JOURNAL OF APPLIED SCIENCES AND DEVELOPMENT

(An international academic research journal)

Volume 5, Number 1-2, October, 2014 ISSN: 4121-8241

Welfare & Industrial Promotions (WIPRO)
International
The Eastern Nigeria Industrial Estate
30 Zik Avenue, Uwani.
P.O. Box 9060, Enugu.
Mobile: *+234-805-315-2828, +234-803-338-7472*
Website: *www.wiprointernational.org*

Published by
Welfare & Industrial Promotions (WIPRO) International
P.O. Box 9060, Enugu
Phone: +234-803-338-7472, 805-315-2828
www.wiprointernational.org

ISSN
4121-8241

Cover, Design & Concept: Rowland Egolum & Felix Ezeh

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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 on the output of Applied Sciences as they relate to development of the society. It is a biannual published April and October beginning from 2010. However, due to high rate of rejection of low-standard papers, the two issues for a year could be published in one Volume, such as Volume 2 Number 1-2 of October 2011 and others. As usual, the current Issue, Volume 5 Number 1-2 of October 2014, is loaded with a variety of sound articles covering contemporary issues in Applied Sciences (including chemical weapons) and Development.

In the first paper titled, "Chemicalweapons: Man-made destroyer of life," Environmental Pollution Chemist/Toxicologist O.C. Eneh (PhD) and F.I. Ogbuefi-Chima submit that since World War I, when aerosol was used effectively on numerous occasions by both sides to alter the outcome of battles, chemical weapons continue to be used to inflict death or harm on human beings. Despite numerous international agreements in force with regard to chemical weapons, reparedness doctrine anticipates the potential for their future use.

The review is an attempt to harmonise and update the scanty and fragmented literature on chemical weapons. It covers the meaning, categories, instances of use, method of destructive action, and implications of use of chemical weapons for sustainable development. It recommends that world leaders should do away with chemical weapons and find alternative means of security and defense.

In the second paper, Ozuru, H.N. (Ph.D), Amue, J.G. (Ph.D) and Amadi, B.Z. (M.Sc.) of Marketing Department, University of Port Harcourt, Choba, Rivers State, Nigeria reported on a comparative analysis of consumer preference of *Bournvita* by Cadbury Nigeria Plc and *Milo* by Nestlé Nigeria Plc in Port Harcourt, Rivers State, Nigeria. Information was elicited from randomly selected fifty (50) respondents with the help of a 5-point likert scale questionnaire. Data were analyzed using descriptive and inferential statistical tools. Amongst the findings is marked preference for *Milo* over *Bournvita* due to effectiveness of sales promotion, taste, and product packaging. Consumption frequency for *Milo* was 65.4%, while that of *Bournvita* was 50%. The paper recommended, among others, that both manufacturers should improve on the tastes of the beverages as well as enhanced distribution system.

In the third article title "Waste-to-wealth MSMEs development and growth for unemployment and poverty reduction and growing Nigeria's economy: Imperative role of the Nigerian diaspora," O.C. Eneh (Ph.D) and A.N. Eneh (Ph.D) reviewed the concepts of entrepreneurship, MSMEs, unemployment, critical skills, poverty reduction, education for economic and social development, brain drain, brain gain,

brain waste, as they affect African countries in the midst of growing unemployment rate and widdening poverty, in order to reveal the imperative role the disapora Nigerians needed to play, especially in selected waste-to-wealth opportunities based on rich natural endowment in Nigeria.

They concluded that growing unemployment and poverty, amidst many other push factors, have led to emigration of many Nigerians to developed countries in the West for greener pastures. Nigeria has, thus, experienced significant brain-drain and brain-waste. But, these Diaspora Nigerians have acquired critical skills and earned capital, both of which they can invest in waste-to-wealth MSMEs development and growth that will create jobs, reduce unemployment and poverty, improve self-reliance and grow Nigeria's economy.

They enjoin the Nigerian Diaspora to bend over backwards to take critical skills and capital back home to develop and grow waste-to-wealth enterprises for unemployment and poverty reduction and rapid economic development of their home country. Contributing to building Nigeria through establishment of waste-to-wealth MSMEs will ensure the retirement of the Nigerian Diaspora to a fatherland that has become better developed for common good and wellbeing.

We thank all our esteemed contributors and enjoin them not to flag in their zeal for research and publishing, especially now that rejection rate appears to be growing. 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 across the globe in all

cognate disciplines (see *Call for Articles*), as we reiterate our commitment to delay-free and efficient processing of all submissions and their subsequent professional and competitive publishing in hard copy and online.

Best regards.

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J. Appl. Sci. Dev. *Vol. 5, No. 1&2, October 2014 [5-24]*

CHEMICAL WEAPONS: MAN-MADE DESTROYERS OF LIFE

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Abstract

Despite numerous international agreements in force with regard to chemical weapons, reparedness doctrine anticipates the potential for their future use. Since World War I, when aerosol was used effectively on numerous occasions by both sides to alter the outcome of battles, chemical weapons continue to be used to inflict death or harm on human beings. They are man-made agents that use the toxic, rather than the explosive, properties of chemical substances, and have been classified as weapons of mass destruction and "condemned by the civilised world". The Germans first opened canisters of chlorine and let the prevailing winds do the dissemination. Shortly thereafter, the French put phosgene in a projectile and this method became the principal means of delivery. In 1917, the Germans employed mustard shells for the first time and simultaneously attempted to use a solid particulate emetic, diphenyl chlorarsine, as a mask breaker. Mustard, an insidious material, penetrates leather and fabrics and inflicts painful burns on the skin. The literature on chemical weapons is scanty, fragmented and dated. This review is an attempt to harmonise and update the literature on chemical weapons. It covers the meaning, categories, instances of use, method of destructive action, and

implications for development of chemical weapons. It recommends that world leaders should do away with chemical weapons and find alternative means of security and defense.

Keywords: *Weapons of mass destruction, Chemical warfare, Environmental pollution*

Introduction

A chemical weapon (CW) is a device that uses chemicals formulated to inflict death or harm on human beings. They use the toxic, rather than the explosive, properties of chemical substances to inflict physical or physiological effects on an enemy. They are man-made agents (in gas or liquid form), which attack the body organs, leading to symptoms and/or death. CWs are classified as weapons of mass destruction, and have been "condemned by the civilised world". From ancient to medieval times, there are textual, literary and archeological evidences of chemical warfare, which is warfare that involves chemical weapons, as distinct from nuclear and biological warfare. Chemical weapons have been used in past conflicts - and preparedness doctrine anticipates the potential for their future use [1].

Much of the lore of chemical weapons has its origin in World War I, when “gas” (actually an aerosol or vapour) was used effectively on numerous occasions by both sides to alter the outcome of battles. The Germans first opened canisters of chlorine and let the prevailing winds do the dissemination. Shortly thereafter, the French put phosgene in a projectile and this method became the principal means of delivery. In 1917, the Germans employed mustard shells for the first time and simultaneously attempted to use a solid particulate emetic, diphenyl chlorarsine, as a mask breaker. Mustard, an insidious material, penetrates leather and fabrics and inflicts painful burns on the skin.

Numerous international agreements are in force with regard to chemical weapons. The Geneva Protocol (officially known as the *Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or other Gases, and of Bacteriological Methods of Warfare*), which prohibits the use of chemical and biological weapons, was signed at Geneva on June 17, 1925 and entered into force on February 8, 1928. One hundred and thirty-three (133) nations are listed as state parties to the treaty. Ukraine acceded August 7, 2003 and is the most recent member nation [2, 3].

The United States of America (USA) did not ratify the protocol until 1975. During the intervening period, Italy employed chemical weapons in Ethiopia and Japan employed it in Manchuria and China, yet both nations were signatories to the Geneva Convention. Despite the accumulation of enormous stockpile of chemical weapons, both sides did not deliberately employ chemical weapons in World War II. Instances of use of chemical weapons in local wars are arguable, except for the Iran-Iraq conflict of 1982-1987.

During the 20th century, about 70 different chemical subsatances have been used or stockpiled as chemical weapons agents. But for recent attempts at terrorism by the Japanese cult, Aum Shinrikyo, virtually all uses of chemical weapons have been as tactical weapons by nations.

While the Geneva Convention prohibits the use of chemical and biological weapons, it does not address the production, storage, or transfer of these weapons. Later treaties have been enacted to address these omissions. The Chemical Weapons Convention (CWC) is the most recent arms control agreement with the force of International law. Its full name is the *Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction*. This agreement outlaws the production, stockpiling and use of chemical

weapons. It reinforces aspects of the Geneva Conventions that also dealt with these agents and was negotiated over a period of 24 years [4].

The CWC is administered by the Organisation for the Prohibition of Chemical Weapons (OPCW), an independent organization based in The Hague. The OPCW administers the terms of the CWC to 188 signatories which represents 98% of the global population. Of the stockpiles, 44,131 of the 71,194 tons declared (61.99%) have been destroyed. The OPCW has conducted 4,167 inspections at 195 chemical weapon-related and 1,103 industrial sites. These inspections have affected the sovereign territory of 81 State Parties since April 1997. Worldwide, 4,913 industrial facilities are subject to inspection provisions [5].

As at 2002, five years CWC entered into force, destruction of 20% of the stockpile was to be completed. After seven years, 45% of the destruction should be complete. Under the treaty, countries must stop any development, production, acquisition, stockpiling and retention of chemical weapons. The CWC requires State Parties to report the location of chemical weapons storage sites, the location and characteristics of chemical weapons production and research facilities and prohibits trade in certain chemicals with countries not party to the treaty.

The verification provisions of the CWC not only affect the military sector, but also the civilian chemical industry, world-wide, through certain restrictions and obligations regarding the production, processing and consumption of chemicals that are considered relevant to the objectives of the Convention. The Convention also contains provisions on assistance in case a State Party is attacked or threatened with attack by chemical weapons and on promoting the trade in chemicals and related equipment among State Parties.

Of 188 signatory nations to the CWC, China, India, Iraq, Libya, Russia and United States (US) have also declared stockpiles, agreed to monitored disposal, and verification, and in some cases, used CW in

conflict. Both military targets and civilian populations have been affected - the effected populations were not always damaged collaterally, but rather at times, the target of the attack [6].

The Russian Federation possesses approximately 40,000 tons of CW agents stored at seven sites. The arsenal consists of the nerve agents sarin, soman and V-gas, the vesicants lewisite and mustard, and the choking agent phosgene. Approximately 80% of the stockpile consists of nerve agents. As of 11 April 1992, Russia did not have a comprehensive destruction act. Although the State Duma unanimously passed such a bill on 27 December 1996, the Federation Council rejected it the following month. Nevertheless, plans for CW destruction continue to be developed. A comprehensive destruction act is needed to provide the legal basis for destruction, irrespective of Russia's ratification of the CWC.

Chemical weapon destruction efforts were hindered by a lack of funding ($3.35 billion is needed). The most significant assistance thus far is the US funding for the construction of a pilot CW destruction facility at Shchuchye (an estimated $600 million). US destruction aid is closely associated with a continuing joint evaluation of Russia's two-stage nerve agent destruction technology: the Russian-US Joint Evaluation Programme. It is being conducted within the framework of the 1990 Bilateral Destruction Agreement and a 1994 Plan of Work addendum.

The US stockpile consists of over 30,000 tons of unitary CW agent and approximately 700 tons of binary components. It includes the nerve agents sarin and VX and the vesicant mustard. They are stored at the nine locations: Johnston Atoll in the Pacific Ocean; Edgewood, Maryland; Anniston, Alabama; Blue Grass, Kentucky; Newport, Indiana; Pine Bluff, Arkansas; Pueblo, Colorado; Tooele, Utah; and Umatilla, Oregon. The cost of destroying the US stockpile is currently estimated at approximately $12.4 billion. Large-scale destruction operations began at the Johnston

Atoll Chemical Agent Disposal System (JACADS) in 1990. The second destruction facility at Tooele, Utah, began operation in August 1996.

Incineration continues to be the US Army's baseline destruction technology, but alternative destruction technologies are also being considered because of the opposition of some parties to incineration. The US Army is required by law to consider alternative destruction technologies for the destruction of bulk agent. Three proposals by private industry plus two developed by the Army have been evaluated by the National Academy of Sciences.

In addition, the research, development, test and evaluation inventory comprises approximately 4,400 kg, and recovered munitions and similar "non-stockpile" items amount to approximately 6100 kg. The programme for items which are not part of the US CW stockpile deals with recovered chemical munitions, chemical agent detector kits and miscellaneous chemical materials stored at an estimated 65 sites. The destruction of non-stockpiled CW materials will cost estimated $15.2 billion.

China ratified the CWC on 25 April 1997 and has declared possession of former chemical weapons production facilities; initial inspections have been conducted. Egypt - has not signed the CWC. Ethiopia - ratified the CWC on 13 May 1996. India ratified the CWC on 3 September 1996. India publicly announced itself to be a chemical weapons possessor on 26 June 1997; initial inspections have not been conducted. Iran ratified the CWC on 3 November 1997, initial inspections have begun. Iraq has not signed the CWC. Israel has signed, but not ratified the CWC. Libya has not signed the CWC. Myanmar has signed, but not ratified the CWC. North Korea has not signed CWC. Pakistan ratified the CWC on 28 October 1997; initial declaration submitted. South Korea ratified the CWC on 28 April 1997. Syria has not signed the CWC.

Taiwan has not signed the CWC. Vietnam has signed but not ratified the CWC.

There are three basic configurations in which these agents are stored. Self-contained munitions, like projectiles, cartridges, mines, and rockets. These can contain propellant and/or explosive components. The next form are aircraft-delivered munitions. This form never has an explosive component. Together they comprise the two forms which have been weaponized and are ready for their intended use. The U.S. stockpile consisted of 39% of these weapon ready munitions. The final of the three forms are raw agent housed in one-ton containers. The remaining 61% of the stockpile was in this form. Whereas these chemicals exist in liquid form at normal room temperature, the sulfur mustard's H, and HD freeze in temperatures below 55 °F (12.8 °C). Mixing lewisite with distilled mustard lowers the freezing point to -13 °F (-25 °C) [7-10].

Higher temperatures are a bigger concern because the possibility of an explosion increases as the temperatures rise. A fire at one of these facilities would endanger the surrounding community as well as the personnel at the installations. Perhaps more so for the community having much less access to protective equipment and specialized training. The Oak Ridge National Laboratory conducted a study to assess capabilities and costs for protecting civilian populations during related emergencies, and the effectiveness of expedient, in-place shelters [11, 12].

Lethal unitary chemical agents and munitions are extremely volatile and constitute a class of hazardous chemical weapons stockpiled by many nations. The most dangerous of these are nerve agents GA, GB, and VX, and vesicant (blister) agents H, HT, and HD. All are in liquid form at normal room temperature. Public opinion has moved to endorse the complete elimination of this class, and progress is being made to fulfill its eradication through international law.

Chemical weapons consitute an important discuss. This review paper draws from literature, with a view to attempting to examine, update and harmonise resources on chemical weapons. After this brief introduction, the rest of the paper is structured as follows: categories of chemical weapons agents, instances of use of chemical weapons, methods of destruction of chemical weapons, implications for sustainable development, and conclusion and recommendation.

Categories of chemical weapons agents

BizzyDays Publications [13] and Isaacs et al. [14] divide chemical weapons into four categories, based on their way of attacking the human body. *Vesicant chemical weapons agents* ('blistering agents' or 'mustard agents') are delivered in gas or liquid form and produce burns and blisters on the skin, eyes, throat and internal organs. They can act as poison if they pass into the blood stream, and can cause death by asphyxiation if they reach the respiratory system. A well-known vesicant substance is mustard gas or dichlorodiethyl sulphide, $(ClCH_2CH_2)_2S$, made from ethene and disulphur dichloride (S_2Cl_2), which attacks the whole body and is carcinogenic (induces cancer). It may take up to 24 hours to start becoming apparent, and about 2-3 days to kill at low rate, from the time it is exposed. Shreve and Brink [15] adds that other cheap and effective blistering agents are nitrogen mustard and lewisite. The most important temporary incapacitating agent is adamsite, which rapidly produces headache and nausea.

Choking chemical weapons agents are relatively simple and common industrial chemicals (like chlorine, Cl_2, and phosgene or carbonyl chloride, $COCl_2$, nitrogen oxide, NO) delivered in gas form and are more volatile (disperses more quickly in the air) than the vesicants. They act exclusively by inhalation, targeting the nose, lungs and throat, and

producing an immediate smothering effect followed by oedema (excess fluid) of the lung possibly resulting in death by asphyxiation.

Blood chemical weapons agents include cyanhydric acid, cyanogen chloride (CK) and hydrogen cyanide, which are cyanide-based poisons that enter the blood stream, disrupting cellular functions in the respiratory system and producing suffocations. Hydrogen cyanide (HCN) can also be absorbed by the skin. Early symptoms of cyanide poisoning include restlessness, headache, palpitations and breathing difficulties, folowed by vomiting, convulsions, respiratory failure and unconsciousness. In a confined space, the volatile HCN quickly reaches lethal concentration levels, hardly leaving the time to display early symptoms, but victims simply fall dead. There is no antidote for cyanide poisoning.

Nerve chemical weapons agents are neurotoxins (like sarin, tabun, soman or VX), which block an enzyme that is necessary for the central nervous system to function, leading to a disruption of muscle function followed by a seizure and, eventually, death. Nerve chemical weapons agents (delivered in gas or liquid form) enter the body by inhalation, skin absorption or being consumed (for example, in a contaminated water supply). Symptoms appear 2-3 minutes after inhalation and 20-30 minutes after absorption or consumption. A thimble-sized portion of the nerve toxin can kill in minutes, and a few particles can produce death in 24 hours.

Another report [16] idnetifies a fifth category as riot control chemical weapons agents and enriches the four already identified categories. Blister chemical weapons agents are sulphur mustard (yperite), lewisite, nitrogen mustard, mustard-lewisite, and phosgene-oxime. Nerve chemical weapons agents are VX, sarin, soman, tabun, and novichole. Choking chemical weapons agents are chlorine, phosgene, diphosgene, and chloropicrin. Blood chemical weapons agents are herygem, cyanide, cyanogen chlorine. Riot control chemical weapons agents are tear agent 2

(SN gas), tear agent 0 (CS gas), and psychedelic agent 3 (BZ). It also puts chemical weapons agents under nerve agents, mustard agents, hydrogen cyanide, tear gases, arsines, psychotomimetic agents, toxins and potential chemical weapons agents. It adds that the Chemical Weapons Convention (CWC) recognises three groups of chemicals according to their purpose and treatment: chemicals used in weapons (like sarin, mustard gas and tabun), those that can be used in weapons (like amiton and BZ), and least toxic substances that can be used for research and production of medicine, dyes, textiles, among others.

It further divides chemical weapons agents mainly used against people into lethal and incapacitating categories. The agent is incapacitating if one-hundedth of the lethal dose causes incapacitation, e.g. through nausea or visual problems. A statistical average determnes the non-absolute limit between lethal and incapacitating substances. Mental incapacitatants are predominantly glycolates, whereas some of the more potent candidates for physical incapacitants have come from research on improved anaesthetics.

Again, chemical weapons may be binary or unitary. Binary chemical weapons use two relatively innocuous chemical precursors stored separately and reacted by mixing to form the toxic chemical agent en route to the target. This concept applies to production of highly lethal but unstable compounds or mixtures of compounds unsuitable for long-term storage. These do not react to produce lethal effects until mixed, usually just prior to battlefield use. Unitary munitions are opposite of binary munitions. Unitary weapons are lethal chemical munitions which produce a toxic result in their existing state. The majority of the chemical stockpile is unitary and most of it is stored in one-ton bulk containers [17, 18].

Instances of use of chemical weapons

Table 1.1 shows some instances of use of chemical weapons [16].

Table 1.1: Some instances of manufacture, stockpile and alleged/real use of chemical weapons

S/N.	Year	Use of chemical weapon
1.	425 BC	Spartans ignited pitch and sulphur to create toxic fumes in the Peloponnesian.
2.	424 BC	Toxic fumes used in siege of Delium during the Peloponnesian War.
3.	1456	City of Belgrade defeated invading Turks by igniting rags dipped in poison to create a toxic cloud.
4.	April, 1863	The US War Department issued General Order 100, proclaiming "the use of poison in any manner, be it to poison wells, or foods, or arms, as wholly excluded from modern warfare".
5.	World War I	Chemical agents used in WWI causing an estimated 1,300,000 casualties, including 90,000 deaths.
6.	1914	French began using tear gas in grenades and Germans retaliated with tear gas in artillery shells.
7.	April 22, 1915	Germans attacked the French with chlorine gas at Ypres, France.
8.	Sept. 25, 1915	First British chemical weapons attack; chlorine gas was used against Germans at the Battle of Loos.
9.	Feb. 26, 1918	Germans launched the first projectile attack against US troops with phosgene and chloropicrin shells. The first major use of gas against American forces.
10.	June 28, 1918	The US began its formal chemical weapons programme with the establishment of the Chemical Warfare Service.

11. 1919	British used Adamsite against the Bolsheviks during the Russian Civil War.
12. 1922-1927	The Spanish used chemical weapons against the Rif rebels in Spanish Morocco.
13. 1936	Italy used mustard gas against Ethiopians during its invasion of Abyssinia.
14. 1942	Nazis began using Zyklon B (hydrocyanic acid) in gas chambers for the mass murder of concentration camp prisoners.
15. Dec. 1943	A US ship loaded with mustard bombs attacked by Germans in the port of Bari, Italy; 83 US troops died in poisoned waters.
16. April 1945	Germans manufactured and stockpiled large amounts of tabun and sarin nerve gases but do not use them.
17. 1962-1970	US used treat gas and four types of defoliant, including Agent Orange, in Vietnam.
18. 1963-1967	Egypt used chemical weapons (phosgene, mustard) against Yemen.
19. 1975-1983	Alleged use of Yellow Rain (trichothecene mycotoxins) by Soviet-backed forces in Laos and Kampuchea.
20. 1979	The US government alleged Soviets use of chemical weapons in Afghanistan, including Yellow Rain.
21. August 1983	Iraq began using chemical weapons (mustard gas) in Iran-Iraq War.
22. 1984	First ever use of nerve agent tabun on the battlefield, by Iraq during Iran-Iraq War.
23. 1987-1988	Iraq used chemical weapons (hydrogen cyanide,

		mustard gas) in its Anfal Campaign against the Kurds, most notably in the Halabja Massacre of 1988.
24.	Mar. 20, 1995	The Tokyo Subway sarin gas attack killed nearly a dozen people and incapacitating or injuring approximately 5,000 others.

Source: Reachingcriticalwill.org, 2011

As far back as 425 BC, Spartans ignited pitch and sulphur to create toxic fumes in the Peloponnesian War. A year after, toxic fumes were used in siege of Delium during the Peloponnesian War. In 1456, city of Belgrade defeated invading Turks by igniting rags dipped in poison to create a toxic cloud. In 1863, the United States of America (US) War Department issued General Order 100, proclaiming "the use of poison in any manner, be it to poison wells, or foods, or arms, as wholly excluded from modern warfare".

During World War I, chemical agents used caused an estimated 1,300,000 casualties, including 90,000 deaths. In 1914, French began using tear gas in grenades and Germans retaliated with tear gas in artillery shells. This was the first significant use of chemical warfare in WWI. On April 22, 1915, Germans attacked the French with chlorine gas at Ypres, France. This was the first significant use of chemical warfare in WWI. On September 15, 1915, in first British chemical weapons attack, chlorine gas was used against Germans at the Battle of Loos. On February 26, 1918, Germans launched the first projectile attack against US troops with phosgene and chloropicrin shells. This was the first major use of gas against American forces. On June 28, 1918, the US began its formal chemical weapons programme with the establishment of the Chemical Warfare Service.

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Between 1962 and 1970, US used treat gas and four types of defoliant, including Agent Orange, in Vietnam. Between 1963 and 1967, Egypt used chemical weapons (phosgene, mustard) against Yemen. Between 1975 and 1983, it was alleged that Soviet-backed forces used Yellow Rain (trichothecene mycotoxins) in Laos and Kampuchea. There was evidence to suggest the use of T-2 toxin, but an alternative hypothesis suggested that the yellow spots labelled Yellow Rain were caused by swarms of defaecating bees. In 1979, the US government alleged that Soviets used chemical weapons, including Yellow Rain, in Afghanistan.

In August 1983, Iraq began using chemical weapons (mustard gas) in Iran-Iraq War. In 1984, first ever use of nerve agent tabun on the battlefield by Iraq during Iran-Iraq War was recorded. Between 1987 and 1988, Iraq used chemical weapons (hydrogen cyanide, mustard gas) in its Anfal Campaign against the Kurds, most notably in the Halabja Massacre of 1988. On March 20, 1995, the Tokyo Subway sarin gas attack killed nearly a dozen people and incapacitated or injured approximately 5,000 others. Thousands did not die from the Tokyo attack due to impurity of the agent. A tiny drop of sarin, which was originally developed in Germany in the 1930s, can kill within minutes after skin contact or inhalation of its vapour. Like all other nerve agents, sarin blocks the action of

acetylcholinesterase, an enzyme necessary for the transmission of nerve impulses.

Methods of destruction of CWs

United States National Bureau Council [17] outlined options and costs for destruction of CWs. Formerly, the most common disposal methods for chemical weapons were land burial, sea dumping, detonation (firing or exploding the munitions) and open-pit burning. These methods may have been thought to be quite clever at the time (out of sight, out of mind), but their danger has since become starkly apparent. Buried munitions pose problems environmentally. Once the munitions begin to corrode and leak, the agents can contaminate the surrounding soil and even get into water sources. Sea dumping of chemical munitions has caused a number of problems. Some of these dumping operations have occurred in relatively shallow water in the Baltic Sea and off the coast of Japan. In both of these regions, dumped chemical weapons caused serious problems for the fishing industry. Fishermen in the Baltic and off the coast of Japan still haul old chemical weapons up in their nets, and are sometimes exposed to still-active agents.

Today, two major confirmed technologies for destroying chemical weapons acceptable under the CWC limits are incineration and chemical degradation. However, there are dozens of alternative technologies, and the number is growing. Under the Baseline incineration process, chemical weapons are first taken to the demilitarization facility, where the chemical agent is removed from the munitions or bulk containers by automated equipment. This puts the workers at the demilitarization plant at a very low risk of contamination.

Chemical degradation (or chemical neutralization) technologies also take many different forms. There are a number of chemicals, namely

alkalis and oxidants, which reduce and often negate the toxicity of chemical agents.

While the technologies for destroying chemical weapons do exist, in practice there are many factors that may come into conflict when the destruction process is carried out. The chemical weapons destruction challenges that must be considered include the high costs of destruction, safety, and environmental, legal and political factors. Although environmentalist groups have legitimate concerns that the weapons be disposed of in an environmentally safe manner, weapons experts generally agree that it is environmentally much more dangerous for the weapons to remain in storage for the additional years required to develop alternative methods of destruction.

Safety must also be carefully considered in the destruction of chemical weapons. This entails precautions and regulations that protect not only employees working in the destruction facility, but also the civilian population surrounding the facility. Highly sensitive monitoring equipment must be used in order to ensure there is no leakage of toxic agents.

The US claims it has 12,000 tons of chemical agents in munitions and another 19,000 tons in bulk storage. Russia, the sole in-heritor of the former Soviet Union's chemical weapons stockpile, officially reports its stockpile to be 40,000 tons. These two countries are the only signatories to the CWC that have admitted to possessing chemical weapons. In 1994, the United Nations Special Commission on Iraq (UNSCOM) declared that Iraqi chemical weapons capabilities had been destroyed, leaving Iraq with no surplus (or any) chemical weapons stocks. A large number of old and abandoned chemical weapons still exist in a number of countries. The total amount of chemical weapons and old and abandoned chemical weapons that must be destroyed worldwide is daunting. The original 1985 cost estimate for the destruction of the US chemical weapon stockpile was

US $1.7 billion. Today, the estimated cost of destruction is about US $9 billion and it is growing.

Implications of chemical weapons for sustainable development

Chemical weapon is a conception of man for his defense and security. It is a contrivance destructive of life and environment [19-24].

The cost of destroying old and abandoned chemical weapons has become stupendous in a world with a whooping population of 1.2 billion people classified as living in abject poverty. The fear of the future use of chemical weapons adds to the torments of these impoverished people, ravaged by diseases. With chemical weapons fabricated with limited resources and used against humans and the environment, sustainable development marches in the negative direction, and the Millennium Development Goals (MDGs) could as well be buried.

Recommendations

World leaders have the responsibility, wisdom and ability to do away with chemical weapons and find alternative means of security and defense. Limited resources ought to be channeled to sustainable development.

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A COMPARATIVE STUDY OF CONSUMER PREFERENCE OF CADBURY *BOURNVITA* AND NESTLÉ *MILO* BEVERAGES IN PORT HARCOURT, RIVERS STATE, NIGERIA

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Abstract

Cadbury Nigeria Plc and Nestlé Nigeria Plc are leading manufacturers of fast-moving consumer goods. Both provide job opportunities and play significant roles in growing Nigerian economy. Bournvita by Cadbury and Milo by Nestlé are similar beverages. A comparative analysis of their consumer preference in Port Harcourt, Rivers State, Nigeria is the object of this study. Information was elicited from randomly selected fifty (50) respondents with the help of a 5-point likert scale questionnaire. Data were analyzed using descriptive and inferential statistical tools. Amongst the findings is that there existed high marked preference for Milo over Bournvita due to effectiveness of sales promotion, taste, and product packaging. Consumption frequency for Milo is 65.4% while Bournvita is 50%. The paper recommended, among others, that both manufacturers should

improve on the tastes of the beverages as well as enhanced distribution system.

Keywords**:** *Consumer, Preference, Product.*

Introduction

Marketing begins and ends with the consumer, and this statement portrays the importance of the consumer to marketers. The needs of the consumers should be accurately identified as satisfied consumers need and tastes are constantly changing and consumer's characteristics like age, occupation, income, marital status are beyond the control of the firm [1].

Marketing manager should always strive hard to match these changing needs, preferences and tastes with want satisfying products. The life of a product or service rests on consumer acceptance because, if it is rejected, the product dies a natural death. It is therefore imperative to understand consumer requirements and characteristics to insure marketing success [1].

Satisfying consumers' wants, needs is the aim of the modern marketing concept. A consumer is an end user of a product/service. The modern marketing concept calls for changing the company's ways of doing things through joint effort of idea sharing, innovative and creative thinking of both parties (company and consumer). Advocates of modern marketing concept believe that consumer's wants, satisfaction and needs should be amongst the firms' main focus for its growth [2].

Research problem

All families in Port Harcourt have different tastes, choices/preferences for the consumption of goods and services. Premised on this, the problem of the study is to find how consumer's preference in purchase of beverages impact on the choice of Cadbury Bournvita and Nestlé Milos in Port-Harcourt.

Objectives of the study

The purpose of this is paper, is to empirically investigate how consumer preferences affect the purchase of Cadbury Bournvita and Nestlé Milo in Port-Harcourt, Rivers State, Nigeria.

Research hypotheses

Ho_1: There is no significant relationship between consumer Tastes and purchase of Cadbury Bournvita / Nestlé Milo in Port Harcourt, Rivers State.

Ho_2: There is no significant relationship between product Quality and Cadbury Bournvita and purchase of Nestlé Milo in Port Harcourt, Rivers State.

Theoretical foundations

The origins of Cadbury Nigeria Plc. dates back in the 1950s when the business was founded as an operation to source cocoa beans from Nigeria and as a precursor to enable the company's founders to tap opportunities for serving the local consumer-market with world-famous, Cadbury-branded products. Cadbury Nigeria is known to be the market leader in sugar confectioneries, gum and food beverages in Nigeria with strong market shares across all the three categories.

In the early 1960s, an initial operation was established to re-pack imported bulk products. This packing operation grew rapidly into a full-fledged manufacturing operation which resulted in the incorporation of Cadbury Nigeria Limited in January 1965. In 1976, the firm became a publicly listed company with shares traded locally on the Nigerian Stock Exchange.

Introduced in 1960, Cadbury Bournvita, the company's flagship brand, was initially imported and re-packed locally on the current site at Agidingbi, Ikeja Lagos. Having consolidated the Food Drinks market in Nigeria, Cadbury Bournvita became in 1965 the first Food Drink to be locally manufactured. Cadbury Bournvita was re-launched in a World Class, Environmentally Friendly Polypropylene Jar in 2011 and remains today a market leader in the Food Drinks category. In

2013, the Nutrition Society of Nigeria (NSN) endorsed Cadbury Bournvita as a Food Drink rich in energy and essential micronutrients, the only Food Drink Brand to be so endorsed [3].

Cadbury Nigeria also developed other product - categories, most notably Candy. Introduced in 1970, TomTom - the big, black and white sweet for soothing relief which has sustained market leadership for over 40 years–remains the most iconic brand in the Nigerian Candy market. It now comes in three variants: Classic, HoneyLemon and Strawberry. The other brand in the company's Candy portfolio is Trebor Buttermint, the delicious sweet with the double pleasure of butter and mint. In 2012, the company expanded its product categories in Nigeria when it launched Tang, the global leader in powdered beverages.

In the mid 1860s Nestlé, a trained pharmacist began experimenting with various combinations of cow's milk, wheat flour and sugar in an attempt to develop an alternative source of infant nutrition for mothers who were unable to breast feed. His ultimate goal was to help combat the problems of infant mortality due to malnutrition. He called the new product Farine Lactée Henri Nestlé which was founded in 1867 at the shores of Lake Geneva in Vevey, Switzerland [4].

Nestlé's first customer was a premature infant who tolerate neither his mother's milk nor any of the conventional substitutes, and had been given up for lost by local physicians. People quickly recognized the value of the new product, after Nestlé's new formula saved the child's life and within a few years, Farine Lactée Nestlé was being marketed in much of Europe. Henri Nestlé also showed early understanding of the power of branding.

Literature review

Cadbury Nigeria owned 99.66% equity in Stanmark Cocoa Processing Company Limited, located in Ondo Town in Ondo State, Nigeria. The Company provides all the cocoa powder required for manufacturing Cadbury Bournvita. Stanmark Cocoa

Processing Company Limited processed cocoa beans into several high quality cocoa by-products (such as cocoa butter, cocoa powder, cocoa cake and cocoa liquor) for local and export markets. In April 2013, Cadbury Nigeria acquired the majority equity-interests in Stanmark Cocoa Processing Company Limited, becoming part of the enlarged Cadbury Nigeria family and now known as Cadbury Nigeria Plc Cocoa Processing Plant. Cadbury Nigeria has grown to become a household name providing consumers with much-loved brands and revenue of ₦35.7 billion in 2013.

***Bournvita* by Cadbury Nigeria Plc**

Cadbury Bournvita "The best start for today and tomorrow" Cadbury Bournvita is packed full of vitality-giving nutrients that keep you and your child mentally and physically active from the start to the end of the day. What's more, it's also fortified with all nourishing vitamins and minerals that children need for healthy growth of their body and mind.

Ingredients in *Bournvita* 500g:

In producing the 500gm, the following ingredients are used: Malt Extract, Sugar, Cocoa Powder, Glucose Syrup, Skimmed Milk Powder, Milk Protein, Emulsifier (E471), Vitamins and Minerals.

Table 1 shows nutritional contents of *Bournvita.*

Table 1: Nutritional contents of *Bournvita*

Nutritional information - Full of vitality	Per 100g	Per 20g
Energy (kcal)	359	71.8
Protein (g)	6.9	1.38
Carbohydrates (g)	82	16.4
Sugar (g)	31	6.2
Total fat (g)	1.9	0.38
Saturated fat (g)	1.2	0.24
Total dietary fibre (g)	0.2	0.04
Sodium (g)	0.18	0.036

Nutritional information – Nourishment		%RDA per 100g	%RDA per 20g
Retinol (Vit A)	6250 (IU)	125	25
Thiamin (Vit B1)	1.9 mg	125	25
Riboflavin (Vit B2)	2.1 mg	125	25
Niacin (Vit B3)	25 mg	125	25
Pantothenate (Vit B5)	12.5 mg	125	25
Pyridoxine (Vit B6)	1.5 mg	125	25
Folic Acid (Vit B9)	0.3 mg	75	15
Cobalamine (Vit B12)	4.5 mcg	75	15
Ascorbic Acid (Vit C)	45 mg	75	15
Vitamin D	300 IU	75	15
Vitamin E	22.5 IU	75	15
Biotin	225 mcg	75	15
Iron	13.5 mg	75	15
Calcium	1800 mg	180	36
Potassium	700 mg	20	4
Selenium	41.3 mcg	75	15
Zinc	11.3 mg	75	15

*RDA = Recommended Dietary Allowance for 10 years and older. To be enjoyed as part of a healthy, active lifestyle [4].

Product categories of *Bournvita*

Chocolate product category of Nestlé and Cadbury, include Cadbury Chocolate Carnival, Cadbury Diary Milk, Cadbury Dairy, Nestlé Milky bar Munchies, etc.

Chocolate consumption in India is extremely low. Per capita consumption is around 160gms in the urban areas, compared to 8-10kg in the developed countries. In Rural areas, it is even lower. Chocolates in India are consumed as indulgence and not as a snack food. A strong volume growth was witness in the early 90's when Cadbury Repositioned chocolates from children to adult consumption. The biggest opportunity is likely to stem from increasing the consumer base. Leading players like Cadbury and Nestlé have been attempting to do this by value for money offerings, which are affordable to the masses [3].

Production of Cadbury Chocolate

Milk chocolate for eating was first made by Cadbury in 1897 by adding milk powder John paste to the dark chocolate recipe of

cocoa mass, cocoa butter and sugar. By today's standards this chocolate was not particularly good: it was coarse and dry and not sweet or milky enough for public tastes.

There was a great deal of competition from continental manufacturers, not only the French, but also the Swiss, renowned for their milk chocolate. Led by George Cadbury Junior, the Bournville experts set out to meet the challenge. A considerable amount of time and money was spent on research and on new plant designed to produce the chocolate in larger quantities [5].

A recipe was formulated incorporating fresh milk, and production processes were developed to produce a milk chocolate 'not merely as good as, but better than' the imported milk chocolate'. Four years of hard work were invested in the project and in 1905 what was to be Cadbury's top selling brand was launched.

Three names were considered: Jersey, Highland Milk and Dairy Maid. Dairy Maid became Dairy Milk, and Cadbury's Dairy Milk, with its unique flavor and smooth creamy texture, was ready to challenge the Swiss domination of the milk chocolate market. By 1913 Dairy Milk had become the company's best-selling line and in the mid-twenties Cadbury's Dairy Milk gained its status as the brand leader, a position it has held ever since [4].

***Milo* by Nestlé Nigeria Plc**

Nestlé Nigeria, as a leader in the fast moving consumer goods (FMCG) sector, has provided opportunities of growth and employment to many in Nigeria including office workers, management staff, work professionals, information technology (IT) specialists, farmers, suppliers of packaging materials, services and other goods. Nestlé size means it offers interesting and attractive office work, field assignments, worldwide projects, and initiatives globally. A leader in Nigeria's food and beverage industry which we are focusing on in this research work. Nestlé serves the Nigerian market through food products that include the popular Maggi food seasoning product. Nestlé

Nigeria Plc products include infant cereals, family cereals, beverage drinks, confectionery, seasoning sauces, table water, coffee, and milk products. Apart from the hugely popular Maggi seasoning other products consumes by Nigerians in large include Nestlé Golden Morn, Nestlé Milo (which we are focusing on), Nestlé Chocomilo, Cerelac, Nestlé Pure Life and Nescafe [3].

We believe that leadership is not just about size; it is also about behaviour. Trust, too, is about behaviour; and we recognize that trust is earned only over a long period of time by consistently delivering on our promises. These objectives and behaviours are encapsulated in the simple phrase, "Good Food, Good Life", a phrase that sums up our corporate ambition.

With socio-economic changes rapidly taking place, the young and not so young population will lead a new life style and chocolate eating is definitely going to be widespread and acceptable. In the industry, both population and family incomes as well as urbanization are on the increase. There has been a significant growth in the middle class, with 5.8 million people having upgraded to the quoted middle class.

Nestlé Nigeria Ltd is a subsidiary of Nestlé S.A of Switzerland. With 7 factories and a large number of co-packers. Nestlé Nigeria is a vibrant company that provides consumers in Nigeria with products of global standards and is committed to long term sustainable growth and shareholders satisfaction. It employs 4983 employees.

In 1978, Nestlé brought a 16-hectare plot of land in the industrial zone of Agbara town, some 60 km from the commercial capital Lagos, and built its first major factory which was inaugurated on Wednesday February 24, 1982 by the Honourable Minister of Agriculture, Mallam Adamu Ciroma, on behalf of the President of Nigeria. Built at a cost of N30,000,000, production at the Agbara factory began on schedule stating with *Maggi* cubes in mid 1981, Nestlé *Milo* October, 1981, whilst Nestlé *Cerelac* – Maize manufacture commenced in January 1982 [6].

Nestlé *Milo* is a chocolate malt food drink which contains a combination of natural ingredients specially

formulated to provide energy for an active lifestyle. The dynamism of the brand is demonstrated in its variety of formats.

Nutritional contents of Nestlé *Milo*

Nestlé Milo delivers wholesome nutrition with a balanced ratio of carbohydrates, protein, minerals and important vitamins (B_1, B_2, B_5, B_6, B_{12}, & C). The unique taste and goodness of *Milo* remains the same whether mixed with hot water or cold water. It is the perfect day-starter at breakfast, refreshing during the day and soothing at night. It is available in 5 different sizes namely: *Milo* 900g (Tin), *Milo* 500g (Tin), *Milo* 500g (Sachet), *Milo* 200g (Sachet), *Milo* 15g (Single Serve) [4].

Nestlé Nigeria embarked on a project in 1988, investing 33million Naira in building and equipment. The plant enabled Nestlé Nigeria to produce malt extract syrup from locally grown and malted sorghum having the qualities of imported Barley Malt Syrup. This was a successful replacement of an imported item in the manufacture of *Milo* food drink in which malt extract is the most important ingredient. The plant is one of the few of its type in the world that transform sorghum into malt extract. The construction of the plant at this time (1988) made Nestlé one of the first Nigerian companies to set up a finally integrated plant for production of Sorghum malt extract in industrial quantities. The production process which involved four stages which are cleaning, malting, extracting and gristing.

Milo is manufactured by evaporating the water content from thick syrup at reduced pressure. The thick opaque syrup is obtained from malted wheat or barley. *Milo* contains some theobromine, a xanthine alkaloid similar to caffeine which is present in the cocoa used in the product; thus, like chocolate, it can become mildly addictive if consumed in quantities of more than 15 heaped teaspoons per day.

Milo is very popular in Malaysia and Singapore, where the brand name is synonymous with chocolate flavored drinks: Milo has a 90% market share in Malaysia (not the often quoted 90% worldwide share of Milo consumption), and Malaysians were said to be the world's largest consumers of Milo. This is

because *Milo* was once used as a nutrient supplement when it was first introduced in the country, and has thus gained a reputation as a 'must have' drink for the old and the younger generations. Milo manufactured in Malaysia is made to dissolve well in hot water to produce a smooth hot chocolate drink, or with ice added for a cold drink. “Milo Vans” were often associated with sports days in these two countries, during which primary school pupils would queue up to collect their cups of *Milo* drinks using coupons.

Chocolate production

The cocoa-bean is the heart of the sweetest delicacy in the world is bitter! This is why, up to the 18th century some native tribes ate only the sweetish flesh of the cocoa fruit. They regarded the precious bean as waste or used it, as was the case among the Aztecs, as a form of currency.

The Varieties: There are two quite different basic classifications of cocoa, under which practically all varieties can be categorized: Criollo and Forastero cocoa. The pure variety of the Criollo tree is found mainly in its native Equador and Venezuela. The seeds are of finer quality than those of the Forastero variety. They have a particularly fine, mild aroma and are, therefore, used only in the production of high quality chocolate and for blending. However, Criollo cocoa accounts for only 10% of the world crop. The remaining 90% is harvested from trees of the Forastero family, with its many hybrids and varieties. The main growing area in West Africa. The cocoa tree can flourish only in the hottest regions of the world [7].

The Harvest: Immediately after harvesting, the fruit is treated to prevent it from rotting. At fermentation sites either in the plantation or at, collecting points, the fruit is opened.

Fermentation: The fermentation process is decisive in the production of high quality raw cocoa. The technique varies depending on the growing region.

Drying: After fermentation, the raw cocoa still contains far too much water; in fact about 60%.Most of this has to be removed.
We could be more natural than to spread the beans out to dry on the sun-soaked ground or on mats? After a week or so, all but a small percentage of the water has evaporated [4].

Cleaning: Before the real processing begins, the raw cocoa is thoroughly cleaned by passing through sieves, and by brushing. Finally, the last vestiges of wood, jute fibres, and even the finest dust are extracted by powerful vacuum equipment [4].

Roasting: The subsequent roasting process is primarily designed to develop the aroma. The entire roasting process, during which the air in the nearly 10 feet high furnaces reaches a temperature of 130 C, is carried out automatically.

Crushing and Shelling: The roasted beans are now broken into medium sized pieces in the crushing machine.
Blending: Before grinding, the crushed beans are weighed and blended according to special recipes. The secret of every chocolate factory lies in the special mixing ratios, which it has developed for different types of cocoa.

Grinding: The crushed cocoa beans, which are still fairly coarse are now pre-ground by special milling equipment and then fed on to rollers where they are ground into a fine paste. The heat generated by the resulting pressure and friction causes the cocoa butter [4].

Nestlé chocolates and confectionaries
Nestlé kit kat has a unique finger format with a 'breaking' ritual attached to it. It is one of the most successful brands in the world and every year over 12 billion Nestlé kit kat fingers are consumed around the globe [7].

Nestlé munch is wafer layer covered with delicious choco layer. It is crisp, light and irresistible that you just ‘can't stop Munching. It is the largest selling SKU in the category!

Nestlé milkybar is a delicious milky treat, which kids love. Re-launched in January2006 with a Calcium Rich recipe, it is a favorite with parents to treat their kids with.

Nestlé bar-one is a luscious nougat and caramel with delicious choco layer. It constantly reminds you that it is ‘Time for Action' [7].

Nestlé milk chocolate is a milk chocolate with a delicious taste that kids just love having at all times if parents allow them.

Methodology

The objective of this paper is to empirically investigate consumer preference between Cadbury Bournvita and Nestlé Milo products in Port Harcourt, Fifty (50) respondents were randomly selected as the sample size of the study. A 5 point likert scale, was used in the questionnaire design. Data were analyzed using descriptive and inferential statistics.

Results

Tables 2 – 29 (Appendix) show results of analysis

Findings

- From our results it was observed that 26 respondents prefer Milo and 24 respondents prefer Bournvita and, in terms of gender, Male are more in majority in preference.
- It was also noted that Younger generations between ages 20-30 consume Milo more at 57.7% while adults and elderly between 40 and above consume Bournvita at 37.5% in terms of age.
- It was also discovered that Milo consumers' income rank high at 26.9 %(30-40, 40-50) while Bournvita rank 25.6 %(30-50).
- Also both *Bournvita* and *Milo* has created a strong brand image among residents of Port Harcourt in Rivers state. Also known to all respondent included in the study.
- Further, Consumers tend to attach more preference for their brand through naming such as; think value for money milo, spice of life (*Bournvita*), think of milo any day, anytime and anywhere milo. Bournvita our traditional brand.
- Product attraction is the key to consumers' preference toward their chosen brand; in terms of quality (42.3%), taste (73.1%), packaging (53.8%), colour and shape for Milo while quality (45.8%), taste (53.3%), and packaging (45.8%).
- Price is not a key factor in consumers' preference toward their chosen brand for milo (50%) and Bournvita (100%).
- Promotion/ Advert also enhance the consumer preference toward the chosen brand for Milo (80.8%) and Bournvita (58.3%), also the medium use in conveying the message also attract their drive for the product.

- ❖ Also discovered that brand ambassadors don't have a relative impact on consumer consumption level and preference here in Port Harcourt. They are neutral, for Milo (42.3%) and Bournvita (41.7%).
- ❖ Consumption frequency is very high for both products. Milo (65.4%) and Bournvita (50%).
- ❖ There is a significant relationship in consumer preference for Milo (69.2%) and Bournvita (66.7%) every fortnightly in the purchase frequency.

Conclusion and Recommendations

From the data collected and interpretation of results, it was concluded that there is a significant impact of sales promotion, taste in consumer sentiment at influencing consumer preference. Sales promotion is usually used to boost sales, thereby increasing profit (i.e. gross profit margin of Nestlé Nigeria Plc improved from 36.85% in 2007 to 39.51% in 2008), according to Lead capital report on Nestlé for 2009. The most significant of the sales promotion techniques that contributed to higher performance in both companies were scratch and win, price off and gifts. In the course of any sales promotion exercise management should strategically facilitate the exercise so that consumers do not doubt the reality of the programme by using credible techniques. For instance, very incredible prizes like winning over a thousand brand new automobiles should be avoided. In addition, the study found that organization promotional strategies enhance consumer buying preference.

It can be inferred from the findings that there is a marked preference for *Milo* over *Bournvita* due to several factors such as effectiveness of sales promotion, product packaging and taste. This corroborates earlier Country report by Euro Monitor International (2013) which states that Nestlé Nigeria's *Milo* led brand sales in 2012 with a 39% trade off value share, Cadbury Nigeria's *Bournvita* held a 33% trade of value and other hot drink segments shared the remaining 27%.

Recommendations

Both Nestlé Nigeria Plc and Cadbury Nigeria Plc and other manufacturing organizations in general should always engage in more promotional mix strategies to further enhance and boost sales performance. There should also be improvement in taste as indicated by respondents and an enhanced distribution system as this strategy can create organized performance which will match the needs of availability of products during or after any advertising or sales promotional campaigns. Cadbury *Bournvita* should re-invigorate its animation programmes for kids on Saturdays as kids look forward to watching a good promotional strategy. Both manufacturers should maintain their consistent line of promotion in order to constantly keep the products fresh in the minds of the consumers.

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Appendix – Results of analysis

Table 2: Descriptive statistics

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
CONSUMER_PREFERENCE	26	1	2	1.50	.510
CONSUMERS	26	1	26	13.50	7.649
GENDER	26	1	2	1.38	.496
AGE	26	2	4	2.58	.758
INCOME	26	1	5	2.96	1.311
CONSUME_BEVERAGE	26	1	1	1.00	.000
PREFERENCE	26	4	5	4.62	.496
TASTE	26	4	5	4.73	.452
PRODUCT_QUALITY	26	3	5	4.27	.724
PRODUCT_PACKAGING	26	2	4	3.46	.647
PRICING	26	2	4	3.04	.720
PROMOTION	26	4	5	4.19	.402
CONSUMPTION_FREQUENCY	26	4	5	4.65	.485
DISTRIBUTION_CHANNEL	26	4	5	4.46	.508
BRAND_AMBASSADOR	26	2	4	3.04	.774
PURCHASE_FREQUENCY	26	2	4	2.38	.637
CONSUMER_PREFERENCE (BOURNVITA)	24	1	2	1.50	.511
CONSUMER (BOURNVITA)	24	1	24	12.50	7.071
GENDER (BOURNVITA)	24	1	2	1.42	.504
AGE (BOURNVITA)	24	2	5	3.96	1.083
INCOME (BOURNVITA)	24	1	5	3.12	1.296
CONSUME_BEVERAGE (BOURNVITA)	24	1	1	1.00	.000
PREFERENCE (BOURNVITA)	24	4	5	4.50	.511
TASTE (BOURNVITA)	24	4	5	4.58	.504
PRODUCT_QUALITY (BOURNVITA)	24	3	5	4.29	.690
PRODUCT_PACKAGING (BOURNVITA)	24	2	4	3.38	.647
PRICING (BOURNVITA)	24	4	4	4.00	.000
PROMOTION (BOURNVITA)	24	2	4	2.75	.608
CONSUMPTION_FREQUENCY (BOURNVITA)	24	4	5	4.50	.511
DISTRIBUTION_CHANNEL(BOURNVITA)	24	2	5	3.38	.875
BRAND_AMBASSADOR (BOURNVITA)	24	2	4	2.75	.737
PURCHASE_FREQUENCY(BOURNVITA)	24	1	4	2.17	.761
Valid N (listwise)	24				

Table 3: Consumer preference of *Bournvita* and *Milo*

		Freq	Percent	Valid Percent	Cumulative Percent
	Mil0	12	46.2	50.0	50.0
Valid	*Bournvita*	12	46.2	50.0	100.0
	Total	24	92.3	100.0	
Missing	System	2	7.7		
Total		26	100.0		

Table 4: Consumer preference (*Bournvita* and *Milo*)

	Freq	%	Valid %	Cumulative %
Milo	13	50.0	50.0	50.0
Bournvita	13	50.0	50.0	100.0
Total	26	100.0	100.0	

Tables 5: Consumer preference (*Milo*)

	Freq	**%**	**Valid %**	**Cumulative %**
1	**1**	3.8	3.8	3.8
2	1	3.8	3.8	7.7
3	1	3.8	3.8	11.5
4	1	3.8	3.8	15.4
5	1	3.8	3.8	19.2
6	1	3.8	3.8	23.1
7	1	3.8	3.8	26.9
8	1	3.8	3.8	30.8
9	1	3.8	3.8	34.6
10	1	3.8	3.8	38.5
11	1	3.8	3.8	42.3
12	1	3.8	3.8	46.2
13	1	3.8	3.8	50.0
14	1	3.8	3.8	53.8
15	1	3.8	3.8	57.7
16	1	3.8	3.8	61.5
17	1	3.8	3.8	65.4
18	1	3.8	3.8	69.2
19	1	3.8	3.8	73.1
20	1	3.8	3.8	76.9
21	1	3.8	3.8	80.8
22	1	3.8	3.8	84.6
23	1	3.8	3.8	88.5
24	1	3.8	3.8	92.3
25	1	3.8	3.8	96.2
26	1	3.8	3.8	100.0
Total	26	100.0	100.0	

Table 6: Consumer preference (*Bournvita*)

		Freq	%	Valid %	Cumulative %
Valid	1	1	3.8	4.2	4.2
	2	1	3.8	4.2	8.3
	3	1	3.8	4.2	12.5
	4	1	3.8	4.2	16.7
	5	1	3.8	4.2	20.8
	6	1	3.8	4.2	25.0
	7	1	3.8	4.2	29.2
	8	1	3.8	4.2	33.3
	9	1	3.8	4.2	37.5
	10	1	3.8	4.2	41.7
	11	1	3.8	4.2	45.8
	12	1	3.8	4.2	50.0
	13	1	3.8	4.2	54.2
	14	1	3.8	4.2	58.3
	15	1	3.8	4.2	62.5
	16	1	3.8	4.2	66.7
	17	1	3.8	4.2	70.8
	18	1	3.8	4.2	75.0
	19	1	3.8	4.2	79.2
	20	1	3.8	4.2	83.3
	21	1	3.8	4.2	87.5
	22	1	3.8	4.2	91.7
	23	1	3.8	4.2	95.8
	24	1	3.8	4.2	100.0
	Total	24	92.3	100.0	
Missing	System	2	7.7		
Total		26	100.0		

Table 7: Gender (*Bournvita*)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	MALE	14	53.8	58.3	58.3
	FEMALE	10	38.5	41.7	100.0
	Total	24	92.3	100.0	
Missing	System	2	7.7		
Total		26	100.0		

Table 8: Age (*Bournvita*)

		Freq	%	Valid %	Cumulative %
Valid	20-30	4	15.4	16.7	16.7
	30-40	2	7.7	8.3	25.0
	40-50	9	34.6	37.5	62.5
	50 & above	9	34.6	37.5	100.0
	Total	24	92.3	100.0	
Missing	System	2	7.7		
Total		26	100.0		

Table 9: Income (*Bournvita*)

		Freq	%	Valid %	Cumulative %
Valid	10-20(TH)	3	11.5	12.5	12.5
	20-30(TH)	5	19.2	20.8	33.3
	30-40(TH)	6	23.1	25.0	58.3
	40-50(TH)	6	23.1	25.0	83.3
	50 & ABOVE	4	15.4	16.7	100.0
	Total	24	92.3	100.0	
Missing	System	2	7.7		
Total		26	100.0		

Table 11: Consumer preference (*Bournvita*)

		Freq	%	Valid %	Cumulative %
Valid	A	12	46.2	50.0	50.0
	SA	12	46.2	50.0	100.0
	Total	24	92.3	100.0	
Missing	System	2	7.7		
Total		26	100.0		

Table 12: Sex (*Bournvita*)

		Freq	%	Valid %	Cumulative %
Valid	Male	16	61.5	61.5	61.5
	Female	10	38.5	38.5	100.0
	Total	26	100.0	100.0	

Table 13: Packaging (*Bournvita*)

		Freq	%	Valid %	Cumulative %
Valid	D	2	7.7	8.3	8.3
	N	11	42.3	45.8	54.2
	A	11	42.3	45.8	100.0
	Total	24	92.3	100.0	
Missing	System	2	7.7		
Total		26	100.0		

Table 14: Pricing: (*Bournvita*)

		Freq	%	Valid %	Cumulative %
Valid	A	24	92.3	100.0	100.0
Missing	System	2	7.7		
Total		26	100.0		

Table 15: Taste: (*Bournvita*)

		Freq	%	Valid %	Cumulative %
Valid	A	10	38.5	41.7	41.7
	SA	14	53.8	58.3	100.0
	Total	24	92.3	100.0	
Missing	System	2	7.7		
Total		26	100.0		

Table 16: Consumer beverage (*Bournvita*)

		Freq	%	Valid %	Cumulative %
Valid	Yes	24	92.3	100.0	100.0
Missing	System	2	7.7		
Total		26	100.0		

Table 17: Quality (*Bournvita*)

		Freq	%	Valid %	Cumulative %
Valid	N	3	11.5	12.5	12.5
	A	11	42.3	45.8	58.3
	SA	10	38.5	41.7	100.0
	Total	24	92.3	100.0	
Missing	System	2	7.7		
Total		26	100.0		

Table 18: Brand ambassador (*Bournvita*)

		Freq	%	Valid %	Cumulative %
Valid	D	10	38.5	41.7	41.7
	N	10	38.5	41.7	83.3
	A	4	15.4	16.7	100.0
	Total	24	92.3	100.0	
Missing	System	2	7.7		
Total		26	100.0		

Table 19: Purchase-frequency (*Bournvita*)

		Freq	%	Valid %	Cumulative %
Valid	Weekly	3	11.5	12.5	12.5
	Fortnightly	16	61.5	66.7	79.2
	Monthly	3	11.5	12.5	91.7
	Quarterly	2	7.7	8.3	100.0
	Total	24	92.3	100.0	
Missing	System	2	7.7		
Total		26	100.0		

Table 20: Consumer beverage (*Milo*)

	Freq	%	Valid %	Cumulative %
Valid YES	26	100.0	100.0	100.0

Table 21: Preference (*Milo*)

		Freq	%	Valid %	Cumulative %
Valid	A	10	38.5	38.5	38.5
	SA	16	61.5	61.5	100.0
	Total	26	100.0	100.0	

Table 22: Taste (*Milo*)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	7	26.9	26.9	26.9
	SA	19	73.1	73.1	100.0
	Total	26	100.0	100.0	

Table 23: Purchase frequency (*Milo*)

		Freq	%	Valid %	Cumulative %
Valid	Fortnightly	18	69.2	69.2	69.2
	Monthly	6	23.1	23.1	92.3
	Quarterly	2	7.7	7.7	100.0
	Total	26	100.0	100.0	

Table 24: Quality (*Milo*)

		Freq	%	Valid %	Cumulative %
Valid	Neutral	4	15.4	15.4	15.4
	A	11	42.3	42.3	57.7
	SA	11	42.3	42.3	100.0
	Total	26	100.0	100.0	

Table 25: Packaging (*Milo*)

		Freq	%	Valid %	Cumulative %
Valid	D	2	7.7	7.7	7.7
	N	10	38.5	38.5	46.2
	A	14	53.8	53.8	100.0
	Total	26	100.0	100.0	

Table 26: Pricing (*Milo*)

		Freq	%	Valid %	Cumulative %
Valid	D	6	23.1	23.1	23.1
	N	13	50.0	50.0	73.1
	A	7	26.9	26.9	100.0
	Total	26	100.0	100.0	

Table 27: Promotion (*Milo*)

		Freq	%	Valid %	Cumulative %
Valid	A	21	80.8	80.8	80.8
	SA	5	19.2	19.2	100.0
	Total	26	100.0	100.0	

Table 28: Brand ambassador (*Milo*)

		Freq	%	Valid %	Cumulative %
Valid	D	7	26.9	26.9	26.9
	N	11	42.3	42.3	69.2
	A	8	30.8	30.8	100.0
	Total	26	100.0	100.0	

Table 29: Purchase frequency (*Bournvita*)

		Freq	%	Valid %	Cumulative %
Valid	20-30	15	57.7	57.7	57.7
	30-40	7	26.9	26.9	84.6
	40-50	4	15.4	15.4	100.0
	Total	26	100.0	100.0	
		Freq	%	Valid %	Cumulative %
Valid	20-30	15	57.7	57.7	57.7
	30-40	7	26.9	26.9	84.6
	40-50	4	15.4	15.4	100.0
	Total	26	100.0	100.0	

WASTE-TO-WEALTH MICRO, SMALL AND MEDIUM ENTERPRISES DEVELOPMENT AND GROWTH FOR UNEMPLOYMENT AND POVERTY REDUCTION AND GROWING NIGERIA'S ECONOMY: IMPERATIVE ROLE OF THE NIGERIAN DIASPORA

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Abstract

Rising unemployment and poverty have led to rapid emigration of people from many countries in sub-Saharan Africa to the developed world. This has dictated brain-drain and brain-waste for the region. However, recent research on emigration from Mexico provides evidence of significant gains from emigration, showing that countries of origin can have brain-gain from emigration. This paper reviews the literature and data on the issues of brain-drain and brain-waste, with a view to highlighting how the Nigerian diaspora can help with brain-gain to develop and grow waste-to-

wealth enterprises for unemployment and poverty reduction, and thereby growing the economy of their home country. Based on present evidence, Nigeria has experienced significant brain-drain and brain-waste, yet the country has plenty of physical wastes yawning for conversion to wealth. The Nigerian diaspora can help to reduce unemployment and poverty and to grow the ecconomy in their home country through waste-to-wealth enterprises development and growth. The study assumes they have acquired in their host countries the critical skills and capital (remittance) needed for micro, small and medium waste-to-wealth enterprises development and growth. Twenty-one examples of waste-to-wealth opportunities were highlighted, which require establishment costs of US$10,000 upwards and cheap and available sites in the country sides. Establishing 10 micro, 10 small and 10 medium waste-to-wealth enterprises in one of the 774 Local Government Areas of Nigeria in a year would create 3,173,400 jobs in one year and 31,734,000 jobs in 10 years, with the potential to reduce unemployment and income poverty to the barest minimum and its desirable multiplier socio-economic effects, including reduction of idleness, social vices and insecurity. It is recommended that the Nigerian diaspora should bend over backwards to take critical skills and capital back home to establish and grow waste-to-wealth enterprises for rapid development of their home country. Contributing to building Nigeria in the recommended way will ensure their retirement to a fatherland that has become better developed.

Keywords: *Diaspora, Brain drain, Brain waste, Brain gain, Employment generation, MSMEs*

Introduction

Nigeria's unemployment figures keep rising since the mid-2000s. About 28.9% of people in 15-24 age bracket have no job. Consequently, income poverty is an issue in Nigeria. Poverty

incidence rose from 27.2 in 1980 to 46.3 in 1985 to 42.7 in 1992 to 65.6 in 1996 and 69.0 in 2010 [1-3].

Understandably, some push and pull factors have drawn many Nigerians to other parts of the world in brain-drain. Indeed, many countries in sub-Saharan Africa (SSA) have experienced rapid emigration to the developed world. Migration and globalisation have deepened the problem of brain-drain from Africa to the advantage of Europe and America. Zeleza (2003, in Eneh) [2] cites studies which indicate that, in the 1980s, an average of 23,000 qualified academic staff emigrated from Africa each year. An estimate in 1995 gave the figure as 50,000. The contemporary academic diaspora in the United States and elsewhere in the North is becoming a force to be reckoned with.

Brain-drain has hampered the ability of countries in sub-Saharan Africa to get out of poverty. It has cost the African continent over $4 billion in the employment of 150,000 expatriate professionals annually. Nigeria, Kenya and Ethiopia are reportedly the most affected. Ethiopia lost 75% of its skilled workforce between 1980 and 1991. In particular, the country produces many excellent doctors, but there are more Ethiopian doctors in Chicago than there are in Ethiopia [4].

Ghana currently has one doctor for every 6,700 inhabitants, as compared with one doctor for every 430 inhabitants in the USA. Yet, Ghanaian trained doctors and nurses leave to work in countries such as Britain, the USA, Jamaica and Canada. Up to 68% of the country's trained medical staff left between 1993 and 2000. Between 1999 and 2004, 448 doctors, or 54% of those trained in the period, left to work abroad [5].

South Africa has been experiencing brain-drain in the past 20 years. This is potentially damaging for the regional economy and is almost certainly detrimental for the wellbeing of regional poor majority desperately reliant on the health care infrastructure, given the HIV/AIDS epidemic [6, 7]. In his 1998 African Renaissance speech, the erstwhile South African President, Thabo Mbeki, said:

> *In our world in which the generation of new knowledge and its application to change the human condition is the engine which moves human society further away from barbarism, do we not have need to recall Africa's hundreds of thousands of intellectuals back from their places of emigration in Western Europe and North America, to rejoin those who remain still within our shores! I dream of the day when these, the African mathematicians and computer specialists in Washington and New York, the African physicists, engineers, doctors, business managers and economists, will return from London and Manchester and Paris and Brussels to add to the African pool of brain power, to enquire into and find solutions to Africa's problems and challenges, to open the African door to the world of knowledge, to elevate Africa's place within the universe of research the information of new knowledge, education and information.*

For the medical sector, the loss of returns from investment for all doctors emigrating is $1.41 billion for South Africa. The benefit to destination countries is huge: $2.7 billion for the United Kingdom only, without compensation [8, 9].

There are moves to reverse brain-drain. Africarecruit is a joint initiative by NEPAD and the Commonwealth Business Council to recruit professional expatriate Africans to take employment back in Africa after working overseas. In 2010, the World Health Organization adopted the Global Code of Practice on the International Recruitment of Health Personnel, a policy framework for all countries for the ethical international recruitment of doctors, nurses and other health professionals [10].

Many Africans in the diaspora are beginning to return to their home countries due to rapid growth and development in many

African nations. Between 2001 and 2010, six of the world's ten fastest-growing economies were in Africa, and between 2011 and 2015, Africa's economic growth is expected to outpace Asia's. Other factors encouraging the reverse of brain drain are the introduction of technologies (such as fast Internet and mobile phones), a better-educated population, and the environment for business driven by new tech start-up companies [10].

How can these Nigerian diaspora help to reduce unemployment and poverty and to grow the economy of Nigeria through waste-to-wealth enterprise development and growth? This is the question this study seeks to address. It is based on review of literature, observations and experience.

Conceptual Literature

Entrepreneurship, MSMEs, unemployment, critical skills, poverty reduction, education for economic and social development, brain-drain, brain-waste and brain-gain are concepts briefly reviewed.

Enterpreneurship

Entrepreneurship is the exploitation of an invention or an untried technological possibility for producing a new commodity or an old one in a new way. As change agents in the economy, enterpreneurs open a new source of supply of materials or a new outlet for products and reorganize an industry. They serve new markets or create new ways of doing things, thereby moving the economy forward. They are the innovators who drive the creative-destructive process of capitalism, and reform or revolutionize the pattern of production (Schumpeter, 1934 in Eneh) [11].

Although enterpreneurship programme has been recently introduced in tertiary institutions, as a means of tackling unemployment, reducing income poverty and improving self-reliance, the programme has become more like the usual teaching subject, ending up at best with the theoretical and head-knowledge

delivery. Critical skills are not being acquired. Like the grammar school programmes, the enterpreneurship programmes have no enterprise-ready and employable products. On annual basis, only 10% (13,000) of the 130,000 graduates et employed [12, 13]. Enterprises thrive on skills and capital. While the critical skills are lacking, the cost of capital is scandalously high in Nigeria at 18-40% in Nigeria, as against 5% in USA, 4% in Malaysia, 3.9% in London and 3% in Asia [14].

The clamour of Nigerian government for a private sector-driven economy [15] has not been realized, as 10 years after the introduction of National Economic Empowerment and Development Strategy, NEEDS, it has failed to sort out Nigeria's needs [16]. And, pro-poor and pro-growth strategy recommended for Nigeria's poverty reduction [17] is yet to be given a chance to succeed in Nigeria.

MSMEs (Micro, small and medium enterprises)

Four sizes of enterprises identified across the globe are micro/cottage, small, medium and large enterprises, based on the number of workers and the working capital (running cost per annum, including staff salaries, rent, utilities and other expendables) of the enterprise. The amount of working capital assigned to a category of enterprise in a particular country differs at different times due to inflation. According to the Nigerian National Council on Industry [18], micro/cottage industry has a total capital outlay of not more than US$10,000 (=N=1.5 million) and/or a workforce of not more than 10 persons, small industry has between US$10,000 and US$325,000 (=N=1.5 million to =N=50 million) capital outlay and/or 11-100 workers, medium industry has US$325,000 to US $975,000 (=N=50 million to =N=150 million) and/or 101 to 300 workers, and large industry has over US$975,000 (=N=150 million) and/or over 300 workers. Each case excludes the cost of land.

Unemployment

Unemployment is a state of worklessness of people between 15 and 60 years age bracket, who are not mentally and/or physically challenged (lunatics and disables) and others living on alms or charity, full-time students and trainees, members of the armed forces, housewives who devote their time entirely to looking after the home, etc., for a minimum period that varies from country to country: one or two days in some countries, one week in Nigeria and 3 months in other countries (Falae, 1971 in Eneh) [19]. In spite of expanded education programmes and improved access to education, unemployment rates are high in Nigeria because higher education has not been applied to construct a knowledge economy to drive socio-economic development. While the white-collar jobs are lacking, enterpreneurship is not thriving because skills and capital, which are two basic factors of successful enterpreneurship, are lacking as well, hence the rising unemplyment rate among the Nigerian population.

Critical skills

Critical skills are the creative and productive resources required for the economic and political development of a country. If the country possesses a critical mass (sufficient people with critical skills), physical capital becomes more productive. Developing countries lack the people with critical skills; there is little knowledge of available natural resources, alternative production techniques, the necessary skills, the existing market conditions and opportunities, and the institutions for economization of efforts for economic rationality [20].

Poverty reduction

Poverty is lack of five things necessary for decent living, namely water, food, health, education, and peace/order. While the first four are physical, the last is emotional – representing things which make people happy and make life worth living, such as love and self-

respect. Poverty reduction is minimizing this lack. Man utilizes the education and technology he has acquired to work to get his needs and keep poverty abay. Education is a means of developing the entire person to enable him live effectively and efficiently in the society (to take part in the present) so that he may advance it (make civilization of the future) (Ukeje, 1984 in Eneh) [2].

Poverty runs across the regions of the globe, but it is most pronounced and acute in sub-Saharan Africa, the Middle East and North Africa, South Asia, and Latin America. Poverty reduction is a global priority since the 1990s. The pro-growth and pro-poor strategy, based on labour-intensive economic growth and investment in people, by way of provision of social services and amenities, is the most effective poverty reduction strategy. Adopting this strategy, Korea and Taiwan provided jobs, bolstered incomes of the poor and induced economic growth, and thereby, reducing poverty from one-third to one-tenth within three decades (1970s-1990s) [17].

Education for economic and social development

The World Bank [21] submitted that the advancement and application of knowledge increasingly drive economic and social development. Education in general, and higher education in particular, is fundamental to the construction of a knowledge economy and society. Porter [22] asserted that knowledge has become the most important factor for economic development in the 21st century. Through its capacity to augment productivity, it increasingly constitutes the foundation of a country's competitive advantage. This is evident in OECD countries, where investments in the intangibles that make up the knowledge base of a country (e.g. research and development, higher education, computer software, patents) are equaling or even exceeding investments in physical equipment [23].

But, as Salmi [24] observed, the potential of higher education systems in developing countries to fulfill this

responsibility is frequently thwarted by long-standing problems. The capacity to generate and harness knowledge in the pursuit of sustainable development and improved living standards is not spread equally among these nations. In 1996, OECD countries accounted for 85% of total research and development (R&D) investment; China, India, Brazil, and East Asia represented 11%; and the rest of the world only 4%. Advanced economies enjoy the fruits of a self-promoting cycle in which the benefits of research help produce the wealth and public support needed to enable continued investments in R&D [25].

Like many developing countries, Nigeria has neither articulated a development strategy linking knowledge to economic growth nor built up its capacity to do so. Although it is Africa's largest country with 20% of the region's population, Nigeria has only 15 scientists and engineers engaged in R&D per million persons. This compares with 168 in Brazil, 459 in China, 158 in India, and 4,103 in the United States of America (USA) [26].

Nigerians are wrapped in a culture noted for industry, creativity and initiative. But, some Nigerians prefer to apply these talents to questionable or illicit pursuits, while many others expect government to provide them with white-collar jobs. With a population of 168 million and ample natural resources, Nigeria is Africa's sleeping economic giant. Two-thirds of Nigerian population struggle to survive on less than one dollar per day [1, 27, 28].

The economic success of newly industrializing nations (e.g. the "Asian tigers") has been linked to substantial prior investment in human resources. These strategic investments, together with particular institutional and policy choices concerning the nature of the university system, the extent of intellectual property protection, the historical evolution of industrial R&D organization, and the division of labour between private industry, universities and government in R&D performance and funding, combine to form what is called a "national innovation system" [29]. Countries that

have increased their innovative capacities have invested heavily in science and engineering education, and also in promoting competition as the basis for innovation [30]. But, available data indicate low levels of investment in research capacity and education, and help to explain why Nigeria's non-oil economy has remained consistently sluggish during a decade of international economic expansion. On the research side, Nigeria's number of scientific publications for 1995 was 711 – significantly less than its output of 1,062 scientific publications in 1981 by a comparatively much smaller university system. In contrast, scientific publications were 3,413 for South Africa, 14,883 for India, 310 for Indonesia, and 5,440 for Brazil [31]. Nigeria's federal university system spends only 1.3% of its budget on research (Hartnett, 2000). For education, Nigeria spends an estimated 2.4% of its GNP while sub-Saharan Africa as a whole spends 5.1% [32, 33].

The cost of running the federal university system in Nigeria totaled $210 million in 1999. Financing for this system comes almost entirely from the federal government. As a result of enrollment growth and currency devaluation, recurrent allocations per university student in the federal system fell from $610 to $360 between 1990 and 1999 – with obvious implications for educational quality. However, agreements covering university salaries and teaching inputs negotiated with government by the Academic Staff Union of Universities (ASUU) in 2001 have raised this amount close to a much healthier $1,000 per student annually [34]. Yet another agreement/MoU (memorandum of understanding) covering university excess workload allowances and revitalisation fund negotiated with the government by the Academic Staff Union of Universities (ASUU) between 2009 and 2013 have just been signed by both parties, thereby raising the hope for a silver lining in the dark cloud [35].

Federal university revenues are received mainly from three sources: the federal government (84%); income generation activities (7%); and various student fees (9%) – even though no

undergraduate tuition fees are charged. In 1992, student fees had represented just 2% of revenues. Technical education is substantially neglected by policymakers and oriented to the teaching of traditional hand skills that are often divorced from labour market requirements. Higher education enrolls a very modest 4% of the relevant age cohort. This level compares poorly with economic competitors such as South Africa (17%), India (7%), Indonesia (11%) and Brazil (12%) [31].

Brain-drain, brain-gain and brain-waste

Brain-drain or human capital flight is the departure or emigration of individuals with technical skills or knowledge from organisations, industries, or geographical regions. Organisational brain-drain involves the flight of talented, creative, and highly trained employees from large corporations, who perceive the direction and leadership of the company to be unstable, or stagnant, and thus unable to keep up with their personal, and professional ambitions. Geographical brain-drain refers to the flight of highly trained individuals, e.g. university graduates, from one geographical location to another. Industry brain-drain refers to the movement of traditionally skilled workers from one sector to another [36].

As with other human migration, there are push and pull factors responsible for brain-drain. The push factors exist in the countries of departure, and include lack of opportunities, political instability or oppression, economic depression, health risks, among others. The pull factors exist in host countries, and include rich opportunities, political stability and freedom, developed economy, and better living conditions. Others are family influence (overseas relatives) and personal preference, such as preference for exploring, ambition for an improved career, among others.

Brain-drain is a parallel to capital flight, which is the movement of financial capital. It was coined by the Royal Society to describe the emigration of scientists and technologists to North America from post-war Europe. The term is also said to have

been first used in the United Kingdom to describe the influx of Indian scientists and engineers. The converse phenomenon is brain-gain, which occurs when there is a large-scale immigration of technically qualified persons. Brain-drain is common among developing nations [37, 38].

Emigrants may not obtain employment commensurate with their educational qualifications. For example, a Nigerian doctor who emigrates to the United States of America (USA) or Europe may not find professional job, but work in the service industry or end up doing menial jobs. This is brain-waste. As an effective export of human resources, brain-drain of education services has become a money machine for countries, contributing over $7 billion to the USA economy [39].

The knowledge and wealth generated in brain-drain is two-fold, both for the country of origin and host country. The latter acquires an additional human capital to fill labour gaps and increase economic development. When the migrant workers return home, they may bring with them new skills and knowledge for speedier economic development in their home country. This will also generate increased demand for higher level education among the population. Furthermore, remittances increase economic development and improve the standard of living in the country of origin [40]. Skilled migrants typically earn more, and therefore, remit more, thus fostering growth of home countries [41]. Remittances for 2011 were estimated at $372 billion worldwide. Mexico and the Philippines had $24 and $34 billion respectively [42].

Emigration of skilled workers who are vital to the development of society and the country as a whole, essentially provides personal benefits for individuals rather than public benefits to the home country [43]. But, skilled migrants face double social marginalisation. Migrants are kept from integrating into their new surroundings either by society or by existing governments, and upon their return home, are shunned by their home community for

unpatriotic dessertion. Migrants have been villainised by host society because they may be perceived as a disruption to existing society - intruders. The migrants themselves, who have struggled to adapt to their new surroundings and way of life, may subsequently perceive themselves as living 'parallel lives' [44].

Selected waste-to-wealth opportunities in Nigeria

Nigerians want because they waste [11]. They are poor, not because they do not have abundant natural resources, but because they waste what they have or cannot harness them. The waste-to-wealth opportunities highlighted below were selected based on their high chances of success at rapid rate, low establishment cost required as MSMEs, availability of raw materials and market for the product, suitability for hinterland location, and available cheap labour.

Nigeria imports large quantities of fertilizer, when it has sufficient animal dung and the capacity for composting. Both resources - material (the dung) and human (capacity to compost) - lie waste. Yet, the market for fertilizer abounds, dictating its importation that has remained the fashion for decades running. In 2005/6 session alone, 76,492.17 metric tons of fertilizer was used in the country [45].

Nigerians export metallic scraps hitherto litering its landscape, when they can establish foundries to convert them to useful products imported into the country as finished goods. Again here, while the material and human resources are under-exploited, the market for the products abounds in the country [11].

Similarly, Nigeria imports ceiling boards which can be cheaply produced from rice husk wastes abounding in all the rice producing states in the country. Not only that the materials are wasted, the nation bears the cost of disposing the waste and/or the attendant environmental degradation and health hazards. Yet, the available human resources are under-exploited and the market for the products abounds in the country [11].

In a similar vein, Nigeria lacks animal feeds and food/laundry starch that can be obtained from cassava peel waste yawning for disposal. This waste is growing in quantity with recent emphasis on commercial cassava production for export. The export commodity is usually cassava chips obtained from peeled, chipped and dried cassava tubers. Waste-to-wealth entrprises are needed to take care of the waste peels by its conversion to useful end-products, such as starchy food, as well as industrial goods, such as starch for laundry and the fermentation industry [11]. In 2007, private poultry farmers numbered 11,313,254, while fish farmers numbered 1,725,969 – all of them requiring animal feeds [45].

Eneh [46] (2013) observed that food security and improvement of nutrition are imperative in poverty-striken Nigeria. Taro (*Colocasia antiquorum*) - a widely cultivated cocoyam – has little demand as food and vulnerability to post-harvest rot. Taro grit can serve as carbohydrate supplement in energy food drink, since taro-guineacorn energy food drink product was almost identical with "Ovaltine" (a product of Cadbury Nigeria Plc) made from cocoa. In 2009, Nigeria was the world leading producer of taro with 4.4 mmt, followed (with a wide margin) by China and Cameroon (1.7 mmt each), Ghana (1.5 mmt) and Papua New Guinea (0.3 mmt). All the other countries put together contributed the remaining 1.7 mmt. Conversion of taro, that is so far wasted to under-exploitation and rot, to energy food drink for the teeming population of Nigerians, who constitute the readily available market for the much-needed food drink at a much more affordable price, is another opportunity for micro, small and medium enterprises (MSMEs).

Nigeria imports food, when most of its land is arable and lying waste. Farming is another enterprise to utilize wasted land to produce various types of crops to feed the growing population of Nigerians. Water for irrigation is available, making off-season crop production possible. Agric programmes of the government now provide financial and material inputs to farmers. Food preservation

enterprises can also be established as forward-integration enterprises.

Dye and colour products are ever demanded for their aesthetic and cosmetic applications, hence their high demand in all societies in all ages. Nigeria imports dyes, when most plants rich in dyes grow well in the country for cheap dye extraction. Both the growth of these plants and extraction of dyes from them are waste-to-wealth projects to help reduce unemployment and poverty and to grow Nigeria's economy [11].

Numerous indigenous plants have medicinal values. Drugs can be easily extracted from them for treatment of abounding poverty-induced ailmments at lower costs than with imported orthodox medicines [11].

For decades, Nigeria has remained a "generator economy", where industries are run on electric power generating sets. Yet, electricity can be generated from the large quantum of wastes litering the environment with attendant environmntal degradation and health hazards. Recently, Nigerian government privatized the power sector. Therefore, electric power generation from wastes is an excellent and timely waste-to-wealth opportunity in Nigeria.

Bentonite has wide application in foundry, civil engineering, binding, metallurgy, ceramics, food processing, oil well drilling, textile industry, oil refining, chemical industry, paper industry and agriculture. Production of bentonite from indigenous clay occuring in over 700 trillion metric tons in Borno and Adamawa States, as well as Edo, Imo, Abia and Anambra is a viable and desirable medium enterprise [11].

Granite stone is obtained by breaking up large granite rock to various sizes. The larger size is used for railway construction, while the smaller sizes are used for building and road construction. Although granite rock occurs widely in large quantity in Nigeria, prodution of crushed granite needs to be raised to meet its very high demand [11].

Lead and zinc ores occur in economic quantities in Ebonyi, Benue, Taraba, Plateau, Nassarawa and Bauchi States. There is no concentrator or smelter of the ores in Nigeria, hence 1.2 million metric tons of lead and lead alloys and 377,487 metric tons of zinc and zinc alloys were imported into Nigeria in 1987 alone [11].

Kaolin has versatile industrial uses in cosmetics, pulp and paper, chalk, agro-allied and parmaceutical production. Nigeria consumes 19,000 metric tons of kaolin per annum. Kaolinic clay deposits occur in economic quantities in Enugu, Kaduna, Anambra, Katsina, Oyo, Kebbi, Ogun, Plateau, Borno and Kwara States. Kaolin production can be undertaken profitably at micro, small or medium scale in Nigeria [11].

Ground industrial mineral from marble or limestone serve as abrasive and filler in chemical, metallurgical and non-metallurgiccal industries (such as paper, paint, pharmaceutical industries). Its demand stands at 90 metric tons per annum, out of which only 25,000 metric tons are supplied by local producers. Limestone production can be undertaken profitably at small or medium scale in Nigeria [11].

Limestone serves as abrasive and filler in chemical, metallurgical and non-metallurgiccal industries (such as paper, paint, pharmaceutical industries). Its demand stands at 90 metric tons per annum, out of which only 25,000 metric tons are supplied by local producers. Limestone deposits occur in 100 million metric tons in Sokoto State, 85 million metric tons in Benue, 70 million metric tons in each of Kogi and Ogun States, 15 million metric tons in Enugu/Anambra, 10 million metric tons in each of Edo and Cross River States, and less deposits in Imo, Bauchi, Niger and Federal Capital Territory (FCT)

Quicklime demand in Nigeria is 101,000 metric tons, with little local supply. It can be produced from abounding limestone deposits in various States in the country [11].

Hydrated lime is one of the most extensively used industrial raw-materials. Its demand is 35,000 metric tons per annum in

Nigeria. It can be produced by hydrating quicklime obtained from locally available limestone [11].

Clay and clay-based materials for tile production are found in economic quantities in nearly all the States of Nigeria. The country spent $400,000 (=N=600 million) in both 1986 and 1987 on importation of flooring tiles. Therefore, local augumentation of prodution of clay flooring tile is both viable and desirable. Similarly, marble tiles need to be produced locally from marble slabs (crystaline form of limestone) found commercially in Sokoto, Benue, Ogun, Kwara, Cross River, Anambra, Edo, Imo, Bauchi, Niger, Enugu and FCT in Nigeria [11].

Although higher institutions of learning are changing to the use of whiteboard marker, most basic eduational schools still use chalk on chalkboards. Calcium sulphate and kaolin, which are major raw-materials for chalk production, abound in most States of Nigeria [11].

With clay abounding in most States in Nigeria and most ceramic artware and toys imported, there is the wisdom and need for local ceramic industries. Talc of all grades is imported, whereas it can be produced from locally abounding talcum materials [11].

As is the quantity of various wastes in Nigeria, so is the list of waste-to-wealth opportunities endless. The few examples given here serve to show the variability and viability of waste-to-wealth enterprises as a means of reducing unemployment and poverty as well as growing Nigeria's economy. A concern of each of the prescribed opportunities can be established at micro, small and medium scales, in country sides and with cheap labour available from the large population of Nigeria.

In the considered opinion of the authors, 10 micro industries employing 10 persons established in a year in each of the 774 Local Government Areas would create 77,400 jobs, 10 small industries employing 100 workers established in a year in each of the 774 Local Government Areas would create 774,000 jobs, and 10 medium industries employing 300 workers established in a year in

each of the 774 Local Government Areas would create 2,322,000 jobs. This means creation of 3,173,400 jobs in a year by the 30 MSMEs. If this happens for the next 10 years, 31,734,000 jobs will have been created by 300 MSMEs to absorb unemployed school-leavers and graduates, reduce income poverty and grow Nigeria's economy rapidly. The multiplier socio-economic effects include reduction of idleness, social vices and insecurity. This is the way to actualise Nigeria's dream of a private sector-led economy and to give a chance to pro-poor and pro-growth poverty reduction strategy.

Conclusion and Recommendations

Growing unemployment and poverty, amidst many other push factors, have led to emigration of many Nigerians to developed countries in the West for greener pastures. Nigeria has, thus, experienced significant brain-drain and brain-waste. But, these diaspora Nigerians have acquired critical skills and earned capital, both of which they can invest in waste-to-wealth MSMEs development and growth that will create jobs, reduce unemployment and poverty, improve self-reliance and grow Nigeria's economy.

Therefore, it is recommended that the Nigerian diaspora bend over backwards to take critical skills and capital back home to develop and grow waste-to-wealth enterprises for unemployment and poverty reduction and rapid economic development of their home country. Contributing to building Nigeria through establishment of waste-to-wealth MSMEs will ensure the retirement of the Nigerian diaspora to a fatherland that has become better developed for common good and wellbeing.

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