make our beds that we are going to sleep on them.

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