BETTERING THE LOTS

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EDITORIAL

Driven by curiosity and speculation as well as quest for new facts and principles, Pure Sciences stop at the development of general laws of nature and are less concerned with the practicality of their results or finds. Applied sciences take over from there, seeking the practical use of scientific knowledge and, therefore, forming the bridge between sciences and development. With the growth of the chemical and electrical power industries in the 19th century, scientific knowledge became of direct use in solving problems and the development of products.

The *Journal of Applied Sciences and Development* was born to publish materials on the areas bordering in the output of Applied Sciences as they relate to Development of the Society. It is a biannual published April and October beginning from 2010.

The maiden Volume 1 Number 1 of April 2010 is loaded with a variety of sound articles covering contemporary issues in Applied Sciences and Development. In the first article, titled Green Chemistry in E-Waste Management and Control in Africa, Onyenekenwa Cyprian Eneh argues that in the information milieu, many developing countries are in a hurry to address "information poverty," bridge development gaps and minimize their exclusion and/or marginalization in the global market economy driven by globalization and powered by the information communications technologies (ICTs).

Understandably, poverty and desirable consumption of ICTs have combined to impose used and inferior ICTs components on these countries. These inferior and used ICTs components soon become unserviceable and abandoned, thus contributing to environmental hazard. They are ubiquitous and improperly discarded in these countries with technological backwardness and weak legal environment to manage and control e-waste. Green or Sustainable

Chemistry has the principles for management and control of the mounting e-waste generated as a result of increasing ICTs diffusion in developing countries. But, the concept of Green Chemistry and Sustainability is still at its infancy in most of these countries.

Considering the crucial and diverse roles of Sustainable Chemistry in e-waste management and control, which is a milestone in the new global paradigm of sustainable development, the author recommends that (1) the concept of Green Chemistry and Sustainability be introduced in the education system in developing countries; (2) policy be put in place for the study of Sustainable Chemistry in schools in developing countries; (3) legal framework be put in place for the practice of Sustainable Chemistry in the industry in developing countries; and (4) more serious measures should be taken at national and international levels to encourage the study of Chemistry and to enhance the regulation of its practice in order to maximize the services of the Chemist in environmental sustainability, which includes e-waste management and control.

In the second article, Chima Theresa Isife argues that the hazards caused in Nigerian homes, schools and industries by use of traditional petrochemical solvents can be avoided by replacing them with environmentally friendly green solvents in the context of sustainable development.

The economic and nutritional importance of soybean informs the need for the review of soybean production, processing and marketing in Nigeria presented by Daniel Sunday Ugwu and Henrietta C. Ugwu in the third paper. There is the need for the poverty-stricken people in developing countries to appropriate the all-important crop

through mass production for the much-needed improvement in their nutritional status and economic growth.

The fourth article by Daniel Sunday Ugwu assessed the effects of HIV/AIDS on the core development sector of agriculture in Enugu State, Nigeria. HIV/AIDS contributes to decreased farm output, scarcity of professionals, decreased workforce, deterioration of health of citizens, reduced household income, increased poverty, low productivity and malnutrition among the people. Disposal of family assets and deterioration of agricultural infrastructure are also other adverse effects of HIV/AIDS in the state. Assessment of the degree of impact showed that reduced household income ranked first followed by increased poverty and decreased workforce. He recommends, among others, that the government, development partners and other agencies should promote access of target groups to treatment, prevention, care and support services with the strengthening of existing institutions/structures in the state. He considers as crucial the issues of capacity building/training of health professionals, peer health educators and counselors. He advocates micro-credit support through cooperatives and support groups of PLWHAs as well as skills training in income-generating activities as a strategy of empowerment of the people to reduce poverty and vulnerability of citizens to HIV/AIDS. A holistic approach integrating all HIV/AIDS programmes is also advocated for maximum impact in mitigating the scourge with the entrenchment of a functional monitoring and evaluation system.

We thank all our esteemed contributors and enjoin them not to flag in their zeal for research and publishing. We must all not relent in our determination to use research and publishing to confront abounding development challenges in developing countries for the

development of the total man. We welcome contributions from all cognate disciplines across the globe (see *Call for Articles*).

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GREEN CHEMISTRY IN ELECTRONIC WASTE MANAGEMENT AND CONTROL IN AFRICA

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Abstract

Poverty and desirable consumption of ICTs have combined to impose used and inferior ICTs components on African countries in a hurry in the information milieu to address "information poverty," bridge development gaps and minimize their exclusion and/or marginalization in the global market economy driven by globalization and powered by ICTs. The inferior and used ICTs components soon become unserviceable and improperly discarded, thus contributing to health and environmental hazards. The concept of Green or Sustainable Chemistry, which has the principles for management and control of the mounting e-waste generated as a result of increasing ICTs diffusion, is still at its infancy in Africa. Highlighting the crucial and diverse

roles of Green Chemistry in e-waste management and control, the paper recommends a number of measures to enhance them.

Introduction

The activities of people and nations conquer and wreck the world in their quest for economic development, which seeks to increase the quantum of economic output without caring about the short- and long-term short-changes of human and material resources arising from the processes.[2] One major area of human activities that generate serious quantum of waste has to do with the information communications technologies (ICTs). Globalisation now defines development, and is powered by ICTs.

For decades running, developing countries lag behind the rest of the world in terms of development.[3] Africa's chances of meeting the Millennium Development Goals (MDGs) targets are most doubtful.[4] The African Development Bank (ADB) has 32 of its regional member countries belonging to low income countries (LICs) with $785 or less per capita income, 14 belonging to the low middle income countries (LMCs) with per

capita income range of $786-$3,115, and only 6 belonging to the upper middle income countries (UMCs) with per capita income range of $3,116-$9,636 (see Table 1).[5]

Enlarging the development despondency of the developing countries is their "information-poverty," which enhances the chances of marginalization and/or exclusion of the "information-haves-not" developing countries from the global market system by the "information-rich" or "information-haves" developed countries. The compelling nature of ICTs is such that the "the computer has succeeded in traversing every facet of human endeavour. It is this infusion of the computer into human activity, plus advances in the telecommunications arena, especially digitization, that characterizes the information revolution. This present revolution has transformed the world into a global, knowledge-based society, referred to as the information society".[6]

Table 1: ADB Member Countries by Gross National Income per Capita

Low Income Countries (LICs): ≤$785	**Low Income Countries (LICs): ≤$785 (Cont'd)**	**Low Middle Income Countries (LMCs): $786-$3,115**	**(UMCs): $3,116-$9,636**
Benin	Malawi	Algeria	Botswana
Burkina Faso	Mali	Angola	Gabon
Burundi	Mauritania	Cameroon	Libya
Cent.Afr. Rep.	Mozambique	Cape Verde	Mauritius
Chad	Niger	Congo	Seychelles
Comoros	Nigeria	Cote d'Ivoire	South Africa
Congo (DRC)	Rwanda	Djibouti	
Eritrea	Sao T. & Principe	Egypt	
Ethiopia	Senegal	Equatorial Guinea	
Gambia	Sierra Leone	Lesotho	
Ghana	Sudan	Morocco	
Guinea	Tanzania	Namibia	
Guinea Bissau	Togo	Swaziland	
Kenya	Uganda	Tunisia	
Liberia	Zambia		
Madagascar	Zimbabwe		

Source: ADB, 2007

In the bid to bridge the unfavourable development gap being widened by information poverty, Nigeria and many other developing countries are promoting vigorous and rapid adoption and integration of ICTs (any communication device or application, encompassing radio, television, cellular phones, computer and network hardware and software, satellite systems, etc.), the consumption of which has become both desirable and imposed choice on developing countries, especially as ICTs have been recognized as primary wealth creating assets [7-10], and could provide the tool for the region to experience some kind of leapfrogging in her developmental trajectory.[11-13] This is consistent with the long held orthodoxy that "one of the key catalysts in the attainment of MDGs is inclusive access to and effective use of ICTs by the entire populace of every country on the globe".[14]

The aggravated and indiscriminate adoption and usage of ICTs by some developing countries is a strategy to address the development challenges of marginalisation and exclusion from the competitive global market system driven by globalization and powered by the ICTs. This informs reported rise in the

consumption of ICTs in developing countries.[15] The digital divide and the concomitant widening gap in development between the developed nations ("information haves") and the developing countries ("information haves-not") had to be addressed.[16-21]

Some developing countries in Africa appear to be in a haste to provide public access to ICTs in the belief that it will contribute in instigating social and economic development or in narrowing the digital divide.[22] The 2006 global e-readiness rankings of countries by the Economist Intelligence Unit ranked some African countries - South Africa 35th, Egypt 55th, Nigeria 60th and Algeria 63rd [14] - an indication that Africa is waking up to the broadband race.

A World Bank publication has it that "the digital divide" between rich and poor nations is narrowing fast ..., telecommunications services to poor countries were growing at an explosive rate and the digital divide was rapidly closing. The Report was based on the premise that people in the developing world were getting more access, especially to cell phone communications, far faster than they got access to new

technologies in the past". However, such reported growth has not captured "quality of access, adequacy of content, effective usage and affordability of access" [14]. Arguably, the gap between the developed and developing countries in terms of quality of access to service and access to quality ICTs products is widening. For instance, the Infostate gap between countries varies from 8 to 225, with sub-Saharan Africa (SSA) occupying the lower rung.[23]

As a result of poverty and low level of development in SSA, the consumption of ICTs in the region is concentrated on the inferior and used components, which have become ubiquitous in the region. Given the economic status of the region, virtually all the used ICTs components that escape recycling and incineration in the developed countries find their final resting place in SSA. These shortly become unserviceable and abandoned, thus contributing to environmental hazard. These inferior and used components are supplied from China - facilitated by the increasing trade between China and Africa. The flourishing trade relations subsisting between Chinese and Nigerian informal exporters and importers provide vibrant

platform through which inferior and used ICTs are shipped into most parts of SSA countries.[24-5]

Besides used and inferior ICTs components, outright e-waste from developed countries is also dumped in Africa. For example, in 1987, metric tonnes of toxic e-waste were dumped in Koko, Delta State, Nigeria by a foreign firm in collusion with Nigerian businessmen. Koko is a town and a port, lying along the Benin River in the western Niger River delta.[26]

Definition of e-waste

Electronic waste, or E-waste for short, is also known as "e-scrap" or "waste electrical and electronic equipment" (WEEE). E-waste refers to loosely discarded surplus, obsolete, broken electrical or electronic devices.[1] It is composed of secondary computers, entertainment devices, electronics, mobile phones, and other items, like television sets, refrigerators, cathode ray tube (CRT), VCRs, stereos, copiers, and fax machines nearing the end of their useful life. It could be sold, donated or discarded by its original owner and destined for reuse, resale, salvage, refurbishing, recycling or disposal.

Environmental Sustainability Challenges of E-waste

Rapid technology change, low initial cost and even planned obsolescence have resulted in a fast growing problem of increasing e-waste generation around the globe. The United Nations Environment Programme (UNEP) estimates that as much as 50 million tonnes of e-wastes are generated worldwide each year. Increasing at a rate of 3-5% per year (faster than any other category of waste), the global volume of e-wastes produced annually is soon expected to double.[27] Although, the majority of e-waste is generated in the industrialized countries, much of it is transferred to Africa, where environmental regulations and treatment capacity is significantly weaker to manage and control it in an environmentally sustainable manner.[15]

In developing countries, e-wastes containing plastics are commonly littered, at best in collection points. Plastics in electronics easily leach off in hot weather, especially when left outside. The record levels were "93 times higher than soil

without contact with e-wastes" [28]. The uncontrolled burning, disassembly, and disposal of e-wastes can cause a variety of environmental problems, such as ground water contamination, atmospheric pollution, and water pollution either by immediate discharge or due to surface run-off (especially near coastal areas). In some cases, the e-waste items are used in filling construction pits and land reclamation sites. This would appear to be most economical and convenient in the short run, but poses serious health and environmental danger in the long run, both on the people and the environment because "toxic chemicals in (ICT) electronic products can leach into the land over time or are released in the atmosphere, impacting nearby communities and the environment".[29]

Despite the potentials of ICTs wastes in destroying the environment, efforts to encourage development in developing countries are mostly directed at such dominant areas as poverty, malaria, HIV/AIDS, wars and the like, and the traditionally known causes of environmental degradation, such as erosion and desert encroachment, as if they are the only sources of underdevelopment in these countries.[15] Limited attention is

directed at the management and control of the environmental hazards posed by increased ICTs consumption on the largely "unprotected" African countries. The attendant unsustainability challenges represent development without sustainability, which is short-sighted and absurd. After all, "the notion of sustainability is also related to wellbeing, (as) sustainability entails growth beyond economic efficiency and wealth but within social and environmentally friendly perspectives that may impact the ability of a community to be free from crime and enjoy civil liberties",[30] and enjoyment of right to clean environment.

With the increasing ICTs consumption and increasing rise in the realization of the impact of e-waste on the environment, the need to address e-wastes issues in Africa has become urgent and apt. Researches need to be directed at the environmental hazards of various dimensions caused by growing volume of e-waste items defacing African landscape and negating sustainable development.

This review paper examines the crucial and diverse role of Green or Sustainable Chemistry in e-waste management and

control in Africa, and recommends measures to enhance the study and practice of Sustainable Chemistry.

Green Chemistry in E-waste Management and Control

In spite of the development potency of ICTs, the disposal of their hazardous e-wastes poses serious sustainability challenge,[30] especially as e-waste can become toxic if discarded improperly. Waste management and control hierarchy are [31]:

1. *source reduction or avoidance*;
2. *waste recycling*, that is, reuse or reclaiming of as much waste as possible;
3. *waste treatment*, that is, treatment of the waste that cannot be reclaimed; and
4. *waste disposal*, that is, disposal of waste residues to air, water or land.

Each component of the hierarchy begs Chemistry (which can be employed to avoid or reduce waste source, recycle waste, treat and dispose waste). Besides Environmental Chemistry - the chemistry of the natural environment, and of pollutant chemicals in nature - Green Chemistry or Sustainable Chemistry seeks to reduce and prevent pollution. Sustainable Chemistry is a philosophy of chemical research and engineering that encourages the design of products and processes that minimize the use and generation of hazardous substances.[32-3]

Sustainable chemistry consists of chemicals and chemical processes designed to reduce or eliminate negative environmental impacts. The use and production of these chemicals may involve reduced waste products, non-toxic components, and improved efficiency. [33]

Green chemistry is a highly effective approach to pollution prevention because it applies innovative scientific solutions to real-world environmental situations. It promotes designing chemical products and processes to the highest level of this hierarchy and for cost-competitiveness in the market. [33]

Green Chemistry deals with source reduction/prevention of chemical hazards; design of chemical products to be less hazardous to human health and the environment; use of feedstock and reagents that are less hazardous to human health and the environment; design of syntheses and other processes to be less energy and materials intensive (high atom economy, low e-factor); use of feedstock derived from annually renewable resources or from abundant waste; design of chemical products for increased, more facile reuse or recycling; reuse or recycle chemicals; treatment of chemicals to render them less hazardous; proper disposal of chemicals; chemicals that are less hazardous to human health and the environment and are less toxic to organisms and ecosystems, not persistent or bio-accumulative in organisms or the environment, and inherently safer with respect to handling and use.[33]

Conclusion and Recommendations

In the information milieu, many developing countries are in a hurry to address "information poverty," bridge development gaps and minimize their exclusion and/or marginalization in the

global market economy driven by globalization and powered by ICTs. Understandably, poverty and desirable consumption of ICTs have combined to impose used and inferior ICTs components on them. The inferior and used ICTs components soon become unserviceable and abandoned, thus contributing to environmental hazard. They are ubiquitous and improperly discarded in these countries with technological backwardness and weak legal environment to manage and control e-waste.

Green or Sustainable Chemistry has the principles for management and control of the mounting e-waste generated as a result of increasing ICTs diffusion in developing countries. But, the concept of Green Chemistry and Sustainability is still at its infancy in most of these countries. Considering the crucial and diverse roles of Sustainable Chemistry in e-waste management and control, which is a milestone in the new global paradigm of sustainable development, it is, therefore, recommended that:

1. the concept of Green Chemistry and Sustainability be introduced in the education system in developing countries,

2. policy be put in place for the study of Sustainable Chemistry in schools in developing countries,
3. legal framework be put in place for the practice of Sustainable Chemistry in the industry in developing countries,
4. more serious measures should be taken at national and international levels to encourage the study of Chemistry and to enhance the regulation of its practice in order to maximize the services of the Chemist in environmental sustainability, which includes e-waste management and control.

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GREEN SOLVENT FOR ENVIRONMENTAL SUSTAINABILITY IN NIGERIA

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Abstract

In Nigerian homes, schools and industries, traditional solvents are causing health and environmental hazards. These hazards can be avoided by replacing petrochemical solvents with green solvents, which are environmentally friendly. This paper reviews available secondary information on the havoc caused by use of traditional solvents, the development and environmental compatibility of green solvents and the need to do away with traditional solvents in Nigeria. It recommends a number of steps towards the replacement of traditional solvents with green solvents in the country.

Introduction

The World is becoming more environmentally conscious. Chemical processes are being developed with their environmental burden in mind. More traditional chemical methods are being replaced with innovations, including new solvents. Solvents are used in most areas, including synthetic chemistry, analytical chemistry, and pharmaceutical production and processing, the food and flavour industry and the materials and coatings sectors.[1] The principles of green chemistry advocate the use of less of them, or to use safer, more environmentally friendly solvents. Some conventional solvents are hazardous (e.g. toxicity and flammability) and the significant contribution that solvents make generate waste in many chemical processes.[2]

Solvent use is of a concern because young people, including pre-adolescents, are the primary users of solvents. It is one of the most used substances by youth after alcohol, tobacco and cannabis. The products containing solvents are readily accessible to young people, as they are inexpensive and in

common, every-day use. It can result in short-term and long-term harm to the health of users or in death. A phenomenon known as Sudden Sniffing Death (SSD) can occur among first time users of solvents or those who have been sniffing for years. Associated problems include family and social disruption from behaviours, such as theft, truancy and vandalism. In some remote communities petrol sniffing has resulted in tragedy for the individual, families and the whole community.[2]

Solvents are inhaled while in use. Many commercial products, from paints to perfumes, contain "evaporative bases" or solvents, such as alcohol, water, turpentine, petroleum by-products and various hydrocarbons (often used as propellants in spray cans). As the solvent evaporates at room temperature, the sniffer breathes the fumes into the lungs to be absorbed into the blood stream. The user can experience a feeling of euphoria, not unlike the effect of alcohol. Other immediate effects, also similar to drunkenness, can be restlessness, weakness, slurred speech, uncoordinated movements, aggression, blurred vision, hallucinations, nausea, vomiting and unconsciousness.[2]

These and other disadvantages of traditional solvents have given rise to the need to replace them with green solvents for environmental sustainability. This work attempts to review what the green solvent is, its uses and impacts on the environment in Nigeria.

Definition of terms

Solvents are chemical substances that can dissolve, suspend or extract other materials, usually without chemically changing either the solvents or the other materials. Solvents can be organic, meaning the solvent contains carbon as part of its make-up; or inorganic, meaning the solvent does not contain carbon.[3]

Solvents are found in products that give off fumes at room temperature and, when inhaled, cause intoxication (similar to alcohol). They include items, such as butane in cigarette lighter gas, aerosol sprays, petrol, some glues, correction fluids, paint thinners, dry cleaning fluid, nail polish removers, nitrous oxide used in whipped cream dispensers, fire extinguishers and other common, often inexpensive, household and industrial products.[3]

Environmental sustainability is the process of making sure current process of interaction with the environment are pursued with the idea of keeping the environment as pristine as naturally possible based on ideal-seeking behaviour.[3]

Green solvents are environmentally friendly solvents or bio-solvents, which are derived from the processing of agricultural crops.[4]

Theoretical and conceptual framework

Although, water (H_2O) has been described as universal solvent because it dissolves – no matter how little – every substance, it does not mix substantially with all compounds. Since it is inorganic in behavior and contains no carbon (C), it does not mix substantially with organic compounds (which contain C). Therefore, notwithstanding the cheapness and universal availability of water, other solvents had to take a major portion of water's role as an industrial solvent, especially for organic substances. Such solvents include acetone, xylene, methyl ethyl ketone (MEK), toluene, lacquer thinner and others, which are petrochemical solvents.[4]

Petrochemical solvents may be flammable, smell bad, have intolerable fumes, irritate the skin, burn and redden the skin and cause it to itch. Because of their environmental hazards, they impose protective clothing, gloves, goggles, and respirators on users. Spilled acetone or wastewater containing it can pose a significant risk to ecosystems and wildlife. Acetone dissipates slowly in soil and because of its high solubility in water; it is a significant groundwater contaminant. Acetone also can cause oxygen depletion in aquatic systems, as it is sometimes consumed by micro-organisms.[4]

Most petroleum-based solvent products give skin irritation. Some ready-to-use cleaning products may contain chemicals that will cause redness or swelling of the skin. Products may contain volatile organic compounds, which may escape to the atmosphere and react to form smog. Smog and other atmospheric pollutants have been shown to cause irritation of the eyes, nose, throat, lungs and to cause asthmatic attacks.[4]

As new environmental laws are implemented and consumer demand for safer products grows, environmentally friendly solvents or green solvents or bio-solvents are being promoted to

take the place of the petroleum-based solvents. The Montreal Protocol identified the need to re-evaluate chemical processes with regard to their uses of volatile organic compounds (VOCs) and the impact these VOCs have on the environment. Green solvents are carbon neutral and were developed as more environmentally friendly, safe alternatives to petrochemical solvents. They are less harsh, non-toxic, zero-carcinogen, biodegradable, contain no ozone depleting chemicals (EPA SNAP solvent), have no Global Warming Compounds, and have no environmentally hazardous ingredients (EHIs). Green solvent can be easily recycled though simple filtering or distillation for repeated reuse, and the low evaporation rate and high solvency formula can significantly reduce overall solvent usage.[5]

Green chemistry, also called sustainable chemistry, is a philosophy of chemical research and engineering that encourages the design of products and processes that minimize the use and generation of hazardous substances.[6] Whereas environmental chemistry is the chemistry of the natural environment, and of pollutant chemicals in nature, green chemistry seeks to reduce and prevent pollution at its source. While green chemistry seems to

focus on industrial applications, it does apply to any chemistry choice.[7] The focus is on minimizing the hazard and maximizing the efficiency of any chemical choice.[8]

Green solvent and Environmental Sustainability

Green solvent can be high performance blend designed as an alternative to acetone - a hazardous and highly flammable petroleum-based solvent. Green solvent is not flammable, contains no hazardous air pollutants (HAPs) and is not a HAZMAT. Because of the flashpoint of green solvents, they are not considered flammable liquid. Acetone and many other solvents have a low flashpoint and are flammable or extremely flammable. The flashpoint of a solvent is the temperature at which it would ignite. The flashpoint of a solvent determines how easily it will ignite and burn.[9]

Bio-solv, a brand of green solvent, is ideally suited for a variety of marine, automotive and industrial cleaning and surface preparation applications, including resin solving, paint and graffiti removal, vinyl graphics removal, adhesive clean-up, parts cleaning, and degreasing. It contains no water and is completely

reactive, unlike other green solvents which may contain up to 50% water.[9]

A bottom-paint job is unpleasant from start to finish, and wiping down the hull with acetone plays a role in that unpleasantness. When a green solvent, such as Bio-solv, was substituted according to the marketer, the product became slightly more expensive than acetone, but well worth it because it lasted longer (since it evaporated slower) than acetone. The biodegradable acetone replacement, which is also called "green acetone," carries the U.S. Environmental Protection Agency's Design for the Environment (DfE) logo. In order to display the DfE logo, the product underwent extensive screening by the EPA and other firms to ensure that none of the ingredients in Bio-solv are unsafe for humans or the environment.[9]

Some green solvents serve as environmental-friendly industrial and residential microbial cleaners designed to use microbes to clean and remediate unwanted hydrocarbons. They deliver maximum cleaning and disposal capabilities with zero harm done to the environment. Some of the solutions specialize in food services (for cleaning and maintaining grease traps), vent

hoods, drain pipes, floor drains, floors and garbage disposals. In municipal sewer treatment operations, green solvents are used for digesting organic wastes, odor control, and for preventing build-up of fats and grease in piping system. For industrial wastewater equipment, green solvents are used to reduce build-up of fat and grease in piping and equipment.[9]

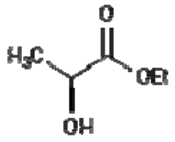
Green solvents are also used in personal homes to remove grease from driveways and grills, control odor, prevent build-up of fats and grease in drain fields. They are important in lawn and garden, where they are used to restore soil natural ability to support plant life.[9]

In automotive repair shops, green solvents eliminate heavy grease and grime. They are also used in refineries and chemical plants, where non-flammable property is desirable for the cleaning of such plants. In plating shops, green solvents are used as degreasers. In the highways, they remove contaminates where accidents occur. Where there is oil spillage, they are used to remedy hydrocarbon spills on soil, surface, salt water and fresh water.[10]

In process industries, they remediate soil around process equipment located outdoors. Also, in maritime industries, green solvents are used as great for bilge tanks, engine room and many other marine purposes. The green solvent is committed to providing multi-use environmentally friendly services to promote a safe and clean way to dispose of contaminated waste, grease oil and fat without using harmful solvents.[10]

An environmentally sensitive non-toxic cleaner/degreaser that really works and can be economically custom-diluted for many different uses is another kind of green solvent. Green solvents are used as all-purpose cleaner for floors, windows, walls, pots, pans, sinks, drains, stained carpets, and greasy tools. Only a little quantity of green solvent gets big jobs done around the house because it is packaged as a concentrate and diluted to clean anything dirty. Green solvents are replacements for most common cleaners, detergents, degreasers and laundry pre-soaks.[11]

Ethyl lactate, derived from processing corn, is a green solvent with the structure shown below:



Ethyl lactate

It is the ester of lactic acid. Lactate ester solvents are commonly used in paints and coatings industry and have numerous attractive advantages, including being 100% biodegradable, easy to recycle, non-corrosive, non-carcinogenic and non-ozone layer depleting. It is a particularly attractive solvent for the coatings industries, as a result of its high solvency power, high boiling point, low vapour pressure, and low surface tension. It is a desirable coating for wood, polystyrene and metals, and also acts as a very effective paint stripper and graffiti remover. Ethyl lactate has replaced traditional solvents, including toluene, acetone, and xylene, resulting in the workplace being made a great deal safer.[11]

Other applications of ethyl lactate include being an excellent cleaner for the polyurethane industry. Ethyl lactate has a high solvency power, which means it has the ability to dissolve a

wide range of polyurethane resins. The excellent cleaning power of ethyl lactate also means it can be used to clean a variety of metal surfaces, efficiently removing greases, oils, adhesives and solid fuels. The uses of ethyl lactate are highly variable as it has eliminated the use of chlorinated solvents.[11]

Reasons for adopting green solvents in Nigeria

There are many reasons to advocate the substitution of traditional solvents for green solvents in Nigeria. First, the Nigerian population is youth.[12] Since young people, including pre-adolescents, are the primary users of solvents, the harms of these solvents impact them negatively.

Secondly, the traditional solvents are used in the laboratories of secondary schools and tertiary educational institutions, which are heavily populated by youths, thereby impacting negatively on increasing number of members of the most important segment of the society of today and the future. The population of the students of secondary schools increased from 4.6 million in 2001 to 6.2 million in 2005 – an annual increase of 0.4 million or 8.7%. Similarly, the population of the students of

universities (and their equivalents) increased from 0.71 million in 2001 to 0.97 million in 2005 – an annual increase of 0.065 million or 3.5%.[13]

Thirdly, the working and productive ages in every society is youth. Since, traditional solvents are involved in synthetic chemistry, analytical chemistry, and pharmaceutical production and processing, the food and flavour industry, the materials and coatings sectors, and the marine industries, which abound in Nigeria, the health of a large number of Nigerian youth in schools and industry is being compromised.

Since the products containing traditional solvents are inexpensive and in common, everyday-use, they are readily accessible to young people, leading in short- and long-run to their harm and death. Changing to green solvents would spare the lives so lost and the environmental and health hazards so occasioned.

Recommendations

Doing away with traditional solvents has become imperative for environmental sustainability in Nigeria. To this end, it is recommended that:

1. Green solvents be used to replace traditional solvents in Nigeria;
2. Awareness of the harms of traditional solvents and the promotion of green solvents need to be stepped up in the country;
3. Lessons on green chemistry and sustainability of the environment need to be integrated into the curricula of schools;
4. Out-of-school programmes on green chemistry and environmental sustainability need to be designed and introduced;
5. Policy needs to be formulated for the teaching and practice of green chemistry and environmental sustainability;
6. Plants, from which green solvents can be produced, need to be planted massively; and
7. Product designs need to be addressed towards the adoption of green solvents.

Conclusion

Most petroleum-based solvent products give skin irritation. Some ready-to-use cleaning products may contain chemicals that cause redness or swelling of the skin. Products may contain volatile organic compounds, which may escape to the atmosphere and react to form smog. Smog and other atmospheric pollutants have been shown to cause irritation of the eyes, nose, throat, lungs and to cause asthmatic attacks. In Nigerian homes, schools and industries, traditional solvents are impacting negatively on health and lives of the teeming population of Nigerian youths because of the characteristic environmental unfriendliness of the solvents.

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SOYBEAN PRODUCTION, PROCESSING AND MARKETING IN NIGERIA

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Abstract

The economic and nutritional importance of soybean informs the need for more studies towards appropriating the all-important crop for improved nutritional status of Nigerians and economic growth of the nation. This paper reviews the origin and historical emergence of this legume crop in the limelight of world agriculture, its production, processing and marketing, its contributions to the economic empowerment and improved nutritional status of rural households, as well as its problems and prospects in Nigeria. In view of its numerous benefits and great potential to occupy a prime position in the

agricultural industry, it was recommended that its mass production be encouraged for the optimum realization of its unlimited potentials.

Introduction

Soybean is a farm crop that belongs to the legume family. It is scientifically called *Glycine Max (L) Merrill.* It was domesticated between the 11th and 17th centuries BC around the north-east China, but was introduced in the Europe only in the 17th century.[1] It has since acquired a world-wide importance as a primary source of vegetable oil and protein.

Benefits of soybean over other grain legumes commonly grown by small-holders, such as groundnut (*Arachis hypogea*), cowpea (*Vigna unguiculata*) and common bean (*Phaseolus vulgaris*) include lower susceptibility to pests and disease, better grains storage quality a large leaf biomass, which gives a soil fertility benefit to subsequent crops, and a secure commercial market for the crop. Nigeria is the largest producer of soybeans for food in West and Central Africa.[1]

Soybeans were first introduced into Nigeria in 1908, but the first successful cultivation was in 1973 with the Malayan variety, which was found suitable for commercial production in Benue State in Central Nigeria.[1] These producing areas of Central Nigeria have been

responsible for a large proportion of the domestic requirement of this cheap source of plant protein.

Following the ban on the importation of soybean and its derivatives in 1984, an increased production of the crop was observed within and outside its traditional producing areas immediately after wards. With the ban, therefore, many growers started putting more land and resources into soybean production.[1]

Though still largely regarded as a relatively new crop, soybean has made a successful incursion into the diet of many Nigerians, particularly children and nursing mothers. Soybean derivatives, such as soy-gari, soy-milk, soy-ogi and soy-lafun, have been developed and found to be good substitutes for more conventional food ingredients like melon, cow milk and cow pea.[2]

Studies have shown that despite the high nutritional value of soybean, relative to other legumes, lack of knowledge of its uses has limited its adoption and production in non-traditional areas of cultivation.[3] Numerous efforts have been put in by research institutes, non-governmental organizations, NGOs, and industry to promote production of the crop in Nigeria in order to bridge the gap of limited adoption and production in non-traditional areas. An appropriate proportion of research was done in the densely populated parts of southwestern Nigeria with the immediate aim of integrating it into the

existing farming system and with the broader aim of seeing how it could alleviate the nutritional status of the people, particularly the women and children.[4,5]

This review paper is aimed at enriching the literature towards appropriating the all-important crop for improved nutritional status of Nigerians and economic growth of the nation.

SOYBEAN PRODUCTION, PROCESSING AND MARKETING

Soybean production

Soybean growth is influenced by climate and soil characteristics. It performs well in the Southern and Northern Guinea Savanna of Nigeria, where rainfall is more than 700 mm. However, short-duration varieties can thrive in the much drier Sudan Savanna when sown early and with an even distribution of rainfall throughout the growing period. The time for planting soybean depends upon temperature and day length. Soybean is a short-day plant and flowers in response to shortening days. It can be grown on a wide range of soils with pH ranging from 4.5 to 8.5. Soybean should not be planted in sandy, gravelly, or shallow soils, to avoid drought stress. It should not be grown in water logged soils or soils with surfaces that can crust, as this will lead to poor seeding emergence.[6]

Soybean matures within 3-4 months after planting and requires timely harvesting to check excessive yield losses. At maturity, the pod is straw colored. It is recommended that soybean be harvested when about 85% of the pods have turned brown for a non-shattering variety, and 80% for shattering varieties.[6]

Nigeria's soybean production increased from about 28 metric tons in 1985 to about 200,000 tons in 1995. The 1995 crop was worth an estimated US $60 million, saving Nigerians an equivalent amount of foreign exchange in just one year.[6]

Total land area under soybean cultivation in the world was 95.2 million ha and total production was 212.6 million metric tonnes. In relation to Africa, soybean was grown on an average of 1.16 million hectares with an average production of 1.26 million metric tonnes in 2005. African countries with the largest area of production were Nigeria (601,000.00 ha), South Africa (150,000 ha), and Uganda (144,000 ha). Soybeans are produced on small holder farms, and as a result, the farming is non-mechanized.[7]

Nigeria's soybean output is forecast to increase to 500,000 metric tonnes in 2008/2009 up from 450,000 metric tonnes in 2007/2008. The increase in output is attributed to favourable weather and the attractive grower prices. Compared to the erratic pattern in 2007, rainfall was favourable both in terms of volume and distribution in 2008. Benue

state is the dominant soybean producing area, but several other states are also increasing production.[7]

Soybean processing

Soybean can be processed into different products, such as soymilk, soybean fortified gari and tapioca, cereal-based traditional weaning food, etc. Variations in processing methods also yield a host of co-products. Soybean processing involves a series of steps to produce commodities for food, industrial and animal feed uses. The processes include threshing, transport, drying, cleaning, packaging and storage. In addition to these soybean foods, soymilk has been identified as one of the promising products. Soymilk is made by soaking soybean in water before grinding and straining. The milk is a white or creamy emulsion which resembles cow milk (conventional milk) in both appearance and consistency.[8] The increasing popularity of soymilk as a beverage worldwide is credited to health benefits, example low cholesterol and lactose, its ability to reduce bone loss, menopausal symptoms prevention, and reduction of heart disease and certain cancers.[8]

Acceptability of soybean products has been enhanced by modification of processing methods. Some of the modified soymilk extraction method includes application of heat, soaking of soybean in ethanol or alkali and acid grinding.[9] There are reports on the use of

natural flavourants to improve soymilk production.[9] In Nigeria and other countries in Africa, maize grains is fermented to give "Ogi".[9] Maize protein is deficient in lysine and tryptophan but has fair amounts of sulphur-containing amino-acids.[10] Improvement of the qualities of tortilla (Maize product) through soybean fortification has been reported.[11] Fortification of soybean product with maize has the potential of creating a valuable food product. Soybean can be processed and incorporated into many other products.

Soybean-based products have become a common market commodity in some areas of Nigeria, where retail sales of soybeans were once virtually non-existent. In Ibadan, for example, retailers selling soybean products increased in number from only 4 in January 1987 to 824 in January 1993. In addition, soybean crushers in the country are operating below capacity and are unable to satisfy the growing demand for vegetable oil.[11]

There is a domestic supply short fall of all vegetable oil estimated at about 300,000 metric tonnes annually, and over the past few years the local price of vegetable oil has been more than double the international price. In September 2008, the Government of Nigeria removed its import ban on crude vegetable oil. Nigeria offers growing market opportunity to US exporters of soybeans, soybean meal, crude soybean oil and value-added soy products, and soy-based ingredients

market opportunity of about 100,000 metric tones of soybean meal exist for US exporters. Additionally, importers and vegetable oil refining companies are anxious to take advantage of the removal of import ban on crude vegetable oil to increase capacity utilization, and opportunity exists for US exporters of crude soybean oil. US soybeans, soybean meal and crude vegetable oil exporters are encouraged to explore these growing market opportunities in Nigeria. The Office of Agricultural Affairs is collaborating with the poultry association of Nigeria to encourage group purchases of US soybeans and products, utilizing USDA export credit facilities.[11]

Recent market development activities in Nigeria by the American Soybean Association World's Initiative for Soy in Human Health (WISHH) programme have generated enormous interest in the value-added soy products and soy-based food ingredients.[11]

ECONOMIC AND NUTRITIONAL IMPORTANCE OF SOYBEAN

Soybeans have been used as food for centuries and its exceptionally good nutritional value is well known. Soybean has been variously described as a "miracle bean" or a "golden bean" because it is a cheap, protein-rich grain. It contains 40% high quality protein, 20% edible vegetable oil and a good balance of amino acid[11] and has, therefore, tremendous potential

to improve nutritional status and welfare of the families of resource-poor farmers.

Mature soybean seed also contains thiamine, niacin, riboflavin, cholin, vitamin E and vitamin K. Theses vitamins are necessary for normal body growth and development. Soybean products serve as essential raw material for vegetable oil industries. An earlier report reveals that soybean ranks the highest among leguminous crops in terms of protein utilization and efficient ratio, compared with other plant sources. The report also reveals that soybean has a high total digestible nutrient percentage of 91.99%, compared to cowpea with 79.52%. Soybean consumption helps in solving nutrition protein-intake problem among the poor people.[11]

Soybean is currently cultivated in all the major agro-ecological zones of Nigeria due to its nutritive value. In the early 1990s, the International Institute of Tropical Agriculture (IITA) promoted the use of protein-rich soybeans in everyday food to curb malnutrition. For many years, soy proteins have found favour in baking industries. Low levels of full-fat soy flour added to wheat flour at levels of 0.5% of the wheat flour allows the production of bread which has increased crumb softness and keeping quality. Soybean can also contribute to the enhanced sustainability of intensified cropping system by improving soil fertility through nitrogen fixation, permitting a longer duration of ground cover

in the cropping sequence and providing useful crops residues for animal feed.[11]

Soybean can be used for industrial processing and for livestock feed. It is highly digestible and has a high degree of unsaturation, containing about 85% unsaturated and 15% saturated fatty acid, making it especially suitable for people who have a level of blood cholesterol and are, therefore, highly susceptible to cardiovascular disease. Consumption of soybean oil is one way of preventing cholesterol accumulation in the blood.[11]

Soybean meal is being used in the manufacture of many chemical products, from paints to fire-extinguisher fluids, making of paper coatings, adhesives, fertilizer, insects sprays and dozens of other products. Soybean is used for various cheap recipes in Nigeria. It oil stands first in the world as edible oil and occupies important place in the economy.[11]

Soybean de-oiled cake is exported and foreign exchange is being earned to the farmers. From soybean whole seed, soymilk is obtained and considered to be the best health drink for infants and adults, and soy-dadawa is considered to be a healthy food. It also improves soil fertility and controls the parasitic weed - (*Striga hermonthica*) when in rotation with maize. It is the source of an excellent vegetable oil. Soybean meal is also recommended as animal feed.[11]

PROBLEMS AND PROSPECTS OF SOYBEAN PRODUCTION, PROCESSING AND MARKETING IN NIGERIA

Average grain yields of soybean is low (<1t/ha) in Tropical Nigeria. Dual-purpose improved varieties of soybean have not reached many soybean growers to increase production, and distribution is also major impediment in soy bean growing. Pod shattering, especially in the hot dry Savanna environments, reduces seed longevity, and lodging is still constraints in soybean production.[12]

Diseases, such as rust, red-leaf blotch, frog-eye leaf, spot bacterial pustule, bacterial blight and soybean mosaic virus, are problems affecting soybean production.[12]

Lack of varieties tolerant to mid season moisture stress and high yielding varieties tolerant to low phosphorus are among the biotic constraints. In Nigeria, farmers lack interest in the production of soybean because there is no huge market for the grain and many people do not know how to prepare the crop for home/domestic consumption.[12]

A key problem associated with utilization of soybean is the presence of certain anti-nutritional factors, which may inhibit the availability of the desirable nutrients, such as proteins and minerals. Some of the prominent anti-nutritional factors in soybean include typsin inhibitors, hemaglutinin, phytic acid, goitrogen, urease activity and

flatulence causing factors (starchyose and raffinose).[12] The significance of soybean trypsin inhibitors (TI) lies in their implication in inhibiting the pancreatic enzymes (trypsin and chymotrypsin), resulting in reduction in protein digestibility both in humans and animals. It causes hypertrophy of the pancreas in smaller animals like cats and chicks.[12]

Efforts have been made to inactivate or remove trypsin inhibitors from soybean.[12] Many approaches had been based largely on heat treatment. Most commercially available soybean production intended for human, such as tofu, soybean milk, soybean-based infant formula, soybean protein, isolates and concentrates, and textured meat analogues have received sufficient heat treatment to cause inactivation of at least 80% of the TIA present in raw soybeans.[13,14] This level of TIA destruction is well above the threshold of 45-50% inactivation found to be necessary for eliminating significant growth inhibition and pancreatic hypertrophy in rats.[14]

Protein solubility is an important target parameter and in the animal and feed industry, the protein dispersibility index is often used to characterize the protein quality of raw material. PDI could be used as a chemical indicator for inactivation of anti-nutritional factors and effect of functional properties.[15]

Though soybean is used in quite a number of African countries as weaning food, there are still problems, such as lack of technical know-

how for its processing into infant foods. Cultural practices favour the use of cereal rather than legumes for weaning infants and the look cooking time.[15]

CONCLUSION AND RECOMMENDATIONS

Considerable efforts had been devoted to the study and production of soybean in Nigeria. These efforts have prompted a great number of people into accepting and consuming soybean and its products due to its high nutritive value. Increased consumption has helped to curb malnutrition, reduction of cholesterol in the blood and also boost energy.

Finally, soybean production has continued to attract families into its cultivation, compared to earlier public or government sponsored programmes to improve agriculture.

The following recommendations are proffered for increased production, processing and marketing of soybean in Nigeria in order to maximize the benefits of soybean products to the teeming population.

1. The agricultural extension system should have increased number of food specialist extension workers in all the states of Nigeria to continue with the education of people on how to produce, process and market soybean products, such as soybean meal and soybean oil.

2. Government should support farmers with facilities, such as processing machines and farm inputs (eg. fertilizer and other agro-chemicals) in order to encourage the cultivation of soybean and improve yields.
3. The marketing system should be developed for soybean products to encourage large scale domestic and export of soybean products in Nigeria.

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THE EFFECTS OF HIV/AIDS ON THE AGRICULTURAL SECTOR IN ENUGU STATE, NIGERIA

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Abstract

The study assessed the effects of HIV/AIDS on the core development sector of agriculture in Enugu State, Nigeria, using field survey, desk study, and data analysis. The findings showed that HIV/AIDS had contributed to decreased farm output, scarcity of professionals, decreased work force, deterioration of health of citizens, reduced household income, increased poverty, low productivity and malnutrition among the people. Disposal of family assets and deterioration of agricultural infrastructure are also other adverse effects in the state. Assessment of the degree of impact showed that reduced household

income ranked first followed by increased poverty and decreased workforce. It is recommended, among others, that the government, development partners and other agencies should promote access of target groups to treatment, prevention, care and support services with the strengthening of existing institutions/structures in the state. Capacity building/training of health professionals, peer health educators and counsellors is also considered crucial. In order to reduce poverty and vulnerability of citizens to HIV/AIDS, micro-credit support through cooperatives and support groups of PLWHAs as well as skills training in income-generating activities are considered critical for the empowerment of the people. A holistic approach integrating all HIV/AIDS programmes is advocated for maximum impact in mitigating the scourge with the entrenchment of a functional monitoring and evaluation system.

Introduction

Enugu State has the highest prevalence rate in the Southeast geopolitical zone of Nigeria. Documented HIV prevalence rates were 1.3% in 1991, 10.2% in 1995/96, 5.2% in 2001, 4.9% in 2003, and 6.5% in 2005[1,2].

HIV/AIDS sentinel survey conducted by the FMOH/Policy Project in 2003 estimated that 76,860 individuals, out of a total state

population of about 3,012,091, were infected with HIV. Further breakdown showed that 4,629 and 6,719 persons infected with the virus are youths aged 15-24 years and pregnant women respectively. The increasing rate of infection has been attributed to early sex debut, child marriage, wife inheritance and multiple sex partners. Others include lack of women empowerment to negotiate sexual matters, polygamy, wife sharing, pervading poverty of access to sustainable income generating activities among women, widowhood practice, female genital cutting and lack of legislation on women rights[3].

With a total population of 3,267,837 (NPC, 2006), the number of people living with HIV (PLWHIV) in Enugu State is about needing prevention and stands at 3,175,037 (97.2%), if we are to achieve the MDGs & UNGASS targets of 80% of our people accessing prevention to care continuum. Out of 92,800 people living with HIV in the state, about 18, 560 of them require Anti-Retroviral Therapy (ART). However, about 2,200,000 people will need to be counseled and tested in order to reach this high population. Currently, less than 1 million people know their HIV status in the state, in spite of high knowledge of HIV causative factors. The number of women that will require prevention of mother-to-child transmission (PMTCT) services is about 150,400. Out of this, the number of expected HIV positive (+ve) women that will require ART is about 8,729 (5.8%). About 3,055 of their children will require Paediatric

Anti-Retroviral Therapy (PART). However, the number of people accessing ART currently is less than 30%[4].

In Enugu State, there are one Teaching Hospital, 7 District Hospitals, 56 Cottage Hospitals, 189 Primary Health Centres (PHCs), 131 Health Posts, and 39 Health Clinics. PMTCT and HIV/AIDS Counseling and Testing Services are available in only 28 and 45 facilities respectively, mostly in urban areas[4].

HIV/AIDS is a developmental problem that has important social and economic consequences. HIV/AIDS has impacted on the different sectors of the Nigerian economy, namely, agriculture, education, wealth creation, commerce and industry, and exacerbates poverty. The HEAP policy document observed that the HIV/AIDS pandemic has impacted on the high man-power intensive sectors of the economy, which includes the agricultural, educational and health sectors, as well as the rural economy[5].

Despite the perceived impact of the HIV/AIDS epidemic on the key sectors of the Nigerian economy, there is paucity of data/information on the current true extent and impact of HIV/AIDS on our communities, as well as the core development sectors of education, health and agriculture. This research focused on the agricultural sector of the Enugu State economy as a case study.

The specific objective of the study is to assess the effects of HIV/AIDS epidemic on agriculture and food security in Enugu State and proffer recommendations for solution based on the results of the study.

Research Methodology

The Study Area

The baseline study was carried out in Enugu State, Nigeria. Enugu State occupies a surface area of about 8000 sq km within the West African tropical rainforest region between latitudes $5^0$55' and $7^0$10' North and $6^0$50' and $7^0$55' East. It is bounded in the East by Ebonyi State, in the West by Anambra State, in the North by Kogi and Benue States and in the South by Abia State.

The state has 17 federally recognized local government areas (LGAs). An additional 39 LGAs were created in 2003, but have not yet been given constitutional recognition and so remain development centres. According to 2006 national census figures, the population was 3,267,837 in 2006. About 59% of the population live in rural areas[6].

Sampling Strategy

Multi-stage sampling technique was used in the selection of respondents for primary data collection. The first stage involved the random

selection of six (6) LGAs from the three (3) senatorial zones of Enugu North, Enugu East and Enugu West. The second stage entailed the random selection of three (3) communities per LGA based on gender, age and willingness, among other criteria. Thus, a total of eighteen (18) communities were sampled for the study. The third stage sampling involved random and purposive sampling of ten (10) households per community.

In addition, 18 key stakeholders were purposively sampled as key informants including community leaders/traditional rulers, town union executives, church leaders, representatives of community-based organizations (CBOs), age grades, women and youth organizations, etc. for in-depth interviews (IDIs). In total, 180 respondents were used for the study. The sampling frame consisting of the LGAs and communities for the study is shown below:

Data Collection and Analysis

Data collection involved participatory methodologies, including observations, focus groups discussions (FGDs), personal interviews (PIs), and in-depth interviews (IDIs) for primary data collection, and desk review/desktop analysis for secondary data collection.

Table 1: *Sampling Frame for the Survey*

S/N	Senatorial Zone	LGAs	Communities
1	Enugu North	1. Nsukka 2. Uzo-Uwani	Edem-Ani, Obimo Ehalumona Nimbo, Nkporogu, Abbi
2	Enugu West	1. Ezeagu 2. Awgu	Obinofia Ndiuno, Akama Oghe Aguobu – owa Amabo, Nenwenta, Mgbowo
3	Enugu East	1. Nkanu East 2. Enugu North	Abakpa 1, Emene, Ugwogo Nike Iva Valley, Ogui Nike New Haven

The questionnaire and the FGD guide were pretested in one of the non-target communities in Enugu State to validate the instruments. In all, 180 questionnaires (10 questionnaires/community), 18 IDIs (1 per community) and 18 FGDs (1 per community) were employed in data collection for the study.

Descriptive statistics, such as percentages, cross tabulations, frequencies, averages, bar charts, were used in the analysis of data. The analyses were facilitated by the use of the Excel package.

Results and Discussion

Socio-economic Background of Respondents

The socio-economic characteristics of the respondents focused on their sex, age, childhood place of residence, place of residence, education, religion, marital status and occupation. Such background information, as their total income per annum and other sources of support, reproductive and sexual behaviours, were also discussed. These characteristics were described against the background of the peoples' Local Government Areas (LGAs) and communities.

Sex*:* Survey results showed that across all the six sampled LGAs for the study, namely, Nsukka, Uzo-Uwani, Ezeagu, Awgu, Enugu East and Enugu North, 56.5% were males and 43.5% females. Within LGAs, Nsukka had 52.8% males and 47% females; Uzo-Uwani 63.9% males and 36.1% females; Ezeagu 61.3% males and 38.7% females. In Enugu East 41.7% were males and 58.3% females while in Enugu North 42.9%

were males and 57.1% females. These figures portend that there was a fair distribution of male and female gender in the sampled population.

***Education**:* Overall, 18.5% of the respondents had no formal education, 3.7% had adult literacy, 36.6% attained primary education, and 32.4% completed secondary education. Thus, majority of them had only primary education. However, 6.5% of the respondents attained tertiary/post secondary education, and 1.4% postgraduate studies.

Religion: In total, majority (89.3%) of the respondents were Christians, while only 7.4% and 2.8% of them were traditional religionists and Muslims respectively across the selected six LGAs in the state.

***Marital Status**:* Survey results showed that 91.6% of the males were married, 5.6% widowed, 0.5% separated, 1.4% divorced and 0.9% unmarried. Their mean age at first marriage was about 30 years, while the mean age of their spouse at first marriage was recorded as 20 years. In terms of number of marriages, 89.9% of the respondents married once, 7.2% twice, 2.4% thrice, and 0.5% more than thrice. On the type of current marriage, 88.3% of the respondents practiced monogamy, while 11.7% of them engaged in polygamous marriages. The dominance of monogamy among the respondents could be associated with the

influence of Christian faith and education. With respect to the total number of wives per household, the study indicated that 41.5% and 41.4% of the respondents had one wife and two wives respectively, 7.3% three wives and 9.8% more than three wives.

Primary Occupation: Majority of the respondents were found to be farmers while others engaged in other primary occupations, such as public service, trading and artisan work. The study revealed that 14% of them were public servants, 37.4% farmers, 25.7% traders, 8.9% artisans, and 7% craftsmen. Those of them that engaged in artisan work were mainly vulcanizers, cobblers, carpenters and masons. The craftsmen were mainly into hair dressing, fashion designing and tailoring. Although their spouses were distributed along the lines of these various primary occupations, some of them were contractors.

Income: During the period under review, 19% of the respondents had less than N70,000.00 annual income, while 18.1% of them earned between N70,001 and N80,000 per annum. Again, a total income of N80,001 to N90,000 belonged to16.2% of the respondents, N90,001 to N100,000 belonged to 16.7%, and above N100,000 belonged to 30.1% of those interviewed. Thus, those that earned more than N100,000 per annum ranked highest across the sampled six LGAs. However, there are

variations in total income per annum of the respondents within selected LGAs.

Other Sources of Support: These were identified to include help and donations from relations (46.4%), help and donations from support groups (2%), and support from development agencies and NGOs (30.1%), CBOs, churches and philanthropic organisations/individuals (21.4%). Figures in parentheses are percentage respondents with respect to their sources of additional support.

Reproduction Behaviour: Survey results showed that the average number of children per household of those interviewed is five (5) comprising of two (2) males and three (3) females. With respect to mortality, the average number of children no more alive is two (2), male or female. About 52% of the respondents had never lost any of their children within their households, while about 48% of them had lost at least one of their children at a certain period of their family life. It was not possible for these respondents to identify the possible causes of death for those that lost their children. However, they perceived that such diseases, as malaria/fever, diarrhea/abdominal pains, measles, convulsion and HIV/AIDS, could have been implicated. On their satisfaction with the number of children they had, about 64% of the respondents opined

that they were satisfied, while only 36% of them claimed they were not satisfied. The mean number of more children desired by these households was recorded as three (3).

Sexual Behaviour: With respect to awareness about HIV/AIDS, all (100%) of the households interviewed stated that they were aware of the disease condition. Their sources of information about HIV/AIDS were identified as radio/newspaper/television (60%), clinics/hospitals (15%), spouse (12%), friends (5%) and NGOs (8%). Figures in parentheses are percentage respondents.

On their knowledge about how HIV/AIDS spreads, 96.2% of them claimed that they understand how it spreads, while only 3.8% of the respondents were ignorant across the six (6) selected LGAs for the study. As a preventive strategy, 62% of them had gone for test to know their HIV sero-status, while 38% of them did not, as at the period of this investigation. It was noted that the knowledge of how HIV/AIDS spreads and one's HIV sero-status were higher in urban LGAs, such as Enugu North, Enugu East and Nsukka, and lower in rural areas, like Uzo-Uwani, Ezeagu and Awgu.

On their HIV sero-status, 11.9% of them confirmed that they were HIV positive and 71.3% HIV negative, while 16.9% of these respondents did not know their sero-status. For the HIV positive

persons, 44% of them fell sick every month, 16% once in three (3) months, 8% once in six (6) months, and 32% once a year, with some variations across the six (6) sampled LGAs. Overall, 50% of the respondents were on anti-retroviral drugs, while 50% of them stated that they were not on anti-retroviral drugs. Ezeagu LGA recorded 100% compliant to the use of anti-retroviral drugs, followed by Enugu East LGA (75%) and Nsukka LGA (66.7%). However, Awgu LGA (71.4%), Uzo-Uwani (60%) and Nsukka (33.3%) registered the highest percentage of non-users of anti-retroviral drugs.

On the amount spent on anti-retroviral drugs (ARV) by users on monthly basis, 18.2% of the respondents spent N1,500, 63.6% of them spent N2,000, while 9.1% of these HIV positive persons spent N2,500 and N3,000 respectively, as at the time of this survey. Regrettably, 92.9% of the respondents did not always have access to the ARV drugs whenever they wanted it while 7.1% of them claimed otherwise. In other words, majority of the HIV positive persons hardly get these drugs as and when due. It was not always available to those that needed them, especially among the rural dwellers. The reasons for non-availability were unaffordability (61.5%), bureaucracy/protocol (30.8%), and ignorance of where to get the ARV drugs (7.7%). Figures in parentheses represent percentage respondents. In other words, they consider the price tag on the anti-retroviral drugs as costly and out-of-reach of the people,

especially the poor in the rural communities of Enugu State. The administrative bottle-necks encountered in purchasing the drug from designated ARV Centres or hospitals actually discouraged the HIV positive persons from visiting these clinics/hospitals/centres in search of ARV drugs. Ignorance on where to purchase the drug compounded the problem and actually constituted a critical factor that adversely contributed to their worsening health condition.

Impact of HIV/AIDS on the Agricultural Sector

Generally, the citizens had the perception that the HIV/AIDS scourge adversely affected the economy, human resources and livelihood systems of the state. Survey results showed that 90.7% of the respondents admit that HIV/AIDS had adverse effects on Enugu State, while only 9.3% of them did not agree with this view point. The impact of the epidemic on agriculture are hereby discussed

The general perception of the people based on the survey was that HIV/AIDS significantly impacted on the agricultural sector in Enugu State. About 78% of the respondents opined that HIV/AIDS adversely affected the agricultural sector, while 16.4% of them disagreed with this position. However, only 5.6% of the respondents claimed they do not know anything about the impact of HIV/AIDS on agriculture. The study

showed that HIV/AIDS had significant impact on agriculture with respect to farm output, number of professionals, workforce, health and poverty. It also adversely affected household income, productivity, nutrition, and agricultural infrastructure.

Survey results indicated that HIV/AIDS decreased farm output and lowered productivity of affected farmers with increased poverty and malnutrition among the people. HIV/AIDS has also constrained infected households to dispose family assets, such as land, grinding machines and processing equipment in order to care for their sick family members, as well as deterioration of agricultural infrastructure among the people. It has caused deterioration in the health of the citizens, scarcity of professionals and decreased agricultural workforce as a result of opportunistic infections/sickness or death from AIDS. The degree of impact of HIV/AIDS on the agricultural sector is ranked in Fig. 1 below. Reduced household income was ranked first (1^{st}), increased poverty second (2^{nd}) and decreased workforce third (3^{rd}) in that order as perceived by the respondents or the people.

With respect to the ways of mitigating the impact of HIV/AIDS on agriculture, the respondents suggested sustained community mobilization/sensitization of the people on HIV/AIDS prevention (20%), provision of ARV drugs and other medicaments to PLWHAs (10%), establishment of more HIV/AIDS counseling centres (14%), as well as

empowerment of the farmers through micro-credit support and income generating activities (24%). In addition, they also considered the provision of rural infrastructure (e.g., access roads, portable water, etc.), as well as farm inputs (15%), capacity building/training for farmers in modern farming practices (17%), among others. Figures in parentheses represent percentage respondents.

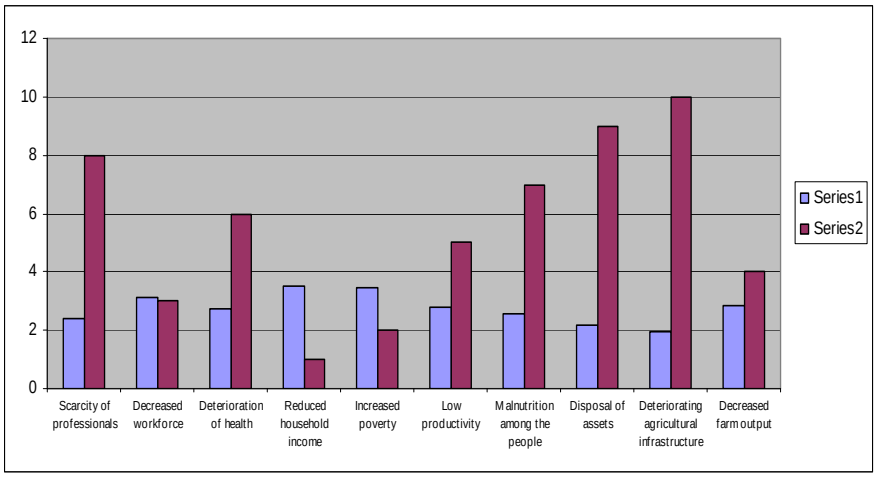

Fig. 1: *Impact of HIV/AIDS on the Agricultural Sector*

CONCLUSION AND RECOMMENDATIONS

The mainstreaming of HIV/AIDS by government and all other partners, therefore, offers a great opportunity for proactive measures to be developed by all stakeholders to deal with the problems of HIV/AIDS in

Enugu State. The challenge is to promote and support the HIV/AIDS multi-streams awareness and action process and consolidate the process towards supporting preventive, care and support interventions as well as promoting mitigation measures as provided in the recommendations hereunder.

Based on the results/findings from this study, the following key recommendations are considered necessary for prompt action:

1. The government, development partners and agencies should focus on ensuring increased access to treatment, prevention, care and support services for the benefit of HIV positive persons and vulnerable groups, such as women, children and the poor. This could be achieved through medium and strategic plan development for the establishment of more health facilities and VCCT centres at strategic locations in the various communities of Enugu State. This will reduce the traveling time and distance of the target groups to the health facilities and VCCT centres, as well as encourage them to easily patronize such facilities/centres. Existing institution/structures should also be strengthened for the management of HIV/AIDS services in the state.
2. Capacity building/training and recruitment of more health professionals, peer health educators and teacher counselors need to be intensified through regular conferences, seminars, and

workshops. This is meant to address the present challenges of increasing number of HIV positive persons and orphan and vulnerable children (OVC) in the state, especially in the rural communities.

3. Government, development agencies, and Non-Governmental Organisations (NGOs) should also facilitate support to micro-finance institutions and co-operative societies in terms of technical assistance and micro-credit facilities as an empowerment strategy to alleviate poverty among HIV positive persons, vulnerable groups (women, children, care-givers). Empowerment of these target groups through provision of micro-credit and income-generating activities will reduce their vulnerability to HIV infection and death from AIDs. They will be in a position to raise their household income base and provide for their households.
4. Government should provide the enabling environment for healthy living through provision of adequate rural infrastructure, such as access roads, portable water, and electricity in addition to health facilities.
5. There is the need to establish a functional database and a monitoring and evaluation system to cater for the data needs of the state with respect to HIV/AIDS prevalence, programme

interventions, responses and performance. With paucity of data in this respect, it will be difficult to measure achievements/progress of interventions, as well as the impact of the HIV/AIDS epidemic on the citizens and the various development sectors in the state. In the light of the above, it will be difficult to leverage support from development partners and donor organizations.

6. Finally, a holistic approach integrating all HIV/AIDS programmes into an overall strategy in the state needs to be adopted to combat the root causes of the transmission of the disease in poverty, ill health, inequality, ignorance, discrimination and exploitation.

With commitment and government political will in addressing the above issues/recommendations, significant progress will be made in mitigating the impact of HIV/AIDS on the core development sectors of the economy and the agricultural sector in particular.

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